

Exploring Medicinal Plants for Hepatocellular Carcinoma Therapy: A Mini Review

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ABSTRACT

The liver is a vital organ involved in numerous physiological processes, including metabolism and the detoxification of xenobiotics. Hepatocellular carcinoma (HCC), the most common type of primary liver cancer, ranks as the fifth most prevalent malignancy worldwide and is the third leading cause of cancer-related deaths. Traditional herbal medicine has long been employed in managing liver diseases, including HCC, offering a complementary approach to modern therapies. Natural compounds derived from medicinal plants have shown potential in mitigating the adverse effects associated with conventional chemotherapeutic agents. Despite the promising in vitro and in vivo anticancer properties demonstrated by several plant-derived compounds, many have yet to be thoroughly validated for their therapeutic efficacy and mechanisms of action. Recent studies have sparked growing interest among oncologists in bioactive phytochemicals as prospective anticancer agents. Some clinical trials in the 21st century have substantiated the role of specific medicinal plants in liver cancer treatment, while ongoing fundamental research continues to elucidate their molecular pathways. This review aims to summarize current findings on medicinal plants exhibiting anticancer activity against HCC, focusing on their bioactive constituents, mechanisms of action, and potential for future drug development.

INTRODUCTION

Cancer is a generic name for a variety of malignancies that can involve multiple parts of the body. These diseases are marked by the sudden, unregulated development of abnormal cells, capable of massifying or proliferating in the body, leading to abnormal growth elsewhere. If the process is not stopped, it will continue until the organism dies[1].

The liver has more functions than any human organ, and is the largest glandular organ in the body. The whole blood stream of a human flows into the liver several times a day. In human metabolism the liver has a central role to play. It also creates prothrombin and fibrinogen, both blood coagulation agents and heparin, a sulfur-acid ester mucopolysaccharide that helps prevent blood clotting inside the circulatory system. The liver also generates bile and secretes. The liver transforms the glucose in sugar [2]. Liver diseases have now become one of the leading causes in humans and animals in the world of morbidity and mortality, and it seems that hepato-toxicity is the most common reason. Liver cancer is among the most deadly types of disease. With 745 000 deaths per year, the mortality rate is the second leading cause of tumor-related death worldwide [3]. In the last 2 decades, the worldwide prevalence of liver cancer has doubled, with almost 83% of cases and 84% of associated deaths in the developed world. HCC management is more complicated than

other malignancies; the treatment options mostly rely on the level of liver cancer, patient operating conditions, number, tumour size and location and the presence or absence of vascular invasion [4]. HCC management is rather complex in the context of the liver cyrrhosis.

HCC treatments are available from loco-regional therapy (RAT), intra-tumor ethanol injecting (arterial ablations) to micro-arterial transmission (yttrium-90) and coagulation (microwave) and operating (surgical resection and liver transplantation) and sorafenib. There are a range of treatment choices for HCC. Chemotherapy's distinctive regimen was attempted with poor reaction [5].

Most adds to the attractiveness of herbal medicine. Herbal proponents contend that herbs can cure and avoid diseases. This adds to the profound conviction that the therapies are "normal" and suit the appearance of a mild and therefore unfavourable alternative to traditional medicine [6]. This analysis discusses the available clinical evidence for herbal medicinal products and the liver in particular for its supposed beneficial effects and highlighted the problems that must be solved if herbal medicines are to be incorporated into the therapeutic arsenal of liver cancer care [7].

NATURAL TREATMENT FOR LIVER CANCER

There are some phytochemicals on the medicinal plants that have powerful antioxidants. Flavonoids (flavonoids, isoflavones, flavonones, anthocyanins, catechins, isocatechins, quercetin), terpenoids, polyphenol (ellagic acid, gallic acid, tuna), alkaloids, saponins, carotenoids, minerals (selenium, cotton, manganese, zinc, chromium, iodine) [8], enzymes (superoxide dismutase, catalase, glutathione peroxidase), polysaccharide may be present in these antioxidants. These antioxidants can be: By shielding cells from 'free radicals'-highly reactive compounds, antioxidants can cure various diseases [9].

CURCUMIN

Diferuloylmethane has powerful antioxidant, anti-inflammatory and anticancerous effects, a substance derived from *Curcuma aromatica*, commonly used for cooking seasoning and colouring. The anticarcinogenic property of multiple cancers has been investigated extensively [10]. The effect of curcumin and tetrahydrocurcumin on the HCC mice's angiogenesis was assessed by Yoysungnoen et al. They observed that the CV was reduced considerably with curcumin and tetrahydrocurcumin. The results were concluded that curcumin and tetrahydrocurcumin's anti-angiogenic properties constitute a general mechanism for their anti-cancer activity [11].

ALLIUM SATIVUM

Allium sativum L. garlic, along with a medicinal qualities, is one of the oldest cultivated plants used as food with a special fragrance and aroma. The occurrence of organic sulphur compounds in garlic is the basis of the chemical prevention activity [12]. The most radical scabbing operation is achieved by the two main compounds in old garlic, S-lylcysteine and S-lylmercapto-L-cysteine. Moreover, the development of chemically induced and transplantable tumours has been reduced in animal models with S-lylcysteine. The use of garlic will also help against the growth of cancer [13].

CAMPTOTHECA ACUMINATE

Camptothecin (CPT) is a Chinese tree *C. acuminata* anti-cancer and antiviral alkaloid (Nyssaceae). Various efforts to develop CPT from cell suspensions have been pursued. Camptothecin's hairy roots manufacture and secrete Camptothecin as well as 10-hydroxycamptothecin, the most active and less harmful natural derived [14].

AZADIRACHTA INDICA

A limonoid analysis shows Neem shows caspase-based cell apoptosis and activates reactive oxygen species to prevent metastatic therapy [15]. The function of M2 macrophages is regulated by neem leaf-glucoprotein, which is converted into the tumour centre into M1. This inhibits melanoma growth and avoids tumour recurrence by distributing tumour mass. Improving the immune response and inhibiting cellular proliferation, promoting cell apoptosis, preventing cancer angiogenesis and restoring cell reduction/oxidation (redox) equilibrium are the fundamental properties for neem components in tumour cells [16].

PHYLLANTHUS AMARUS

Cell cycle arrest, DNA repair intervention, and invention of carcinogenic metabolic activation of this plant are the source of anti-cancer operations [17]. *P. amarus* extract was also present in mice, carrying Lewis lung carcinoma, with anti-angiogenic effects by interrupting the migration of vascular endothelial cells [18].

WITHANIA SOMNIFERA

The key ingredient of this plant is withanolide A and withaferin A. Withaferin A, mainly present in the leaves, induces quick apoptosis in cells of cancer. The paths of cell signals by this formula largely rely on the high conferrin A material in the formulation [19]. Induction of cell cytotoxicity into cellular cell lines was seen in *W. somnifera* formulation. *W. somnifera* up also controls a mice (bearing tumour) T population with elevated expression to the level of IL-2 and IFN-gamma [20].

CONCLUSION

Cancer remains a major global health challenge, affecting populations in both developed and developing countries. Conventional cancer therapies, while effective to some extent, often pose significant risks to healthy cells due to their toxic

side effects. This underscores the urgent need for alternative and complementary treatment approaches. Medicinal plants, rich in diverse secondary metabolites, have shown great promise as sources of novel anticancer agents. Specifically, plant-derived compounds have played a pivotal role in the discovery of therapeutic agents for hepatocellular carcinoma (HCC). Despite significant advances in modern medicine, no current pharmacological treatments fully restore hepatic function or promote liver cell regeneration effectively. Herbal medicines have demonstrated the potential to bridge this gap, offering hepatoprotective and anticancer benefits with lower toxicity profiles. However, comprehensive research is still required to validate these effects through rigorous clinical trials and mechanistic studies. Future efforts should focus on standardizing herbal formulations, improving pharmacological monitoring, and elucidating precise molecular pathways. Advancing this area of research will be crucial to developing safe, effective, and scientifically backed plant-based therapies for liver cancer.

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