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Review Article

A Review on the Anticancer Properties of Selected Edible Fruits

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ABSTRACT

Cancer continues to pose a formidable global health challenge, primarily driven by oxidative damage, chronic inflammation, and disruption of molecular signalling pathways. The limitations of current therapeutic approaches, including off-target toxicity and resistance, have spurred growing interest in bioactive compounds from natural sources, particularly edible fruits, for their potential in cancer prevention and intervention. This review examines the anticancer attributes of specific fruits; dragon fruit, guava, annona, wild cucumber, papaya, mangosteen, and cherry, highlighting their rich phytochemical profiles and multifaceted mechanisms of action. These fruits are abundant in bioactive constituents such as flavonoids, carotenoids, xanthones, acetogenins, and enzymatic antioxidants. Their mechanisms include scavenging reactive oxygen species, inducing apoptosis, suppressing metastasis, arresting the cell cycle, and modulating inflammatory mediators. This review shows that acetogenins of Annona muricata exerts mitochondrial inhibition; lycopene of papaya and guava exhibit antiproliferative effects; and anthocyanins of cherries exhibit antioxidant activity. Wild cucumber supports detoxification and enhances antioxidant responses, reinforcing its protective role. The review was conducted through an extensive literature search across databases like PubMed, Science Direct, Scopus, and Google Scholar. Although preclinical data are encouraging, translational hurdles such as standardisation and clinical validation remain. Further integrative research is essential to realise the full therapeutic potential of fruit-derived phytochemicals in oncology.

INTRODUCTION

Cancer remains a predominant global health challenge, characterised by the unregulated growth of abnormal cells driven by genetic mutations and environmental exposures. Key carcinogenic factors include chemical agents, ionising radiation, and oxidative stress [1, 2]. It is estimated that

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roughly three-quarters of cancer cases are linked to environmental causes, particularly the cellular damage induced by reactive oxygen species (ROS), which plays a pivotal role in the onset and progression of tumours [3].

As a result, there is growing scientific interest in dietary antioxidants as a preventive strategy against cancer. Edible fruits are especially valued for their abundance of bioactive compounds, known for their antioxidant, anti-inflammatory, and antiproliferative effects [4]. These compounds include flavonoids, phenolic acids, carotenoids, anthocyanins, and essential vitamins, all of which help mitigate oxidative damage and regulate molecular pathways involved in tumour genesis [5, 6]. A broad array of laboratory, animal, and epidemiological investigations supports the incorporation of fruits in regular diets as a natural approach to reduce cancer risk. This review examines the anticancer properties of specific fruits, focusing on their phytochemical content and underlying biological mechanisms.

Dragon Fruit (*Hylocereus* spp.)

Native to the Americas but widely cultivated in Asia, dragon fruit, particularly red fleshed *Hylocereus polyrhizus* and white fleshed *Hylocereus undatus*, is a tropical fruit recognised for its vibrant pigmentation due to betacyanins and high fibre and mineral content. Its anticancer efficacy is largely linked to antioxidants such as betacyanins, flavonoids, and polyphenols, which reduce oxidative stress by neutralising ROS implicated in carcinogenesis [7]. Notably, *H. polyrhizus* has shown cytotoxic effects on MCF-7 breast cancer cells, with enhanced efficacy when phytochemicals are delivered using nanoparticle carriers to improve absorption and cellular entry [8] . Betalains and polyphenols also neutralise nitric oxide radicals, which contribute to tumour growth. Studies report that methanolic extracts of the fruit induce apoptosis in liver cancer cells, suggesting the involvement of mitochondrial pathways [9]. Comparative assessments of dragon fruit from regions such as Thailand and Israel demonstrated its effectiveness against prostate and colon cancer cell lines with minimal toxicity to normal cells [10].

Guava (*Psidium guajava* L.)

A well-known tropical fruit from the Myrtaceae family, guava is traditionally used for its medicinal properties in managing infections and inflammation. It exists in white or pink-fleshed varieties. Guava is particularly rich in vitamin C, a potent antioxidant that protects cells by neutralising reactive carcinogens [11]. The flavonoid apigenin in guava displays cytostatic and anti-metastatic effects, especially on colon and oral carcinoma cells. Lycopene, the red pigment carotenoid, hinders cancer cell proliferation and induces programmed cell death [12]. Another key component, kaempferol, has been effective against thyroid carcinoma, triggering apoptosis via oxidative stress and restricting cell movement and invasiveness [13, 14].

Annona (*Annona muricata* L.)

Commonly called soursop or graviola, *Annona muricata* is a tropical tree with widespread use in folk medicine, particularly for its fruit and leaves. Its notable anticancer activity is credited to annonaceous acetogenins (AGEs), a class of fatty acid derivatives unique to the Annonaceae family. These compounds inhibit mitochondrial complex I, disrupt oxidative phosphorylation, and reduce ATP synthesis, mechanisms that lead to cancer cell death [15, 16]. AGEs also regulate cancer-related signalling pathways, such as down regulation of EGFR in breast cancer and the modulation of apoptotic proteins like Bax and Bcl-2 [17]. Extracts from *A. muricata* have demonstrated activity against numerous cancers including breast,

ovarian, liver, colon, lung, and haematological malignancies. Key acetogenins like Annonacin, Bullatacin, Annomuricin E, and Uvaricin have shown potential even against chemotherapy-resistant tumours [18, 19].

Wild Cucumber (*Cucumis pubescens* Willd.)

This lesser-known plant, native to India and part of the Cucurbitaceae family, is characterised by its bristly leaves and fruits. Recent studies have highlighted its rich antioxidant profile, particularly enzymes like superoxide dismutase (SOD), catalase, and glutathione peroxidase (GPx), which help counteract ROS mediated carcinogenesis [20]. MTT assays confirmed its antiproliferative effect against A549 lung carcinoma cells, with evidence of apoptosis induction. The plant's inhibitory effect on glutathione S-transferase (GST), a detoxification enzyme, also suggests a role in reducing tumour initiation from environmental carcinogens [21, 22].

Papaya (*Carica papaya* L.)

Cultivated globally, papaya belongs to the Caricaceae family and is rich in bioactive nutrients like vitamins A, C, and E, and phytochemicals such as carotenoids, flavonoids, alkaloids, and saponins [23]. Phytochemicals such as quercetin, caffeic acid, rutin, α-tocopherol, papain, and isothiocyanates modulate ROS levels and enhance antioxidant defences by activating key signalling cascades [24]. Lycopene in papaya is especially effective in preventing prostate cancer [25]. Other compounds, including cucurbitacin B, resveratrol, piperlongumine, PEITC, BiTC, and various flavonoids, work by inducing apoptosis and blocking tumour-promoting pathways [26].

Mangosteen (*Garcinia mangostana* Linn.)

Mangosteen is a tropical evergreen tree prized for its pericarp, which is particularly rich in xanthones, polyphenolic compounds with therapeutic properties [27]. Prominent xanthones such as α-mangostin, β-mangostin, γ-mangostin, and garcinone E have demonstrated strong anticancer effects. These include triggering apoptosis, halting cell division, and suppressing invasion and metastasis of cancer cells [28].

Cherry (*Prunus avium* L.)

Sweet cherry fruits are rich in anthocyanins that provides much of its biological activity. Cherries also provide melatonin, hydroxycinnamic acids, and flavanols, all of which exhibit antioxidant potential and remain bioavailable following digestion [29]. Their anti-inflammatory properties have also been recorded, with evidence suggesting that cherry extracts modulate cytokines such as TNF-α and IL-6, disrupting tumour-promoting inflammation [30].

DISCUSSION

The current review underscores the wide-ranging anticancer activity of several edible fruits, owing to their diverse phytochemical constituents. These bioactive agents, including flavonoids, acetogenins, xanthones, carotenoids, and antioxidant enzymes, confer antitumor benefits by targeting mechanisms such as free radical elimination, induction of apoptosis, disruption of cell survival pathways, and inhibition of inflammatory responses.

Oxidative stress, recognised as a major contributor to carcinogenesis, is effectively counteracted by fruit-derived antioxidants. Compounds such as vitamin C (from guava), lycopene (from papaya), and betacyanins (from dragon fruit) help neutralise ROS and reinforce endogenous defence mechanisms by activating SOD, catalase, and GPx.

Some compounds, such as acetogenins from *Annona muricata* and xanthones from *Garcinia*

mangostana, are particularly promising for their selective cytotoxicity, attacking cancerous cells while sparing healthy ones. Similarly, the ability of *Cucumis pubescens* to inhibit GST suggests potential in halting carcinogenesis at an early stage.

In addition to antioxidative and cytotoxic activities, many of these fruits exert anti-inflammatory effects. For instance, sweet cherries suppress inflammatory mediators such as TNF-α and IL-6, thereby weakening the tumour-supportive microenvironment.

Innovative delivery systems, such as nanoparticle-based formulations, are showing promise in enhancing the bioavailability and effectiveness of these phytochemicals. An example is the increased anticancer efficacy of nano-encapsulated dragon fruit extract in breast cancer models.

Despite the fact that most of the studies are preclinical, rigorous standardisation, isolation of active components, and pharmacokinetic research including human clinical trials are necessary to validate the efficacy of fruits in anticancer therapy. Overall, integrating these fruit-derived compounds into clinical protocols or dietary guidelines may offer a practical route for cancer prevention and management, but this will require sustained interdisciplinary investigation.

CONCLUSION

The fruits discussed in this review demonstrate noteworthy anticancer potential, primarily due to their wealth of phytochemicals that intervene in oxidative stress, inflammation, and tumour-related signalling cascades. Although current knowledge is predominantly based on laboratory and animal studies, the accumulating evidence supports the concept of fruit-enriched diets as a complementary strategy in cancer prevention. Nonetheless, further clinical trials and mechanistic studies are necessary to realise their full therapeutic promise in oncology.

Conflict of interest

The author declares that there is no conflict of interest in this review article.

REFERENCES

1. Wang J, Rani N, Jakhar S, Redhu R, Kumar S, Devi B, Simal-Gandara J, Shen B and Singla RK. Opuntia ficus-Indica (L.) Mill. anticancer properties and phytochemicals: current trends and future perspectives. Front. Plant Sci. 2023; 14 (1236123):1-21.
2. Suganthi A, Josephine RM. Evaluation of antioxidant and anticancer activity of Pithecellobium dulce fruits. Int. J. Pharm. Sci. Rev. Res. 2023; 78(1): 46-51.
3. Entezari M, Majd A, Falahian F, Mehrabian S, Hashemi M, Lajimi AA. Antimutagenicity and anticancer effects of Citrus medica fruit juice. Acta Medica Iranica. 2009; 47(5): 373-377.
4. Kandasamy P, Shanmugapriya C. Medicinal and nutritional characteristics of fruits in human health. Journal of Medicinal Plants Studies. 2015; 4(4): 124-131.
5. Saminathan V, Doraiswamy R. Phytochemical analysis, antioxidant and anticancer activities of durian (Durio zibethinus Murr.) fruit extract. J Res Pharm. 2020; 24(6): 1-12.
6. Jaikumar B, Jasmine R. A review on a few medicinal plants possessing anticancer activity against human breast cancer. International Journal of Pharm Tech Research. 2016; 9(3): 333-365.
7. Arivalagan M, Karunakaran G, Roy T, Dinsha M, Sindhu B, Shilpashree V. Biochemical and nutritional characterization of dragon fruit (Hylocereus species). Food Chemistry. 2021; 353: 1-23.

8. Divakaran D, Lakkakula JR, Thakur M, Kumawat MK, Srivastava R. Dragon fruit extract capped gold nanoparticles: synthesis and their differential cytotoxicity effect on breast cancer cells. Materials Letters. 2019; 236, 498–502.
9. Padmavathy J, Raju D, Saraswathi VS, Kayalvizhi M, Sadasivam SG. Therapeutic significance of Hylocereus undatus (dragon fruit): A review. Asian Journal of Pharmaceutical and Clinical Research. 2021; 14(5):44-49.
10. Pasko P, Barton H, Zagrodzki P, Oboz M, Włodarczyk A, Gawlik M. Comparative study of chemopreventive properties of dragon fruits from Thailand and Israel: antioxidant activity, polyphenol profile, cytotoxicity, and human serum albumin binding. Journal of Food Science. 2021; 86(4), 1245–1256.
11. Correa MG, Couto JS, Teodoro AJ. Anticancer properties of Psidium guajava - a mini-review. Asian Pacific Journal of Cancer Prevention. 2016; 17: 4199-4204.
12. Ryan S, Karen DM, Bernard McPG, Amy BC. Anticancer activity of Guava (Psidium guajava) extracts. Journal of Complementary and Integrative Medicine. 2010; 7 (1):1-12.
13. Biswas S, Talukdar P, Talapatra SN. Presence of phytochemicals in fruits and leaves of guava (Psidium guajava Linn.) for cancer prevention: A mini review, Journal of Drug Delivery and Therapeutics. 2019; 9(4):726-729.
14. Lok B, Babu D, Tabana Y, Dahham SS, Adam MAA, Barakat K, Sandai D. The anticancer potential of Psidium guajava (Guava) extracts. Life. 2023; 13 (346): 2-22.
15. Moghadamtousi SZ, Fadaeinasab M, Nikzad S, Mohan G, Ali HM, Kadir HA. Annona muricata (Annonaceae): a review of its traditional uses, isolated acetogenins and biological activities. International Journal of Molecular Sciences. 2015; 16(7): 15625–15658.
16. Yang C, Gundala SR, Mukkavilli R, Aneja R. Synergistic interactions among flavonoids and acetogenins in Annona muricata extract confer protection against prostate cancer. Carcinogenesis. 2015; 36(6): 656–665.
17. Ioannis P, Anastasis S, Andreas Y. Graviola: a systematic review on its anticancer properties. American Journal of Cancer Prevention. 2015; 3 (6): 128-131.
18. Ilango S, Sahoo DK, Paital B, Kathirvel K, Gabriel JI, Subramaniam K, Jayachandran P, Dash RK, Hati AK, Behera TR, Mishra P, Nirmaladevi R. A review on Annona muricata and its anticancer activity. Cancers. 2022; 14 (4539): 2-39.
19. Rady I, Melissa B, Roxane-Cherille BN, Chamcheu, Mbeumi SB, Anwar MdR, Mohamed H, Babatunde AS, Kuiate JR, Noubissi FK, Khalid A, Sayed E, Whitfield GK, Chamcheu JC. Anticancer properties of Graviola (Annona muricata): a comprehensive mechanistic review. Oxidative Medicine and Cellular Longevity. 2018; 1826170: 1-39.
20. Kaushik U, Aeri V, Mir SR. Cucurbitacins- an insight into medicinal leads from nature. Pharmacognosy Reviews. 2015; 9 (17): 12-18.
21. Sundari T, Kavitha R, Gnanamangai BM, Saranya S. Assessment of in- vitro antioxidant properties and anticancer potential of Cucumis pubescens Willd. A medicinal fruit, utilizing human lung cancer cell line (A549). J App Biol Biotech. 2024; 12(6):185-192.
22. Delgado-Tiburcio EE, Cadena-Iniguez J, Santiago-Osorio E, Ruiz-Posadas LdM, CastilloJuarez I, Aguiniga-Sanchez I, Soto-Hernandez M. Pharmacokinetics and biological activity of Cucurbitacins. Pharmaceuticals. 2022; 15 (1325): 1-24.
23. Srivastava R, Jaiswal N, Kharkwal H, Dubey NK, Srivastava R. Phytomedical properties of Carica papaya for boosting human immunity

against viral infections. Viruses. 2025; 17 (271): 1-28.

24. Kong YR, Jong YX, Balakrishnan M, Bok ZK, Weng JKK, Tay KC, Goh BH, Ong YS, Chan KG, Lee LH, Khaw KY. Beneficial role of Carica papaya extracts and phytochemicals on oxidative stress and related diseases: a mini review. Biology. 2021; 10 (287): 1-20.
25. Kumarasinghe HS, Kim JH, Kim SL, Kim KC, Perera TD, Kim SC, Lee DS. Bioactive constituents from Carica papaya fruit: implications for drug discovery and pharmacological applications. Appl Biol Chem. 2024; 67 (103): 1-23.
26. Patel S, Rana K, Arya P, Nelson J, Hernandez V, Minakova V. Anticancer activity of phytochemicals of the papaya plant assessed: a narrative review. J Cancer Prev. 2024; 29(3):58-68.
27. Obolskiy D, Pischel I, Siriwatanametanon N, Heinrich M. Garcinia mangostana L.: a phytochemical and pharmacological review. Phytotherapy Research. 2009; 23 (8):1047-1065.
28. Muchtaridi M, Wijaya CA. Anticancer potential of α-Mangostin. Asian J Pharm Clin Res. 2017; 10 (12): 440-445.
29. Fonseca LRS, Silva GR, Luis A, Cardoso HJ, Correia S, Vaz CV, Duarte AP, Socorro S. Sweet cherries as anti-cancer agents: from bioactive compounds to function. Molecules. 2021; 26 (2941): 1-30.
30. Adkins YDS, Reddy A, Woodhouse LR, Mackey BE, Erickson KL. Sweet bing cherries lower circulating concentrations of markers for chronic inflammatory diseases in healthy humans. J Nutr. 2013; 143(3):340-344.

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