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Review Article

Ethnopharmacological review of boswellia serrata for anticancer activity

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ABSTRACT

Boswellic acid is an Ursane group compound belonging to triterpenoids. It is the major constituents of the gum derived from plant *Boswellia serrata* Roxb. It belongs to Family Burseraceae. It is also known as *B. glabra* and commonly known as the Salai guggal, white guggal, Indian olibanum. *Boswellia serrata* is medium-sized tree widely distributed in the India and Africa. B. Serrata is highly medicinal as well as economically potential. Currently, it is has the potential use in various herbal and ayurvedic formulations for the treatment of various disorders which include inflammation and other types of disorders. Since ancient and centuries anti-cancer drugs discovered from herbal medicines have been used in clinical practice. The active constituent of such formulations being vincristine, vinblastine and the camptothecene derivatives, topotecan, irinotecan and etoposide. There is current need for herbal and ethnopharmacological therapeutics to develop the novel anti-cancer drugs which is safe with effective mechanism. The new discoveries of developing combined ingredients from effective traditional formula or single ingredient as per the traditional medicine theory should be focused. This new approach will promote the academic research and the industry development of traditional medicine. This ethnopharmacological review is mainly focused on anticancer activity of *Boswellia serrata.*

1. Introduction

Herbal medicinal plants are important part of pharmacognosy, ayurveda, and ethnopharmacology. They have been used since the ancient era for the therapeutics related to mankind and for veterinary purposes. Also accordingly as per the 20^{th} century the Herbal medicinal plants should be safe for therapeutics and if single ingredient is used should be as per the standards of FDA.[1] Products obtained from the natural origin have been used for the past centuries and today have great significance in pharmaceutical industry. Most of the products derived from the natural sources are now successfully employed in pharmaceutical formulations as drugs.[2] Boswellic acid consists of a series of pentacyclic triterpene molecules that are produced by the plant *Boswellia serrate.*[3] The potential applications of Bowsellic acid for treatment of cancer have been focused hereIt may help the researchers for further investigation.[4] Boswellia serrate roxb is also known as Indian olibanum and is found in the central and northern part of east India especially dry hill forest of Rajasthan, Madhya Pradesh, Gujarat and Bihar etc.[5] The species produced olibanum resin of various qualities, which are commonly known as Salahi white guggul or Indian olibanum or kundru.[6]

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1.1. Taxanomical Classification of B. serrate[7]

1. *Kingdom: Plantae*
2. *Clade: Tracheophytes*
3. *Clade: Angiosperms*
4. *Clade: Eudicots*
5. *Clade: Rosids*
6. *Order: Sapindales*
7. *Family: Burseraceae*
8. *Genus: Boswellia*
9. *Species; B. serrata*
10. Common Name: *Boswellia serrata Roxb.*

1.2. Phytochemical profile of Boswellia Serrata

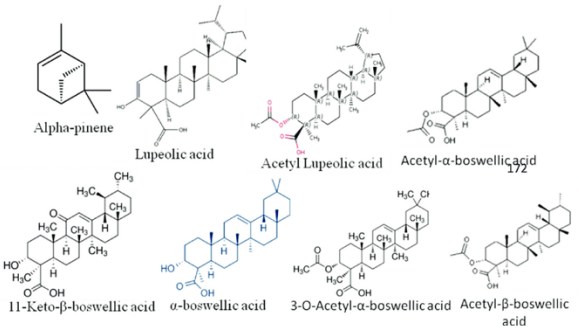

Fig. 1: Active constituents of Boswellia Serrata

The Boswellia serrata dried gum or the resinous part contains the active constituents such as monoterpenes, diterpenes, triterpenes, tetracyclic triterpenic acids and four major pentacyclic triterpenic acids i.e. β-boswellic acid, acetyl-β-boswellic acid, 11-keto-β-boswellic acid and acetyl-11-keto-β-boswellic acid, etc.[8]

2. Review on Anticancer Activity of Boswellia Serrata

Cancer is a crucial disease and co-associated with genetic make up, and mostly risky in geriatric patients and later stages of the life. With advancement of modern research and chemotherapeutics there has been a revolution of in the development of anti-cancer drugs.[9] BSE (Boswellia Serrata Extract) is reported to affect the propagation of growing Breast cancer and brain tumor cells. It is a known inducer of apoptosis further in a study it was observed that the ethanolic extract tested showed cytostatic, cytotoxic and apoptotic abilities against leukaemia and brain tumour cells. It was found to induce apoptosis and act as a potent antiproliferative agent.[10,11] In an investigation with BSE which contained 60% BAs have showed that it apparently inhibited tumors and inflammation in mice. BSE has also reported anti-cancer activity in Ehrlic ascites carcinoma and S-180 tumors, in mice. This might occur by possible mechanism of action of inhibiting the cell proliferation and proliferation by interfering with biosynthesis of DNA, RNA and proteins.[12] It reduces the tumour cell proliferation and induce apoptosis in several in vitro animal experiments.[13,14] The effectiveness of BSE against peri-tumoral oedema could be increased by improving the bioavailability of AKBA.[15,16]

The Boswellia Serrata nanoparticle formulation has shown with significant activity to produce anticancer effect for the treatment of prostate cancer.[17,18] Boswellic acid nanoparticles induced apoptosis DNA fragmentation, outcome of which leads to DNA fragmentation which causes high potential of apoptosis.[19] Suhail et al. demonstrated that Boswellia sacra essential oil prepared by hydro distillation has been tumor cell-specific cytotoxicity in several type of cancer cells.[20] Consistent with anti-proliferative and proapoptotic properties in cultured breast cancer cells, Boswellia sacra essential oil has been observed to produce cytotoxicity in metastatic breast cancer cell lines resistant to a cancer medicine[21,22] Serum concentration of MMP-7, MMP-9 and EGF, and plasma TGF-β and TNF-α levels were assayed by using ELISA procedure.[23] Immunohistochemistry technique was used to estimate the expression of COX-2 and cyclin D1 in the colon. Colonic β-catenin, K-ras and c- myc gene expression was detected by RT-PCR. In addition, histological study of colon tissue was performed. the Colon cancer group showed significant increase in the studied biochemical markers. In the contrast the treated groups all showed significant reduction in these markers. The Colon cancer group had significantly elevaluated COX-2 and cyclin D1 expression in colon tissue. In contrast, all treated groups showed a marked decrease in COX-2 and cyclin D1 expression[24] The Cancer group showed significant upregulation of the expression level of β-catenin K-ras and c-myc genes in the colon tissue. While all treated groups exhibited significant downregulation of the expression levels of these genes. Histopathological examination of tissue sections from the colon in the cancer group showed dysplasia and anaplasia in epithelial cell lining of the glandular structure. While treatment with 5-fluorouraci extract or Boswellia serrata extract showed a marked improvement in the histological characteristics of colon tissue.[25] It was also observed that acetyl-keto-b-boswellic acid [AKBA] inhibited cell growth in a several colon cancer cell lines. Flow cytometric Cell cycle analysis showed that cells were arrested at the G1 phase after AKBA treatment and analysis showed that cyclin D1 and E, CDK 2 and 4 and phosphorylated Rb were reduces in AKBA-treated cells, while p21 expression was increases.[26] The growth inhibitory effect of AKBA was dependent on p21of the apoptotic effect of AKBA, suggesting that p21 may be have protected cells against apoptosis by inducing a G1 arrest. AKBA inhibits cell growth in colon cancer cell.[27] Streffer et al. A clinical study with brain tumor patients was also performed, in which BSE was administered to 29

patients having glioma in three groups at different doses before surgery. After seven days of treatment, the reduction in the size of perifocal edema was found to be the greatest in the case of the group with the highest consumption of extract, to a lesser extent in the group used, without effect were observed doses lower than group receiving dose.[28] Sinha and associates. also found that boswellic acid also inhibited basic fibroblast growth factor [bFGF]-induce angiogenesis using the Matrigel Plug in vivo assay. Recent studies have also demonstrated that BAs can act as anti-angiogenic agents.[29] Singh et al. studied that BAs could even be considered as an alternative drugs to corticosteroids, as they have been shown to reduce cerebral peri-tumoural edema by modulating the of function P-glycoprotein [PgP]. Pgp has gained importance as the transporter, mainly for a drug disposition and the resulting clinical response; both BA and BSE inhibited the transport activity of PgP in the micromolecular range.[30] In the normal cells, ABA does not show apoptosis, ABA induces DNA fragmentation in melanoma and fibrosarcoma, ABA is a cytostatic rather than a cytotoxic agent, As it induces differentiation, apoptosis and cytostasis in various cell line, and can be used in a chemoprophylaxis intervention strategies, either to interrupt the appearance of a primary tumour or to reduced the probability of metastasis.[31] BAs has been shown to induce cell differentiation and inhibit topoisomerase I and II.[32]

3. Conclusion

Medicinal plants have a long history of therapeutic uses around the world and are still an important traditional medicinal plants and herbal product are safe for patients. Natural product has served as a primary source of medicines in the century, and about half of the pharmaceuticals used today are derivatives of natural product. Boswellic acid is made up of a chain of triterpene molecules cyclic molecules of which is produced by plants Boswellia serrata. Potential application of boswellic acid for cancer treatment have been focused here. In this ethnopharmacological review the anticancer pontential of boswellic acid is highlighted. it may help the researchers for further investigation.

4. Source of Funding

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5. Conflict of Interest

None.

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