

Ananas comosus peel as an ecofriendly phytotherapy for the remediation of cancer

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ARTICLE INFO	ABSTRACT
<p>Research Article Received on May 16, 2023 Revised on June 25, 2023 Accepted on July 13, 2023 Published on October 18, 2023</p> <p>Article Authors Shashi Soni, Uroosa Noor, Neelesh Kumar Maurya, Ena Gupta</p> <p>Corresponding Author Email enaravish@gmail.com</p>	<p>Pineapple is botanically named as <i>Ananas comosus</i>, which is a wide growing crop in the World and ranks third in tropical fruit consumption and production. Its massive utilization in the confectionary and canning industry leads to the production of enormous amount of by-products like as crown, peel and core. While, the peel of pineapple alone accounts the largest proportion from total waste production i.e. about 32-40% and it constitutes various nutrients along with some vital secondary metabolites like myricetin, chlorogenic acid, ferulic acid, gallic acid, epicatechin, catechin, quercetin, trans-cinnamic acid, salicylic acid, p-coumaric acid, tannic acid etc. It also provides best role in ethnomedicine. Cancer is a life threatening disease, which affects the cells of the body that consequently injures DNA of the cells, and this injury accumulates in the body. Many studies suggested that waste extracts of pineapple peel shows anti-carcinogenic activity against various human cancer cell lines viz A549 (lung cancer), MCF-7 (breast cancer), HCT116 (colorectal carcinoma), U118 (glioblastoma), CaCo-2 (human colorectal adenocarcinoma), Skov-3 (ovarian sarcoma), HeLa (cervical cancer cell), HT29 (colon cancer) closed to the values of doxorubicin whereas no anti-cancer activity was reported against HL-60, HFB4 (normal cell lines) and HepG2 (liver cancer). In conclusion, the peels generated as pollutant in environment could be transformed into worth as an eco-friendly agent for the prevention of cancer against different and many cancer causing cell lines.</p>
<p style="background-color: #d3d3d3;">PUBLICATION INFO</p> <p>International Journal of Agricultural Invention (IJAI) RNI: UPENG/2016/70091 ISSN: 2456-1797 (P) Vol.: 8, Issue: 2, Pages: 206-209 Journal Homepage URL http://agriinventionjournal.com/ DOI: 10.46492/IJAI/2023.8.2.10</p>	<p style="background-color: #d3d3d3;">KEYWORDS</p> <p><i>Ananas comosus</i>, Anti-Carcinogenic, Cancer Cell Lines, Eco-Friendly, Bioactive Compounds</p>

HOW TO CITE THIS ARTICLE

Soni, S., Noor, U., Maurya, N. K., Gupta, E. (2023) *Ananas comosus* peel as an ecofriendly phytotherapy for the remediation of cancer, *International Journal of Agricultural Invention*, 8(2): 206-209. DOI: 10.46492/IJAI/2023.8.2.10

Huge utilization of fruit peels have been mentioned in the ethno medicinal field due to its higher content of crude fibre, certain vitamins and minerals. Recycling of fruit waste is a valuable step to reduce pollution of environment from their deterioration. Varied secondary metabolites present in different fruit peels shows various health benefits like iron can relieve anaemia, counteract calcium losses and strengthen bone, tryptophan content condensed in fruit peels are converted into serotonin and ultimately helps to relieve stress and overcome depression, prevent cardiovascular diseases like high blood pressure, atherosclerosis etc., weakens acid reflux, heart burn, restore electrolyte losses

after dehydration and many more health effects like cancer prevention etc. Around billion pounds of peels are thrown into the landfills on taking an account that 500g/day of fruit is consumed by each individual from which 40%, waste is generated (Afsharnezhad *et al.*, 2017). *Ananas comosus* is commonly known as 'Pineapple' and belongs to the family Bromeliaceae. World's largest producer of pineapple is Brazil. Fruit pulp industry uses only 22.5-35% edible portion of pineapple and remaining is discarded like as peel, stems, core and crown as waste because of its high sugar content specifically having pectin (an insoluble fibre) along with high content of proteins and crude fibre.

Fibre is considered as a functional food because it interferes in metabolism of carbohydrate and lipids and subsequently promotes the feeling of satiety by acting against constipation. The fruit is eaten fresh as well as in canned fruit and juice form, from which about 3/4th part is wasted as by-product which has been proved as best for diet supplementation due to its nutritional potential and cost-effectiveness. Pineapple peel exhibits hard and irregular shape but having good nutritional properties that it could be used in various food preparations like in candy, juices and teas. Large portion of this waste accounts to peel only that is 34.7%, which is profound in polyphenolic compounds, sucrose, glucose, fructose, cellulose, fibre, bromelain, iron, potassium, calcium, vitamin C, A, B complex and sufficient amount of insoluble fibre, so of great interest in utilizing it as source of fibre and antioxidants instead of wasting (Damasceno, 2016, Dorta and Sogi, 2017).

Previous reports on animal studies suggested a modulatory effect of pineapple peel on catalase activity and lipid peroxidation in alcohol-induced toxicity, which indicates its significant use in the management of toxic conditions. Antioxidants mop the free radicals (ROS) generated during aerobic respiration, increased level of which leads to many chronic diseases like cancer, inflammation, atherosclerosis and obesity. Pineapple peel exhibits good antioxidative activity because it contains good amount of major phenolic compounds like gallic acid, ferulic acid, catechin, epicatechin, p-coumaric acid, salicylic acid, tannin etc. (Emmanuel *et al.*, 2016). Cancer is one of the major fatal diseases in current scenario. Proliferation and uncontrolled cell growth are the major characteristics of cancer, which is a family of diseases unique to multicellular animals. It is the leading and second leading cause of death in economically developed countries and developing countries, respectively. Besides, of major progress in the treatments of cancer it is not up to expectations and now it is at turning point, demands a better way for studying and treating cancer. In this manner, many preventive measures are being developed from which natural sources are preferred because of their pharmacological and feasibility along with cost effective approaches (Kaiser, 2021). Pineapple peel is mine of polyphenolic compounds hence could be studied for its pharmacological properties.

Hence, this article aims to suggest the potential of pineapple peel as source of antioxidant compounds for the prevention of chronic diseases specifically cancer prevention. Thus, utilization of pineapple peels as phyto-remedy towards cancer instead of disposing it as waste and environmental pollution.

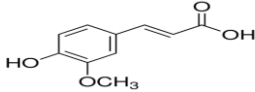
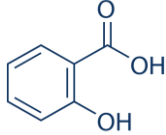

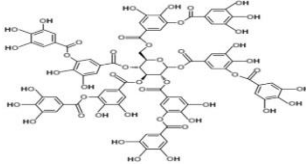
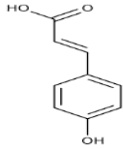
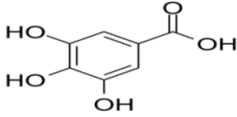
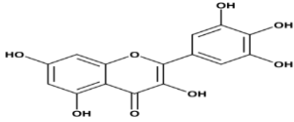
Major Bioactive Compounds in *A. comosus* Peel

Major bioactive compounds present in pineapple peel are phenols, terpenoids, saponin, flavanoids, lignin, carotenoids, ascorbic acid, coumarins, epicatechin, catechin, gallic acid, myricetin, ferulic acid, salicylic acid, trans-cinnamic acid, tannic acid etc. which are responsible for the mesmerizing therapeutic applications of pineapple peel (Upadhyay *et al.*, 2010, Kaur *et al.*, 2018, Novaes *et al.*, 2013). Chemical formula and structure of some bioactive compounds present in pineapple peel are depicted in table 1.

A. comosus Peel as Phytotherapy towards Cancer

Various *in vitro* and *in vivo* studies have been performed for knowing the anti-cancer property potential of *A. comosus* peel and revealed some positive results. Many food products supplemented with pineapple peel powder are developed for consumption by individuals. Cancer affects the cells of the body, which injures the DNA and increases progressively (Gupta *et al.*, 2013). Various types of cancer are spread around the world from which lung, breast, colorectal, liver and blood cancer is most common. Peel of pineapple exhibits good prebiotic potential due to its higher content of insoluble fibre, which ultimately relieves the diseases of colon like chronic diarrhoea, inflammatory bowel syndrome, colon cancer etc. Rashad *et al.*, 2015, studied the *in vitro* anticancer activity of fermented and unfermented pineapple peel enriched food products against four different human cancer cell lines *viz* HL-60 or normal HFB4, HepG2 (liver cancer), A549 (lung cancer), MCF-7 (breast cancer) and HCT116 (colon cancer) cell lines. Result of the study showed cancer-preventing effect against HCT116, A549 and MCF-7 cell lines closed to the values of doxorubicin drug, whereas no effect against HL-60 and HepG2 cells was observed. Sah *et al.* (2016) developed yogurt supplemented with pineapple peel powder and studied its antiproliferative properties against HT29, a colon cancer cell line.

Table 1. Chemical formula and chemical structure of some bioactive compounds present in *A. comosus* peel

Bioactive Compounds	Chemical Formula	Structure
Ferulic acid	$C_{10}H_{10}O_4$	
Salicylic acid	$2-(HO)C_6H_4CO_2H$	
Trans-cinnamic acid	$C_6H_5CH=CHCOOH$	
Tannic acid	$C_{76}H_{52}O_{46}$	
p-coumaric acid	$HOC_6H_4CH=CHCO_2H$	
Gallic acid	$(HO)_3C_6H_2CO_2H$	
Myricetin	$C_{15}H_{10}O_8$	

Result analyzed that pineapple peel supplemented yogurt exerted higher antiproliferative effect in comparison to non-supplemented yoghurt. In the same manner (Li *et al.*, 2013) also studied, the inhibitory effect of pineapple peel against HT-29 and A549 cancer cell lines and suggested its strongest effect against both the cell lines. Bhatnagar *et al.* (2014) formulated the nanoparticles of bromelain encapsulated in poly (lactic-co-glycolic acid) and further it was coated with Eudragit L30D polymer to make it sustainable in the gastric acidic conditions. Cytotoxicity assay in various human cell lines (MCF-7, HeLa and CaCo-2) showed reduced IC_{50} value and altered the

apoptosis related expression of marker proteins hence improving its therapeutic efficacy. On oral administration of NP's in tumour burdened mice showed significant anti-cancer activity and also increased their life span. Baran *et al.* (2021) also synthesized the silver nanoparticles (AgNP's) from *Ananas comosus* fruit peel waste and its characterization was accomplished with X-ray diffraction diffractometer (XRD), Fourier transform infrared spectroscopy (FTIR), transmission electron microscopy (TEM), UV- visible spectrophotometer (UV-Vis) and Fourier scanning electron microscope (FESEM).

Furthermore, anticancer potential was analyzed through MTT assay on different cancer cell lines viz U118, CaCo-2 and Skov-3. Results of the study showed 25-81% of inhibition of cell lines at a lowest concentration of 25µg/mL. Hence, proved the promising role of *A. comosus* peel as an anticancer agent. These studies highlight the anticancer potential of *A. comosus* peel due to its mesmerizing antioxidative and prebiotic potential because of profound phytochemicals and insoluble fibre content. Many chronic diseases can be prevented with the consumption of pineapple peel. Thus, it can be proved as a phytotherapy towards cancer.

Conclusion

The major waste generated from pineapple fruit is peel, which is used to be discarded causing environmental pollution. Harnessing of this waste is utmost important for environmental point of view and because of utilizing its mesmerizing pharmacological potential. Its higher polyphenolic and insoluble fibre content is responsible for antiproliferative effect. Application of pineapple peel as pharmaceutical and nutraceutical compound could be studied for future prospectus. It is a phytotherapy towards colon cancer and many other chronic diseases.

References

Afsharnejad, M., Shahangian, S. S., Panahi, E., Sariri, R. (2017) Evaluation of the antioxidant activity of extracts from some fruit peels, *Caspian J. Environ. Sci.*, 15(3): 213-222.

Baran, A., Keskin, C., Baran, M. F., Huseynova, I., Khalilov, R., Eftekhari, A. and Kavak, D. E. (2021) Ecofriendly synthesis of silver nanoparticles using ananas comosus fruit peels: anticancer and antimicrobial activities, *Bioinorganic Chemistry and Applications*, pp: 1-8.

Bhatnagar, P., Patnaik, S., Srivastava, A. K., Mudiam, M. K., Shukla, Y., Panda, A. K. and Gupta, K. C. (2014) Anti-cancer activity of bromelain nanoparticles by oral administration. *Journal of biomedical nanotechnology*, 10(12): 3558-3575.

Damasceno, K. A., Gonçalves, C. A. A., Pereira, G. D. S., Costa, L. L., Campagnol, P. C. B., Almeida et

al. (2016) Development of cereal bars containing pineapple peel flour (*Ananas comosus* L. Merrill), *J. Food Qual.*, 39(5): 417-424.

Dorta, E. and Sogi, D. S. (2017) Value added processing and utilization of pineapple by-products, *John Wiley & Sons Ltd.*, pp: 196-220.

Emmanuel, E. U., Onagbonfeana, E. S., Adanma, O. C., Precious, O. C., Faith, A. I., Ndukaku, O. Y. (2016) In vivo and in vitro antioxidant and hypolipidemic activity of methanol extract of pineapple peels in wistar rats, *Int. J. Biosci.*, 8(6): 64-72.

Gupta, E., Purwar, S., Sundaram, S., Rai, G. K. (2013) Nutritional and therapeutic values of *Stevia rebaudiana*: A review, *J. Med. Plants Res.*, 7(46): 3343-3353.

Kaiser, J. (2021) Cancer, *Encyclopedia of Evolutionary Psychological Science*, pp: 871-874.

Kaur, A., Jain, Y., Mittal, K., Mittal, N. (2018) Synergistic effect of pineapple peels & green tea on antioxidant levels of pineapple peels infused Kangra green tea, *G. J. B. B.*, 7(3): 392-395.

Li, F., Li, S., Li, H. B., Deng, G. F., Ling, W. H., Wu et al. (2013) Antiproliferative activity of peels, pulps and seeds of 61 fruits, *J. Funct. Foods*, 5(3): 1298-1309.

Novaes, L. C. L., Ebinuma, V. C. S., Mazzola, P. G., Júnior, A. P. (2013) Polymer-based alternative method to extract bromelain from pineapple peel waste, *Biotechnol Appl Biochem*, 60(5): 527-535.

Rashad, M. M., Mahmoud, A. E., Ali, M. M., Nooman, M. U., Al-Kashef, A. S. (2015) Antioxidant and anticancer agents produced from pineapple waste by solid state fermentation, *Int. J. Toxicol. Pharmacol. Res.*, 7(6): 287-296.

Sah, B. N. P., Vasiljevic, T., McKechnie, S., Donkor, O. N. (2016) Effect of pineapple waste powder on probiotic growth, antioxidant and antimutagenic activities of yogurt, *J. Food Sci. Technol.*, 53(3): 1698-1708.

Upadhyay, A., Jeewan, P. L., Shinkichi, T. (2010) Utilization of pineapple waste: a review, *J. Food Sci. Technol. Nepal*, 6: 10-18.