Research Journal of Food & Nutrition
Volume 1, Issue 1, 2017, PP 10-12

Sugarcane: Safety Concerns on its Cytogenotoxic Damage, While Hopes as a Source of Anticancer Agents

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Received Date: 06-11-2017 ***Accepted Date: 11-11-2017*** ***Published Date: 16-11-2017***

LETTER TO THE EDITOR

As a source of white sugar the sugarcane (*Saccharum* spp.) is a popular cash crop. In many countries, it is used as an alternative healing herb of many diseases. It is oleaginous, diuretic, laxative, tonic, cooling, aphrodisiac and useful in fatigue, thirst, anemia, ulcers etc. (Karthikeyan and Samipillai, 2010). Sugarecane, especially the species, *Saccharum officinarum* L. has long been used in folk medicine in treating a number of disorders, and used in the above-mentioned purposes as well as antidote, antiseptic, antivenomous, bactericide, cardio-tonic, demulcent, intoxicant, ulcer and stomach disorder (Ghiware et al., 2014). It is known for its antioxidant, anti-inflammatory (Chung et al., 2011; Abbas et al., 2013; Ghiware et al., 2012; Khan et al., 2015), cytoprotective (Ghiware et al., 2014) due to the capability to inhibit the free radicals (Abbas et al., 2014) and radiation (Kadam et al., 2008) induced DNA damage.

However, sugarcane can induce toxic effects in human and other animals due to its ability to upload toxic heavy metals (e.g. - Cd, Pb) and micronutrients (e.g. - Cu, Zn, Mn) (Damodharan and Reddy, 2014). In a study, the risk of cancer in the oral cavity or pharynx was seen with the exposure to occupational solvent in the sugarcane farmers (n = 34) (Coble et al., 2003). Atmospheric particulate matter may be genotoxic. The frequency of micronuclei formation in peripheral blood lymphocytes and buccal cells was found higher in the sugar cane workers (n = 23) in Brazil (Silveira et al., 2013). In another study, the particulate matter from sugarcane burning was found mutagenic in *Salmonella* strains (Alves et al., 2016).

According to the literature reports, the sugarcane is also one of the potential sources of anticancer agents. Tricin-7-O-b-(600-methoxycinnamic) - glucoside, a flavone isolated from the *S. officinarum* juice was found to exhibit potent 1,1-diphenyl-2-picrylhydrazyl radical ($DPPH^{\bullet}$) scavenging capacity than the standard drug, Trolox. Moreover, It showed an anti-proliferative activity against several human cancer cell lines (breast (MCF-7), multidrug resistant breast (NCI-ADR), prostate (PC-03), ovary (OVCAR03), lung, non-small cell (NCI-H460), colon (HT-29), melanoma (UACC-62) and kidney (786-0)) in a concentration-dependent manner (Duarte-Almeida et al., 2007). In this study, a strong cytotoxic effect was observed toward the breast resistant NIC/ADR cell line.

Cathepsin B and L, the lysosomal cysteine proteases are evident to play important roles in tumor cell invasion. An imbalance between these cathepsins and their endogenous inhibitors, the cystatins, may cause metastasis of cancer cells. In a study, cystatin (0.2 – 2.0 µM) isolated from *S. officinarum* was found to reduce the invasive ability of human breast cancer (MDA-MB-231) cells by modulating the effects of cathepsin B and L (Gianotti et al., 2008). On the other hand, the anthocyanin at 0.625 µg/mL from the *S. officinarum* peel was found to exert an anti-prolifertive effect on HT29 cells (51.2% inhibition) (Pallavi et al., 2012).

In a recent study, a number of chemical compounds was isolated from the mid-polarity sugarcane extracts such as steroids sitosterol, stigma sterol and campestral, phenolic acids, *p*-hydroxy benzoic, *p*-hydroxycinnamic, vanillic and ferulic acid, terpenoids α-tocopherol and β-carotene and a novel substance in sugarcane, the flavonoid aglycone tricin (5,7,4-trihydroxy-3,5-dimethoxyflavone), where the phenolic acids and the flavonoid tricin were found to exert prominent cytotoxic effects on some human cancer cell lines (U251 (glioma); MCF-7; NCI-ADR/RES (multiple drug resistant ovary cells); 786-0 (kidney); NCI-H460; PC-3 (prostate); OVCAR03; HT-29; HaCat (normal human keratinocytes)) within the GI_{50} (concentration necessary for 50% cell growth inhibition) values <0.025 to >250 µg/mL (Alves et al., 2016). Naturally fermented sugar cane vinegar was found to strongly scavenged DPPH radicals as well as induction of apoptosis human leukemia cell HL-60, THP-1, Molt-4, U-937, Jurkat, Raji and K-562 cells (Mimura et al., 2016).

The cash crop, sugarcane is rich with antioxidant (cytoprotective) compounds that can protect cells from oxidative stress results from various sources. The toxic effects may lead to the pro-oxidative effects of each antioxidant as well as their combined effects on the cells. Environmental other contaminants along with the chronic exposure of each or collective toxin are also two important factors, including other considerations such as patient's path physiology, age, gender etc. in the context of sugarcane-induced genotoxic and mutagenic effects. The cytotoxic effects on human cancer cell lines along with the inhibition capability of tumor cell invasion and proliferation have been already reported with a number of sugarcane-derived compounds. Notably, the development of resistance of anticancer therapy is a crucial challenge for medicinal scientists. The sugarcane-derived compounds, cystatin and the flavonoid tricin have been found to act against some drug-resistant cancer cell lines. Sugarcane may be an important herb containing anticancer drugs.

CONFLICTS OF INTEREST

None declared.

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