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PHARMACOGNOSTIC PROPERTIES AND ANTI-CANCEROUS ACTIVITY IN SWEET POTATO (*Ipomoea batatas*)

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Abstract

Sweet potato (*Ipomoea batatas*) is a dicotyledonous plant that belongs family, Convolvulaceae. The presence of wide variety of antioxidants, including beta-carotene, lutein and zeaxanthin help to protect cells from damage, reduce inflammation and can lower the risk of chronic diseases like heart disease, cancer and cognitive decline. Despite their natural sweetness, they have a relatively low glycaemic index and can regulate blood sugar levels and prevent spikes in insulin levels, making them a good choice for people with diabetes. Sweet potato is a highly valuable food crop in the present scenario and hence the present study selected the tubers. The phytochemical and anti-cancerous properties using DLA cell line were carried out and the results revealed the presence of phytochemicals such as alkaloids, flavonoids, phenol, quinones, saponins, steroids, tannin, terpenoids and protein. The in vitro cytotoxicity assay conducted with the cell line DLA (Dalton's Lymphoma Ascites) proved 59% efficacy of water extract of tubers.

Key words: *Ipomoea batatus*, Phytochemicals, Anti-cancer, DLA cell line

I. INTRODUCTION

Sweet potato (*Ipomoea batata* L.; Lam.) is a dicotyledonous plant which belongs to the family Convolvulaceae. It is the seventh most widely produced crop after wheat, rice, maize, potato, barley, and cassava (Jung et al., 2011). Sweet potato ranks second in position as largest root crop grown worldwide after cassava (Ray R. C. and Ravi, 2005). Sweet potato tubers, leaves, and shoots are good sources of nutrients for humans and animals. It is the main food crop of the tropical and subtropical areas and provides nutritional advantage to the people of rural and urban regions by enhancing its production and increasing the consumption (Alam et al., 2016). Sweet potato tubers contain macronutrients such as starch, dietary fibre, protein, micronutrients including minerals such as manganese, copper, potassium and iron, vitamins mainly B complex, vitamin C, vitamin E and provitamin A as carotenoids, flavonoids, and coumarins (Bovell and Benjamin., 2007). Due to its content of several bioactive secondary metabolites, the sweet potato attracts the attention of the food industry, consumers and scientists (Parveen et al., 2020). These phytochemicals provide

physiological benefits that lead to promote the health and lifespan in consumers (Shandilya U.K. and Sharma. A., 2017).

Compared to other root and tuber crops, the sweet potato contains more carbohydrates and proteins, as well as certain vitamins and minerals and it has higher levels of provitamin A, vitamin C and minerals than wheat or rice (Wang et al., 1997). Almost every part of sweet potato like stem, leaf and root can be eaten and these parts may vary in terms of the nutrients, bio actives, non-nutrients and antinutrients composition. The root is most commonly consumed worldwide. Today they are recognized as highly nutritious and help in the prevention of chronic diseases. Consumption of anthocyanin rich sweet potatoes reduces lower risk of diabetes, cardiovascular disease and cancer, and has also been associated with improved cognitive function (Emily et al., 2022). Beta-carotene present in the sweet potato reduces the risk of breast cancer in Premenopausal women and ovarian cancer in postmenopausal women (Saha et al., 2022).

Sweet potatoes have many health benefits such as providing important nutrients, vitamins, and minerals. Parle and Monika studied that sweet potatoes contain high concentrations of biologically active compounds which have several medicinal values for certain human diseases like diabetes, obesity, cancer, oxidative stress, emphysema and ulcer (Mlind and Monika 2015). Woolfe J.A. reported that 100g of sweet potato tuber contains 14187 IU of vitamin A and 8509 micro gram of beta carotene. Vitamin A helps the body to maintain the mucus membrane and skin healthy and an important nutrient for vision. Mineral content in the sweet potatoes such as phosphorus, calcium, iron and soluble fiber such as raffinose, stachyose verbascose absorbs excess fat or cholesterol in the blood has been reported by Nurdjanah et al., 2019. Sweet potatoes tubers, leaves and shoots are good sources of nutrients for humans and animals. It is the main food crop of the tropical and subtropical areas and provide nutritional advantage to the people of rural and urban regions by enhancing its production and increasing the consumption (Alam et al., 2016).

There are different varieties of sweet potatoes such as normally cultivated white and yellowish fleshed ones. The NIH reported that beta carotene present in the tubers can reduce the risk of ovarian, breast cancer, etc. Hence for the present study selected sweet potato as the plant material and the phytochemical analysis and anticancer activity were carried out. The *in vitro* cytotoxicity studies have proved that the tuber of sweet potato can inhibit the growth of Dalton's Lymphoma Ascites cells (DLA).

II. MATERIALS AND METHODS

A. Plant material

Sweet potato (*Ipomea batatas)* belongs to the family Convolvulaceae is selected for the study. The tubers of yellow fleshed sweet potatoes were collected from localities of Podimattom, Kanjirappally during the month of October 2024. The flesh of the tuber was subjected to Soxhlet extraction, phytochemical screening and in vitro cytotoxicity assay.

B. Extraction by Soxhlet apparatus

The flesh of sweet potato tuber (1 kg) was air dried under shade at normal temperature then it was powdered in a mixer grinder and further used for Soxhlet extraction process. The bioactive compounds from the plant were extracted by using solvent as distilled water in Soxhlet extraction apparatus. The known volume of sweet potato powder 1kg was weighed, packed and placed in the Soxhlet apparatus along with 500ml of solvent as distilled Water at their corresponding boiling points and run continuously for 4-5 hours (until almost no plant residues was left in the recycled solvents) respectively in order to get the bioactive compound (Reji et al., 2013). After 5 hours of Soxhlet extraction the crude extract of 37 ml was collected by distillation. The crude extract was stored at 4º C. These stored plant extracts were tested for the phytochemical screening and anti-cancerous study.

C. Phytochemical screening

The presence of different phytochemicals extracted in different solvents was confirmed by the following tests. Test for alkaloids and protein were conducted following the method of Santhi et al., 2011. Test for alkaloids and quinones were conducted following the method of Evans 2002. Test for phenol and saponins were conducted following the method of Pradeep et al., 2014. Test for steroids was conducted following the method of Khan et al., 2010. Test for tannins was conducted following the method of Yusuf et al., 2013. Test for terpenoids was conducted following the method of Siddiqui et al., 2009.

D. *In vitro* cytotoxicity study

The test compound was studied for short term in vitro cytotoxicity using Dalton's Lymphoma Ascites cells (DLA). The test compound was dissolved in DMSO and concentration range between 2 µl/ml to 0.5 µl/ml was used for study.

The tumour cells aspirated from the peritoneal cavity of tumour bearing mice were washed thrice with PBS or normal cell lines. Cell viability was determined by trypan blue exclusion method. Viable cells suspension (1×10^6 cells in 0.1 ml) was added to tubes containing various concentrations of the test compounds and the volume was made up to 1 ml using phosphate buffered cell line (PBS). The control tube contained only cell suspension. These assay mixtures were incubated for 3 hours at 37 C. further cell suspension was mixed with 0.1 ml of 1% trypan blue and kept for 2-3 minutes and loaded on a haemocytometer. Dead cells take up the blue colour of trypan blue while live cells do not take up the dye. The number of stained and unstained cells were counted separately.

$$\% \text{ of cytotoxicity} = \frac{\text{No. of Dead cells}}{\text{No. of live cells + No. of dead cells}} \times 100$$

III. RESULTS AND DISCUSSION

A. Soxhlet Extraction

The flesh of sweet potato tuber (1 kg) was air dried under shade at normal temperature then it was powdered in a mixer grinder and further used for Soxhlet extraction process. The bioactive compounds from the plant were extracted by using solvent as distilled water in Soxhlet extraction apparatus. As a result, 50 ml of crude extract was obtained. Then using the concentrated extract following results was obtained through further analysis.

B. Phytochemical Screening

Test for Alkaloids

2 ml of crude extract in addition with 2 ml of concentrated HCl followed by few drops of Mayer's reagent was subjected to alkaloid screening. The sample showed positive result to the alkaloid test due to the presence of yellow precipitate (Table 1).

Test for Flavonoids

2 ml of crude extract in addition with 1 ml of 2 N sodium hydroxide was subjected to flavonoid screening. The sample showed positive result to the flavonoid test due to the presence of yellow precipitate (Table 1).

Test for Phenol

1 ml of crude extract in addition with 2 ml of distilled water followed by few drops of 10% ferric chloride was subjected to phenol screening. The sample showed positive result due to presence of green colour (Table 1).

Test for Quinones

1 ml of crude extract in addition with concentrated sulphuric acid was subjected to quinone screening. The sample showed positive result due to presence of red colour (Table 1).

Test for Saponins

2 ml of crude extract in addition with 2 ml of distilled water and shaken in a graduated cylinder for five minutes length wise was subjected to saponin screening. The sample showed positive result due to the formation of 1 cm layer of foam (Table 1).

Test for Steroids

1 ml of crude extract in addition with 1 ml of chloroform and few drops of concentrated sulphuric acid was subjected to steroid screening. The sample showed positive result due to the appearance of brown ring (Table 1).

Test for Tannins

1 ml of crude extract in addition with 2 ml of 5% of ferric chloride was subjected to tannin screening. The sample showed positive result due to the presence of greenish black colour (Table 1).

Test for Terpenoids

0.5 ml of crude extract in addition with 2 ml of chloroform and concentrated sulphuric acid was subjected to terpenoid screening. The sample showed positive result due to the presence of red brown precipitate (Table 1).

Test for Protein

1 ml of crude extract in addition with 2 ml of 5% ferric chloride was subjected to protein screening. The sample showed positive result due to the presence of violet colour (Table 1).

Table 1: Table showing results of phytochemical screening in sweet potato extracted with water.

Sl. No:	Tests performed	Results	
		Positive (Present)	Negative (Absent)
1	Alkaloids	Positive	NIL
2	Flavonoids	Positive	NIL
3	Phenol	Positive	NIL
4	Quinones	Positive	NIL
5	Saponins	Positive	NIL
6	Steroids	Positive	NIL
7	Tannin	Positive	NIL
8	Terpenoid	Positive	NIL
9	Protein	Positive	NIL

The study conducted by Laveriano-Santos et al., 2022 provides an in-depth analysis of the phytochemical constituents, biological activities and the effects of processing on sweet potatoes. They did a comprehensive overview of the bioactive compounds present in sweet potatoes, including carotenoids and polysaccharides, which have been linked to various health benefits such as antioxidant, anti-inflammatory and hepatoprotective effects. Additionally, the author highlights the potential of purple sweet potatoes, rich in anthocyanin, as a unique food option and source of functional ingredients for healthy food products. They also emphasize the need for further research on the impact of processing and cooking methods on the retention of these bioactive compounds. Sun et al., 2019 evaluated the phenolic profiles, antioxidant activities, antiproliferative activities and cytotoxicity of ten sweet potato varieties in different colours. Fourteen metabolites were identified, with hyperoxide, ferulic acid and caffeic acid being prominent.

Principal component analysis showed similar phytochemical compositions in HX22, YS15 and YS7. Mohanraj and Sivasankar 2014 provided a comprehensive review of sweet potato (*Ipomoea batatas* [L.] Lam) as a valuable medicinal food. The study emphasized its high nutritional value and medicinal properties, including anti-cancer, antidiabetic and anti-inflammatory activities. They also highlighted the phytochemical composition of sweet potato, biological activities of its compounds, pharmacological effects of sweet potato extract and clinical studies supporting its medicinal applications. The study underscored sweet potato's potential in promoting health and suggests its use in developing therapeutic and industrial products.

The same result was also observed in our study proved the sweet potato having alkaloid, flavonoid, phenol, quinones, saponins, steroids, tannin, terpenoid and protein exhibited the same phytochemical properties.

C. Anti-cancerous study

0.5 µl/ml of crude extract which was dissolved in DMSO were subjected for short term in vitro cytotoxicity using Dalton's Lymphoma Ascites cells (DLA). The sample showed 9.02±1.4 % of cell death while using 0.5 µl/ml extract. 1.0 µl/ml, 1.5 µl/ml and 2 µl/ml of drug concentration showed 15.5±1.5, 28.5±2.2 and 56.2±1.6 % cell death respectively (Table 2).

Table 2: Table showing in-vitro cytotoxicity results of sweet potato using DLA cell line.

Sl. No:	Drug concentration (µl/ml)	% Cell death
1	0.5	9.02±1.4
2	1	15.5±1.5
3	1.5	28.5±2.2
4	2	59.2±1.6

These results of the study demonstrate the significant cytotoxic effect seen in sweet potato (Figure 1). Karna et al., 2011 also reported the polyphenols in sweet potato leaves have anti prostate cancer activities shown in G1 phase arrest followed by mitochondrial mediated caspase dependent intrinsic apoptosis in PC-3 prostate cancer cells in in vitro. Ramakrishnan et al., 2021 studied that phytochemical such as alkaloids, anthraquinones, oxalates and steroids can provide an anticancer effect and these compounds are present in sweet potato leaves have been reported by Nguyen et al., 2021.

In the present study also obtained the same results and it proved the tubers of sweet potato have 59.2±1.6 % of cell death in DLA cell line and it thereby proved that sweet potato has anti-cancer activity.

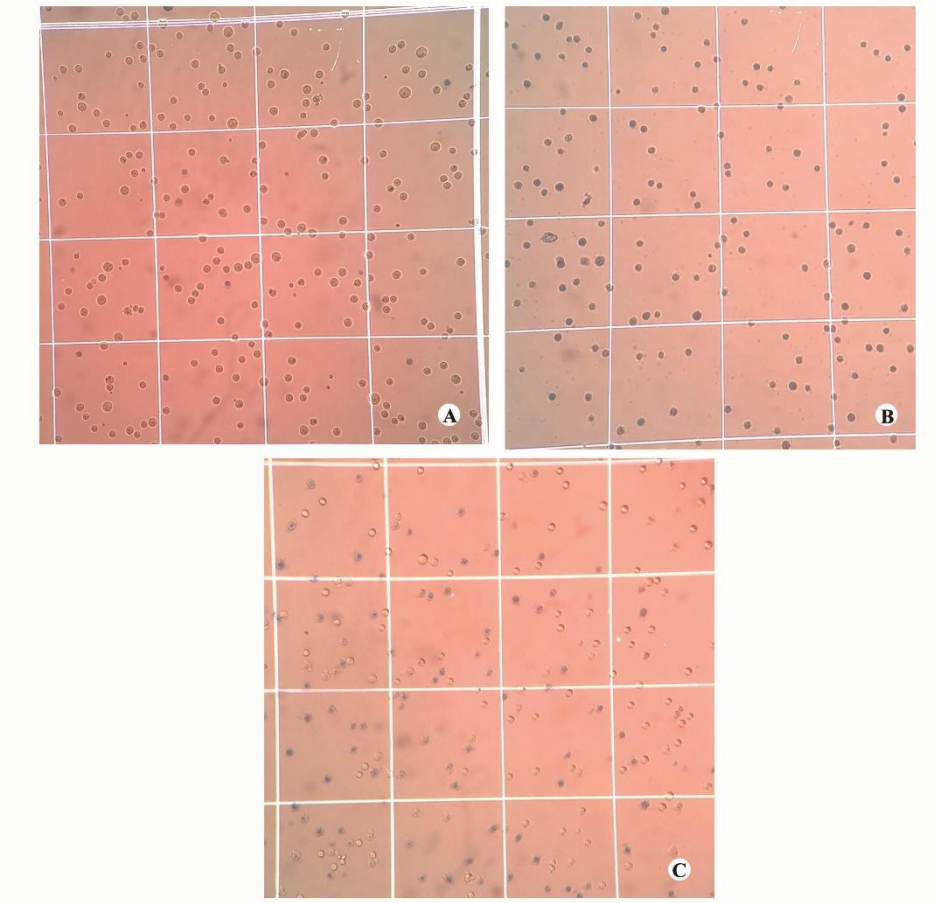

Figure 1: *In vitro* cytotoxicity assay result of tubers of Sweet potato with DLA cell lines. (A). 100%live cells control, (B). 100% dead control and (C). 59.2% dead cells with 2.0 µl/ml water extract.

IV. CONCLUSION

Sweet potato esteemed for its nutritional density and phytochemical properties have garnered attention for their potential health benefits, including their intriguing role in cytotoxicity studies. The study investigated the cytotoxic potential of sweet potato on mice cell line DLA using in vitro cytotoxicity assay, while also examining the correlation between cytotoxic effect and phytochemical profiles. The findings from this study provide a strong foundation for future research aimed at exploring and harnessing the therapeutic potential of sweet potatoes thereby contributing to the development of natural, effective anti-cancer strategies. This research emphasizes the potential of incorporating sweet potatoes into the diet as a preventive measure against cancer, promoting health and wellness through natural dietary choices.

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