

A Review on Role of Red Wine Polyphenols in Cancer Treatment

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Abstract

This paper presents an overview of the role of red wine polyphenols in cancer treatments. Nowadays one of the deadliest diseases in the world is cancer. According to the World Health Organization, cancer is known to be the second leading cause of death across the world. The most common cancer treatment plans are either surgery, radiation therapy or chemotherapy. But these conventional cancer therapies result in serious adverse effects in humans. A recent study shows that an antioxidant found in grape skins and seeds, known as resveratrol, a part of a group of phenolic compounds called polyphenol. Grape polyphenols are used for preventing diseases caused due to oxidative stress. It prevents cancer cells from replicating and spreading inside and enhances the effectiveness of radiation and chemotherapy cancer treatments. Various phytochemicals found in wine such as lignans, quercetin, and resveratrol have estrogenic properties. Animal research suggests that they synergistically change the gene expression in cancer cells to inhibit their growth and colony formation and thus reduce the incidence of cancer.

Keywords: Red Wine; Cancers; Polyphenols; Resveratrol; Phenolic Compounds; Antioxidants; Phytochemicals

Abbreviation

EGCG: Epigallocatechin Gallate; TPA - 12-O-Tetradecanoylphorbol-13-Acetate

Introduction

Cancer is one of the major reasons for death in both men and women. Studies say that about 6 million people die each year worldwide due to cancer. Chemotherapy is a drug treatment method where strong chemicals are used for killing fast-growing cancer cells in our bodies. Patients undergoing chemotherapy face a lot of side effects like pain, hair loss, loss of appetite, nausea, diarrhoea, constipation, fatigue, bleeding etc. To reduce these side effects, chemoprevention is introduced as a relatively new and promising cancer prevention strategy in recent times. Chemoprevention uses naturally occurring substances to inhibit or delay tumorigenesis. Even many phytochemicals found in edible plants play a specific role in different stages of the carcinogenic process [1]. Even after considerable progress in the development of anti-cancer treat-

ment, cancer is still a major threat to mankind. Various research proves certain foods and dietary patterns lead to reduced cancer risk and increased chance of survival after a cancer diagnosis [2]. Numerous studies demonstrate that fruits and vegetables contain natural polyphenols which are used for the prevention and treatment of cancer since the antioxidant, anti-inflammatory quality of fruits and vegetables leads to modulation of multiple molecular events involved in carcinogenesis [3].

Classification	Representative Members	Major Dietary Sources
Hydroxycinnamic acid	Ferulic acid, Chlorogenic acid	Coffee, Cereal grains
Lignans	Sesamin, Secoisolariciresinol Diglucoside	Flaxseeds, Sesame
Stilbenes	Resveratrol, Pterostilbene, Piceatannol	Grapes, Berries, Red Wine

Table a

Classification		Representative members	Major dietary sources
	Anthocyanins	Delphinidin, Pelargonidin, Cyanidin, Malvidin	Berries, Grapes, Cherries, Plums, Pomegranates
	Flavanols	Epicatechin, Epigallocatechin, Egcg, Procyanidins	Apples, Pears, Legumes, Tea, Cocoa, Wine
	Flavanones	Hesperidin, Naringenin	Citrus fruits
Flavonoids			
	Flavones	Apigenin, Chrysin, Luteolin	Parsley, Celery, Orange, Onions, Tea, Honey, Spices
	Flavonols	Quercetin, Kaempferol, Myricetin, Isorhamnetin, Galangin	Berries, Apples, Broccoli, Beans, Tea
	Iso flavonoids	Genistein, Daidzein	Soy
Phenolic acids	Hydroxybenzoic acid	Ellagic acid, Gallic Acid	Pomegranate, Grapes, Berries, Walnuts, Chocolate, Wine, Green Tea

Table 1: The classification of natural polyphenols.

This table demonstrates recent discoveries about the anti-carcinogenic properties of natural polyphenols and briefly describes the mechanism of action, and major sources from laboratory experiments and clinical trials [3].

It is found that grapes and red wine are rich sources of polyphenols and thus have an immense contribution to cancer treatment. Alcohol intake increases the risk of cancer, but studies and surveys say that consumption of wine rather than beer and spirits lowers the risk of rectal cancer [4].

This line graph provides a pictorial representation of the relative risk of rectal cancer associated with different types of alcohol consumption [4].

The aim of this overview is to summarize various recent studies on various useful wine components and using red wine as a chemopreventive measure in cancer treatment.

Red wine Polyphenols in cancer chemoprevention

Some important polyphenols in red wine are resveratrol, anthocyanins, catechins, quercetins, tannins, and gallic acid [5]. Phenolic components provide the colour and taste of red wine and it also works as a wine preservative. Tannins constitute majority of polyphenols. Wine Polyphenolic compounds contains non-flavonoids like hydroxycinnamates, hydroxybenzoates, stilbenes and flavonoids like flavan-3-ols, flavanols, anthocyanins [6].

Cancer Chemopreventive activity of resveratrol

Resveratrol, a type of polyphenol found in red wine has chemopreventive activity in different stages of carcinogenesis [7]. Research state that red and purple grapes used for red wine preparation have more resveratrol than green grapes and thus have more benefits.

Resveratrol acts as an antioxidant and antimutagenic compound that mediates anti-inflammatory effects [8]. Resveratrol inhibits cellular events that are associated with tumor initiation, promoti-



Figure 1

on, and progression. According to clinical studies resveratrol also inhibits events associated with tumor initiation and thus prevents tumor promotion. Resveratrol inhibits cancer promotion and a dose dependent manner like - human promyelocytic leukemia HL-60 cells were treated with 12-o-tetradecanoylphorbol-13-acetate (TPA) [9].

Cancer Chemopreventive activity of quercetin

Quercetin is a type of flavonoid found in red wine has chemopreventive nature with little or no side effects to normal cells due to its antioxidant, anti-tumor, and anti-inflammatory activity. Low dose of quercetin exhibit inhibition of cancer cell proliferation by arresting cell cycle at G1 phase and is thus known to inhibit proliferation of wide range of cancer like breast, cervical, prostate, colon, and lung [10]. Quercetin show direct proapoptotic effects on tumor cells and thus inhibit numerous human cancer cell progression [11]. A proper combination of resveratrol and quercetin in concentrations equivalent to that found in red wine can inhibit oral squamous carcinoma cell growth and proliferation [12].

Cancer Chemopreventive activity of Catechin

Catechins are group of polyphenol-based secondary metabolites mostly found in red wine tea, coca and other fruit drinks and plant products [13,14]. Catechins are usually found as aglucones or are esterified as with gallic acid [15].

Studies say that catechin can prevent lung cancer A549 cells with an inhibition rate of 19.76% by increasing the expression p21 and p27 in cancer cells [16].

Polyphenols as aromatase inhibitors

After menopause, aromatization of androgen precursor present in adipose tissue is the major synthetic source of estrogen [17]. Aromatase, a cytochrome P450 is an enzyme that synthesizes estrogen by converting C19 androgens into C18 aromatic estrogenic steroids. Since case of breast tumor aromatase expression is enhanced compared to that of surrounding non-cancerous tissue, it is important to suppress estrogen formation in breast of postmenopausal women by aromatase inhibition [18-21].

Polyphenols present in red wine can decrease aromatase activity and thus inhibits estrogen production [22].

Discussion

The study demonstrates the role of red wine polyphenols in cancer treatment. Cancer is considered one of the world's deadliest diseases. It is treated generally by surgery, radiation therapy or chemotherapy which have numerous side effects. So, adopting chemopreventive measures like having dietary food and beverages rich in polyphenols such as resveratrol, quercetin, catechin etc. is of great importance. Red wine contains such useful polyphenols; hence, moderate wine consumption is considered a new and promising cancer-preventive strategy.

Conclusions

Polyphenols have been found beneficial plant compounds with antioxidant properties which help in protect against various diseases. They can be classified into flavonoids, phenolic acid, lignans and stilbenes. Red wine is an important dietary source of polyphenols which exhibit number of biological effects in different *in vitro* and *in vivo* systems. It has been shown that some red wine polyphenols such as resveratrol, quercetin and catechins have been shown to inhibit *in vitro* and *in vivo* carcinogenesis due to their antioxidative or anti-inflammatory properties. Polyphenols can inhibition of growth of transformed cells and hence can act as suppressing agent. Grape polyphenols present in red wine can be used as cancer chemopreventives. Red wine polyphenols can decrease aromatase activity, indicating potential treatment of breast cancer, since aromatase plays an important role in the carcinogenesis of breast cancer by inhibiting estrogen production.

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