

Pomegranate (*Punica granatum*): A Powerhouse of Health and Nutrition

Transforming India's arid regions, the pomegranate has emerged as a cornerstone of the 'Viksit Bharat' vision. This resilient superfood drives rural prosperity by yielding high returns per acre, encouraging youth to embrace modern agribusiness. Nationally, booming exports of premium varieties like 'Bhagwa' strengthen India's global trade footprints, while advanced processing units foster lucrative rural entrepreneurship. By seamlessly blending water-efficient, climate-smart cultivation with robust value-addition industries, pomegranate farming secures both nutritional health and economic resilience. It stands as a definitive, highly scalable blueprint for sustainable agricultural innovation and nationwide development.

Keywords: Health and Nutrition; Nutritional quality; Nutritive value; Value added products

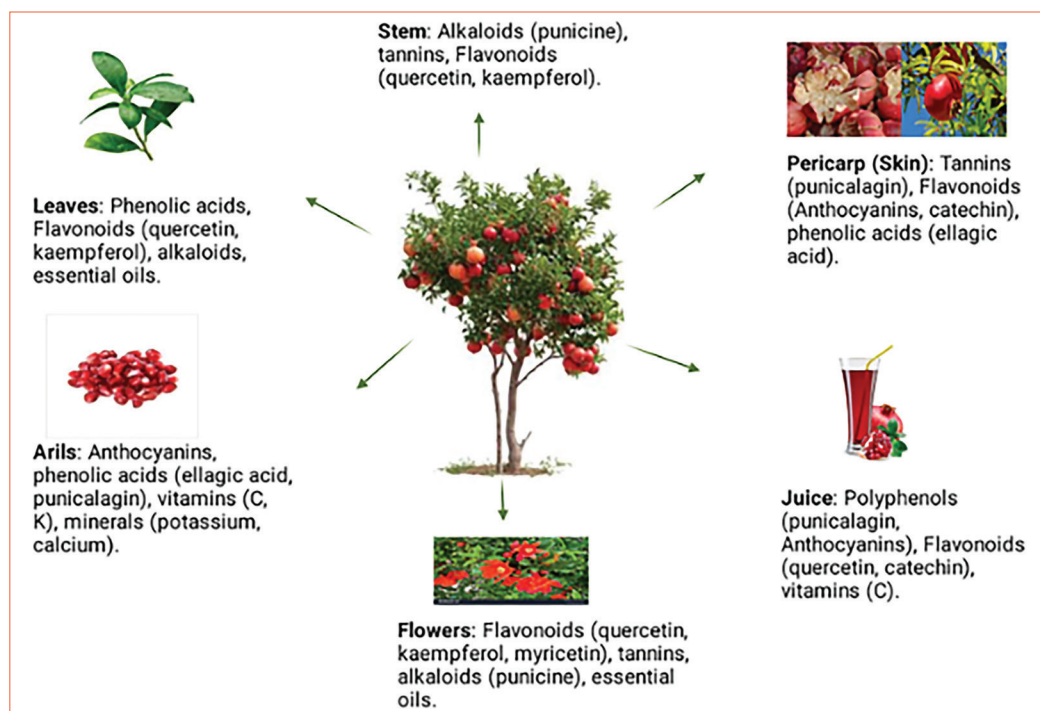
INDIA is one of the largest producers of pomegranates globally, particularly in states like Maharashtra, Karnataka, Gujarat, and Andhra Pradesh. The crop is well-suited to arid and semi-arid climates, and its cultivation can help improve the economic status of farmers in these regions. India exports a substantial quantity of pomegranates to international markets, including the Middle East, Europe, and the United States. This trade brings in foreign exchange and strengthens India's position in global agriculture market. Pomegranate is widely recognized as a superfruit and more in demand by consumers due to its exceptional nutritional profile and diverse health benefits. It is rich in vitamins (C, K), dietary fiber, and essential minerals, along with a high concentration of bioactive compounds such as polyphenols, flavonoids, anthocyanins, and ellagitannins. These compounds exhibit strong antioxidant activity, helping to neutralize free radicals and reduce oxidative stress in the body. Pomegranates are processed for utilization in the food, pharmaceutical and cosmetic products. The growth of the agro-processing industry creates opportunities for value-added products, enhancing the income for producers and contributing to India's manufacturing sector. Pomegranate farming supports a large workforce, providing employment not just in cultivation but also in processing, packaging, and transportation.

Nutritional quality of pomegranate: The pomegranate fruit is composed of approximately 50% edible part constituting of arils and 50% non-edible peel on a fresh weight basis. Within the arils, seeds are found and represent between 4-10% of the total fruit weight. The pomegranate juice made from arils contain 85% water, 10% total sugars (mainly fructose and glucose), and

1.5% pectin, organic acids (ascorbic, citric and malic) and bioactive compounds such as phenolic compounds and flavonoids mainly anthocyanins. Arils also provide 12% of the daily value (DV) for vitamin C and 16% for vitamin-K per 100 g serving. The red color of arils and juice can be attributed to anthocyanins, such as delphinidin, cyanidin, and pelargonidin glycosides.

Pomegranate peel, accounting about 50% of the whole fruit, is the non-edible fraction comprised mainly of several bioactive compounds such as hydrolysable tannins (pedunculagin, punicalin, punicalagin and ellagic and gallic acids), flavonoids (catechins, anthocyanins, and other complex flavonoids), complex polysaccharides and minerals (phosphorus, magnesium, calcium, potassium and nitrogen). The primary polyphenols in peel are gallic acid (14.14%), proto catechuic acid (14.51%), chlorogenic acid (2.35%), vanillic acid (3.851 %), coumarin (3.53%), caffeic acid (2.74%), oleuropein (0.59%), ferulic acid (1.85%), quercetin (0.94%), and caffeine (6.42%). Pomegranate peel is known for high antioxidant activity and anti-microbial properties.

Pomegranate seeds are important co-product of the pomegranate juice processing industry. Seeds contain a significant amount of lipid, protein, sugars, dietary fiber and essential minerals. In addition to this, the pomegranate seeds contain nutraceuticals, such as sterols, γ -tocopherol, hydroxyl benzoic, punicalic acid, and phenyl aliphatic glycosides such as phenethyl rutinoid; besides the contents of most minerals excluding vitamin K are higher in seeds than in arils. The soft seeded varieties of pomegranate contain seed oil up to 25-26% (V/W), which is mainly rich in conjugated linolenic acid (70%). Seeds contain punicalic, palmitic, stearic, oleic, and linoleic acids. Seed oil is also a rich source of a steroidal estrogen,



Phytochemical distribution in different parts of the pomegranate (Source: Saeed *et al.*, 2025)

estrone, and contains γ -tocopherol, a rare and potent form of vitamin E and the phytosterols: β -sitosterol, stigmasterol, and campesterol.

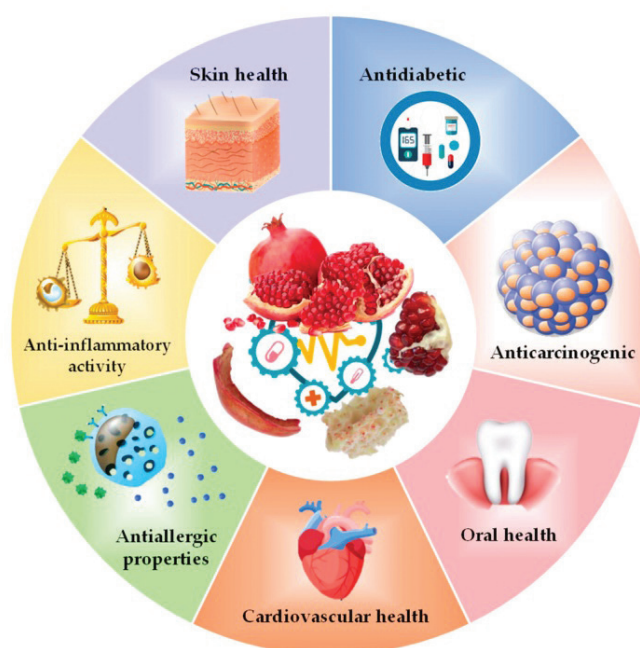
Pomegranate flowers contain a variety of secondary metabolites such as polyphenols with strong antioxidant activity. It contains mainly ellagic acid, anthocyanins, triterpenes, oleanolic acid, ursolic acid, and gallic acid.

Nutritive value of pomegranate fruit (values per 100g edible portion): The edible portion (100 g) of pomegranate provides approximately 65–78 kcal of energy, 15.4–19.6 g carbohydrates (including about 14.5 g natural sugars), 3.4–5.1 g dietary fiber, and 5.3–16 mg ascorbic acid (vitamin C). It also contains essential minerals such as calcium (3–12 mg), phosphorus (8–37 mg), iron (0.3–1.8 mg), potassium (133–259 mg), magnesium (4–44 mg), and sulphur (~12 mg). Pomegranate is a moderate-energy fruit, making it suitable for a balanced diet without excessive calorie intake. The carbohydrates and natural sugars provide quick energy, while the relatively high dietary fiber content supports digestion, improves gut health, and helps regulate blood sugar levels. The presence of ascorbic acid (vitamin C) enhances immune function, aids in collagen synthesis, and acts as an antioxidant to combat oxidative stress. Among minerals, potassium plays a crucial role in maintaining heart health and regulating blood pressure, while magnesium supports enzyme activity and muscle function. Calcium and phosphorus contribute to bone strength, and iron is essential for hemoglobin formation and prevention of anemia. Additionally, trace elements like sulphur are involved in protein synthesis and detoxification processes in the body.

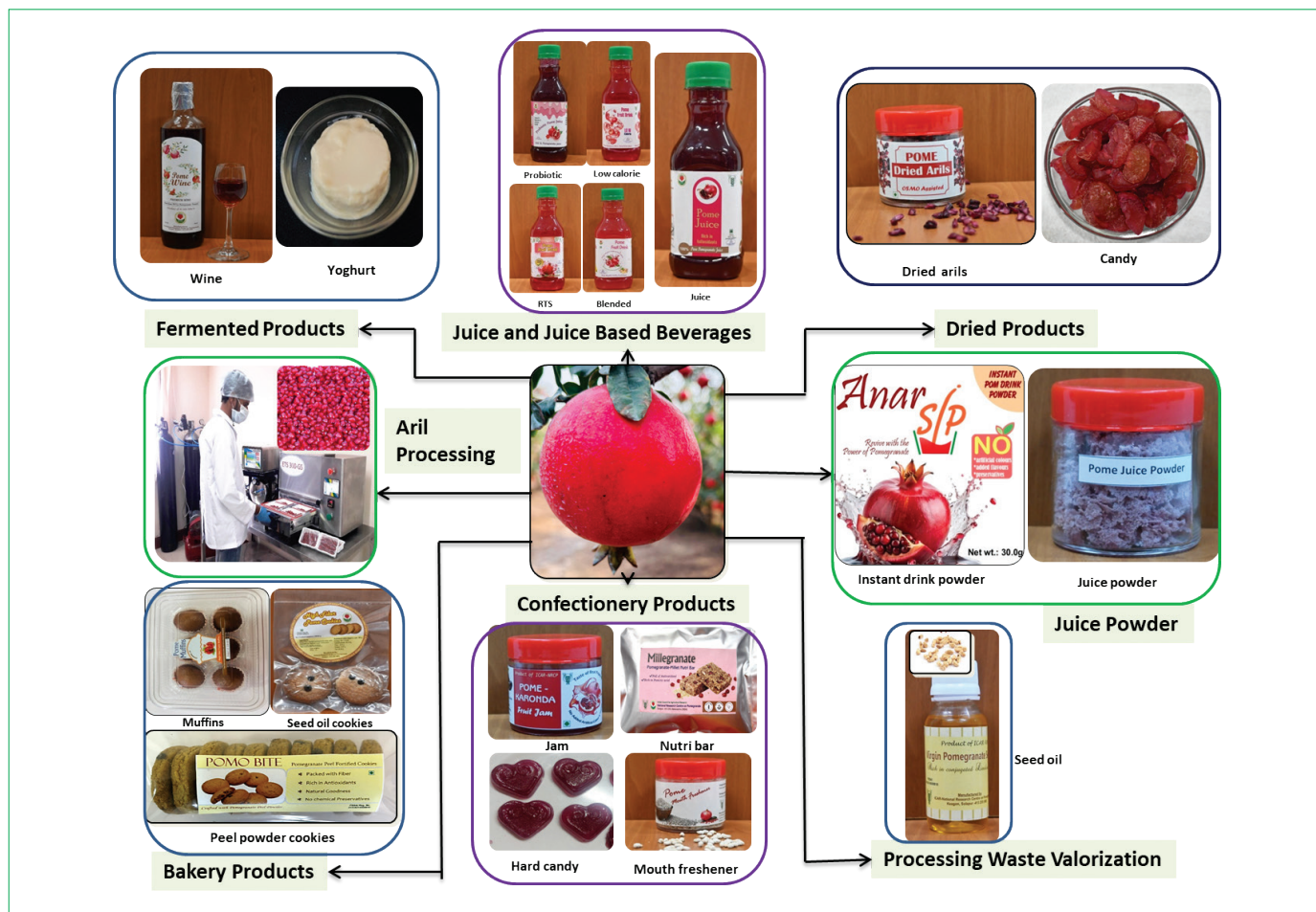
Therapeutic benefits of pomegranate: Regular consumption of pomegranate has been shown to provide significant cardiovascular protection by lowering systolic blood pressure, improving endothelial function, inhibiting LDL oxidation, and reducing atherosclerotic plaque

formation. In terms of anti-diabetic activity, pomegranate aids in regulating blood glucose levels, enhancing insulin sensitivity, and modulating carbohydrate metabolism enzymes. The fruit also exhibits promising anti-cancer properties, as its polyphenols can inhibit cancer cell proliferation, induce apoptosis, and suppress tumor growth in cancers such as prostate, breast, and colon. Its anti-inflammatory action involves down regulation of pro-inflammatory cytokines and enzymes like COX and NF- κ B, making it beneficial in managing chronic inflammatory conditions including arthritis

and metabolic disorders. Furthermore, pomegranate demonstrates potent antimicrobial activity against a wide range of bacterial and fungal pathogens, supporting its use in food preservation and therapeutic formulations. Emerging studies also highlight its neuro-protective effects, where it helps reduce oxidative damage in neural tissues, potentially lowering the risk of neurodegenerative diseases like Alzheimer's. Additionally, its polyphenols act as prebiotics, improving gut microbiota composition and enhancing digestive health. Altogether, these diverse biological activities make pomegranate a powerful natural therapeutic agent with applications in functional foods, nutraceuticals, and preventive healthcare systems.



Therapeutic benefits of pomegranate (Source: Das *et al.*, 2021)



Value added products from pomegranate developed by ICAR-NRCP, Solapur

Value added products from pomegranate: Pomegranate offers immense potential for processing and development of value-added and functional food products. The arils, seeds, and peel can be efficiently utilized to minimize postharvest losses and enhance profitability. A wide range of products has been developed by NRCP, Solapur including minimally processed fresh arils, pomegranate juice, Ready-To-Serve (RTS) beverages, probiotic pomegranate drinks, Pome-lime-ginger RTS beverages, and low-calorie pomegranate drinks. Additionally, fermented products such as pomegranate wine, and processed items like jam, squash, dried arils, anardana, and juice powder are gaining popularity. The seeds can be used for pomegranate seed oil extraction and development of innovative products like seed-based mouth fresheners and nutribars. Furthermore, pomegranate peel, a major by-product, can be valorized into peel powder-fortified muffins, peel extract-enriched soy yoghurt, and other functional foods due to its high polyphenol content. Thus, pomegranate serves as a versatile raw material in horticultural processing, supporting the development of diverse, health-oriented value-added products.

ICAR-NRCP, Solapur has developed and patented an advanced process for extraction of pomegranate seed oil that ensures maximum retention of its valuable nutrients and bioactive compounds. Building on this innovation, the institute has also developed gel capsules of pomegranate seed oil, providing a convenient nutraceutical form for

human consumption. Furthermore, encapsulation of the oil using spray drying technology has been standardized to enhance its stability, protect sensitive bioactives from oxidation, improve shelf life, and facilitate its incorporation into functional food formulations. The utility of this technology is significant in both nutraceutical and functional food sectors. The encapsulated forms (gel capsules and spray-dried powder) enable controlled dosage, ease of handling, and improved bioavailability, while also allowing its use as an ingredient in health supplements, fortified foods, beverages, and cosmetic formulations.

SUMMARY

Putting all the aspects in a nutshell, the pomegranate has all the potential to contribute in 'Viksit Bharat' by improving agriculture, boosting economic growth, promoting health and nutrition, sustainable livelihood, and supporting rural development. Through strategic focus and innovation, the cultivation and processing of pomegranates can play a key role in India's journey toward becoming a developed nation.

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