

Potentiality of *Musa acuminata* in Curing Cancer

Anu Augustine¹ and Geethalakshmi Sundararaman*²

¹⁻²Department of Biotechnology, Sree Narayana Guru College, Coimbatore - 641 105, Tamil Nadu, India

Abstract

Since ancient times, bananas have been one of the most popular foods all across the globe. Bananas are a fantastic source of energy since they include a wide range of nutrients, including carbs, vitamins, protein, fiber, and iron. As a result, it plays a significant role in ensuring proper metabolism, cancer avoidance, immune system resilience, and healthy digestive feature. The Najalipoovan, Poovan, Etha, Palenkodan, Robesta, Chemkadali, Pachakadhali, Sundari, and Kannan are the banana cultivars that this article reviews in terms of their nutritional makeup and ability to combat cancer. This review highlights the anticancer property of *Musa acuminata* against human breast cancer, bone cancer and colon cancer. The natural compounds can be used for cancer treatment and for reducing the chemotherapeutic compounds causing side effects. The current application of the *Musa acuminata* product is potentially used in food and pharmaceutical industries and needs further studies.

Key words: Bioactive compounds, Banana peel, Crude protein, Anticancer properties

Musa species fruits are more common in the world. In the subtropics and tropics, the banana is a well-liked and often eaten fruit. This fruit is edible and may be produced in almost any climate with little to no special care. Water, carbs, fat, proteins, vitamins, minerals, and water are all abundant. Bananas come in a wide variety, and most of them are hybrids. The calorie density, tissue binding components, protein, vitamins, and minerals all included in a single banana make it an ideal snack. It's a readily digested and nutrient-dense source of vitamin C, which strengthens the immune system [19]. By inter- and intra-specific hybridization, bananas are created from the two wild species *Musa acuminata* (with an AA genome) and *Musa balbisiana* (with a BB genome). This has resulted in the emergence of a number of genome groups, including AA, AB, AAA, AAB, ABB, AABB, AAAB, and ABBB [57].

Parts of the *Musa acuminata* plant are utilized medicinally, since it has a wide variety of pharmacological qualities. Antioxidant qualities may be found in the *M. acuminata* flower. *Salmonella spp.*, *Aspergillus niger*, *Candida albicans*, *Staphylococcus aureus*, *Proteus mirabilis*, *Bacillus subtilis*, and *Micrococcus sp.* are all destroyed by the antibacterial characteristics of this flower. Different kinds of illnesses respond well to the flower's antibacterial and antifungal properties [54]. The banana peel and pulp contain a variety of bioactive substances that have been proven to have antioxidant, anti-diarrheal, and anti-healing characteristics. These chemicals include carotenoids, phenolic compounds, biogenic amines, pro-vitamin A, and others [60].

The phenolic compound used for treatment of Parkinson's treatment because it contains L-dopa and dopamine [37]. *M. acuminata* stem extract gel can be used for traumatic ulcer healing [41]. The *M. acuminata* effectively used in various diseases treatment including chronic degenerative disorders [48]. The individual bioactive compounds from different plant parts need further studies and explore the potential for development of the drug. This review highlights the bioactive components and their current application for developing anticancer drug discovery for future studies.

Musa acuminata

M. cavendishii, *M. paradisiaca*, and *M. sapientum* are three of the *Musa* species that are most often cultivated. When fully developed, while *M. sapientum*, often known as the true banana, is frequently eaten raw, Pure triploid acuminate cavendishii, sometimes referred to as the dessert banana, is less starchy and sweeter.

All parts of this species have medicinal properties. It is a treatment for many illnesses, both modern and ancient, and it has origins in Ayurveda. Banana (*Musa*) may be used to treat a variety of gastrointestinal issues, including ulcers, diabetes, hypertension, cancer, ulcers, diarrhea, urolithiasis, Alzheimer's disease, and infections. It also has uses in the treatment of pain, the production of food and medication, nanomedicine, the management of pollution, apoptosis, and the cell cycle, among other areas of medicine [17]. According to [52], the banana peels show antioxidant and anticancer properties. Based on the

Received: 29 Oct 2022; Revised accepted: 14 Jan 2023; Published online: 25 Jan 2023

Correspondence to: Geethalakshmi Sundararaman, Department of Biotechnology, Sree Narayana Guru College, Coimbatore - 641 105, Tamil Nadu, India, Tel: +91 9952411764; E-mail: s.geethalakshmi@gmail.com

Citation: Augustine A, Sundararaman G. 2023. Potentiality of *Musa acuminata* in curing cancer. *Res. Jr. Agril Sci.* 14(1): 189-194.

cytotoxic study in HeLa cell line shows the *Musa* peels used for cancer treatment.

Ripe banana fruit is used to treat gastrointestinal issues because it is naturally alkaline, which balances acid conditions, helps to create a thick protective mucus layer [44], and calms stomach lining inflammation brought on by ulcers. Furthermore, the fruit is applied to wounds and burns to speed recovery. Applying a paste made from a ripe banana that has been beaten into a paste to a burn or wound may provide instant pain relief. When applied cold, banana leaves help heal minor burns and cuts [19].

Patients with ulcer can eat bananas, but only very rarely. The salt and iron content are high. It's great for your heart, your blood pressure, and your waistline since it's loaded with potassium and fiber. Lectin has antioxidant properties. Substances known as free radicals may be eliminated from the body with the aid of antioxidants. Cell damage and, in extreme cases, cancer may result from an excess of free radicals in the body. Bananas are an excellent source of several beneficial nutrients, including fiber, potassium, folate, and antioxidants like vitamin C. All of these things are good for your heart. As a result, it is safe to suggest it to women with anemia [29].

The genomes of *Musa acuminata* and *Musa balbisiana* contribute two different traits. These are the largest and widely distributed *Musa* sp. According to Simmonds and Shepherd [47], *M. acuminata* (AAA) are parthenocarpy and sterility whereas *M. balbisiana* (BBB) are hardiness, drought tolerance, disease resistance and starchiness [14]. The genomes of *M. acuminata* are denoted by AA and *M. balbisiana* is denoted by BB. *Musa acuminata* and *Musa balbisiana* each provide a unique feature based on their DNA. These are the largest and widely distributed *Musa* sp. *M. acuminata* (AAA) are parthenocarpic and sterile whereas *M. balbisiana* (BBB) are hard, drought tolerant, disease resistant and contains high starch [14].

The mixture of *M. acuminata* and *paradisica* is another name for *balbisiana* [21]. hybrid bananas that include *M. acuminata* and *balbisiana* plants yield fruit. *M. acuminata* is the most widely spread species of *Musa* [11]. In Malaysia the most favored banana type is AA diploid i.e., Mas banana, it also has a high demand for commercial planting [62]. The phloem exudates of *Musa acuminata* pseudo stem, the first domesticated plant species with effective lectin activity, will be examined to ascertain the plant's contribution to cancer prevention and the mechanism by which it always succeeds. The cytotoxic impact of *Musa acuminata* lectin protein (MALP) has been studied and shown to be promising against a number of human cancer cell lines. Its anticancer potential is shown by the dramatic reduction of tumor growth through interfering with angiogenesis and apoptosis [51].

The essential oil of *Musa* spp., shows some biological activities and it has potential medicine for curing tumors [43]. The anthocyanins of *Musa* flower bracts have anti-cancer compounds [53]. The cytokines IFN, TNF- α , and interleukin-2 are induced in response to the *Musa* lectin. The lectin prevents hepatoma and leukemia cells (L1210) from growing (HepG2). The *Musa* lectin exhibit anti- HIV and anti-cancer properties [10]. The banana flower is a dietary fiber rich and it has antioxidant properties. *Musa* flowers can be used for colon cancer treatment. This flower contains high concentrations of phenolic content, this compound have anticancer activity against cancer cells [12], [15].

The *Musa* fruit consumption can reduce breast cancer [24]. Mondal *et al.* [31] says that the *Musa* have anti-cancer properties. The phytochemical compound contains anti-cancer characteristics that might inhibit the proliferation of cancer cells

and potentially cause advanced cancer cells to undergo apoptosis. An extract from *Musa* fruit juice prevents a colon cancer cell line from proliferating. HT-29 [40] Vitamin C-rich foods like oranges and *Musa* fruit have anticancer qualities that prevent the uncontrolled spread of cancer cells. This study shows that these extracts have a high level of cytotoxic activity against the human breast cancer cell line MCF 7[2].

Cancer

Cancer is among the world's worst diseases. Normal cells may be destroyed by the uncontrolled development and division of aberrant cells [28]. In 2020, researchers will have collected enough data to conclude that the global population has doubled. This year, there will be 2.26 million new cases of breast cancer, 2.21 million new cases of lung cancer, and 1.9 million new cases of colon and rectum cancer, according to the American Cancer Society [63]. There are many toxic compounds used for this treatment. The cytotoxicity properties are different from one type to another type of cancer. Most of the chemotherapy drug cytotoxic properties are not specific for tumor cells and normal cells. The *Musa* has a number of pharmacological activities and antioxidant properties [18].

The prevalence of cancer has increased to surpass all other causes of mortality in the globe. The baby in the womb is not immune to cancer, which may harm people of all ages. Over ten million new instances of cancer are identified annually, and this is due to the mutation of normally functioning cells. The World Health Organization estimates that cancer is responsible for 13% of all deaths worldwide. According to a study conducted by the World Cancer Research Foundation, there are now 18.1 million instances of cancer worldwide. There are 9.3 million male-related causes of death and 8.8 million female-related ones. 2.3 million new causes are formed. In female lung and breast cancer for 11.7%. In male colon, liver and prostate cancer for 18%. We are expecting 28.4 million causes in 2040 [56].

The plants can be used for cancer treatment because the phytochemical compounds like alkaloids exhibit cytotoxicity against colon cancer and other compounds show anticancer properties to specific cancers [46]. Now most of the cancer research targets on plants and plant derived products because they identified the anti-cancer potent analogues and their properties [39]. The anti-inflammatory properties of *Musa acuminata* stem extract are expressed at all doses [3] and the expression of TNF- α and NF- κ B is reduced. According to Okon *et al.* [35], the bioactive chemical saponins may be found in the fruit of the *Musa acuminata* tree. It aids the immune system, making it more effective in warding off infections and other microbial attacks. The other phytochemical constituents such as alkaloids and glycosides increase haematopoiesis and increase red blood cells. *Musa* used to restore excessive bleeding blood and stimulate cytokine erythropoietin. Srinivas *et al.* [51] states that *Musa acuminata* have anticancer properties and it inhibits HeLa and EAC cells growth.

Breast cancer

In women, breast cancer accounts for one in four incidences of the disease. But because of early detection among women, the survival rate has increased. It is more efficient therapy 50 to 80% of breast cancer diagnosed in early stages [25]. When breast cancer has spread to other bodily regions, it is said to be metastatic [55]. The multiple stages of breast cancer development make prevention extremely difficult. Eventually, it reaches far-flung places like the brain, liver, lungs, and bone. Preventing illness by early detection is best. Numerous factors, including sex, ageing, estrogen, family history, mutations, and

way of life, increase the risk of getting breast cancer. The cancer affected glandular tissues and stromal tissues [45]. Breast cancer causing genes are identified and it acts as a key role in identification of tumor initiation and progression.

BRCA1/2

Breast cancer is linked to the BRCA 1 and BRCA 2 genes. These genes are found on chromosomes 17q21 and 13q12. Both of them are code tumor suppressor proteins. BRCA 1 deficiency [8]. An in vitro dose-dependent induction of apoptosis was used to assess the anticancer effectiveness of an aqueous methanol extract of Nendran banana peel against the MCF-7 breast cancer cell line [13].

Human epidermal growth factor receptor 2 gene

This gene, sometimes referred to as *h*er2 or *c-erbB-2*, is situated on the long arm of human chromosome 17. (17q12). This gene amplification and overexpression can cause 20-30% of breast cancer [58].

Epidermal growth factor receptor (EGFR)

This gene is also called *c-erbB-1* or *Her 1*. This gene located in the short arm of chromosome 7(7q12). It induces cell differentiation, proliferation and overexpression of this gene causes 30% of inflammatory breast cancer [55].

According to studies by Salama et al., banana leaf acetone extract shown potent action against breast and liver hepatocellular carcinoma cell lines [43]. The leaves of the fruit have medicinal use as an antibacterial and anticancer agent because they contain bioactive metabolites. In addition to garbage recycling in the fight against pollution.

Bone cancer

The three most common types of bone cancer today are osteosarcoma (35 percent), chondrosarcoma (30 percent), and Ewing's sarcoma (16 percent). Malignant fibrous histiocytomas and bone fibrosarcoma account for less than 1% of primary bone tumors (MFH). Young people and adolescents are more likely to develop osteosarcoma and Ewing's sarcoma [7]. The tumor necrosis factors have a major role in growth regulation, differentiation, inflammation, tumorigenesis, autoimmune diseases and its human TNF α promoter [36]. The -308-position shift in the allele is associated with several illnesses. Patients with malignant tumors had a much higher frequency of the TNF 308.2 allele, and reports of increases in the TNF308.1/ TNF 308.2 genotype have been made for a variety of tumor types. Bone growth is stifled while bone respiration is sped up because to this TNF α . The antiproliferative and cytotoxic functions of osteoblasts studied vary widely amongst different cell lines [36]. The RUNX2 is an essential transcription factor for osteoblast differentiation. This gene regulates different human cancers. The RUNX2 gene involved in osteosarcoma pathogenesis can regulate cell cycle controlling [20].

The microRNA are endogenous noncoding RNAs and it regulates gene expression [60]. Micro RNA molecules have roles in cellular development and proliferation programs. The specific miRNA target tumor suppressor gene. The miR-34 family was implanted in an osteosarcoma tumor. Osteosarcoma tumor cells influence miRNA expression. The EWS-FLI1 fusion protein produced in Ewing sarcoma induces changes in miRNA expression [34]. TP53 and RB1 gene shows high risk of development of bone cancer [6]. Oncogenes, tumor suppressor genes, proliferation, angiogenesis, and apoptosis are all targets of miRNA, which affects tumorigenesis and progression. Unique miRNA profiles may be seen at various cancer stages. When it comes to identifying cancer, miRNAs

serve as vital road signs. Cancers of the bone, breast, lung, colon, and multiple myeloma are all controlled by microRNAs. The use of miRNA in cancer diagnosis and treatment with the goal of preventing bone metastases [64].

Colon cancer

The large intestine, colon, and rectum are the digestive organs that make up the bottom part of the digestive system, and they are the ones most often affected by colon cancer, as stated by Alana et al. [1]. A diet that is high in red and processed meat, sugar, alcohol, and a dearth of vegetables and fruits is linked to a higher risk of colon cancer. The risk of colon cancer is decreased by the antioxidant, antiproliferative, and proapoptotic effects of the bioactive compounds. They are successful in eliminating colon cancer cells [49]. Chromatin remodeling complexes contain SWI/SNF families disrupted by cancer [30]. The mutation for mismatch repair gene, suppressor gene and oncogenes cause colon cancer [9]. According to Moinova, the colon cancer gene was suppressed by the SWI/SNF family of proteins' helicase-like transcription factor (HLTF), a member [36]. In colon cancer, methylation and epigenetic gene silencing often target HLTF, a gene known to suppress the disease.

Pettersson et al. [38] states that the enzyme cyclooxygenase -2 (COX-2) involved the colon cancer formation. The COX-2 protein expression stimulates colon cancer cells (HT29). 2-Pentanone inhibits COX-2 protein and prostaglandin expression. The similar observations were made by Macharia et al. [23], who suggested that *Musa acuminata* and *Musa balbisiana* exhibit anticancer activity against human colon cancer. Increased level of COX-2 enzyme expression shows colon cancer. The PPP12R1B gene is a tumor suppressor gene and it is located in human chromosome 11q22-24. This gene can regulate cell cycle and cellular growth control [61].

Anticancer activity of Musa varieties

Banana flower extract boosted the expression of p53 and p27 while decreasing the expression of cyclin D1 and cyclin-dependent kinase 6 [22]. *Musa* species exhibit anticancer activities in breast, cervical, prostate, colon and skin cancer. *Musa's* bioactive chemical exhibits properties such as antiproliferative activity, cell cycle arrest induction, death, and invasion prevention [31]. *Musa* peel's anticancer properties have also been shown to be effective against human pancreatic, breast, colon, and liver cancer cell lines [33]. The phytochemical elements included in the ethanol extract of red peel *Musa acuminata* Colla include many potential co-chemotherapy drugs (ERBP). The MCF-7 breast cancer cell's viability is decreased, and metastasis is prevented. *Musa* peels and blooms exhibit antioxidant and anticancer effects, according to a similar finding by Mathew et al. [26].

Anthocyanin isolated from methanol extracts of *M. acuminata* bract inhibited MCF-7 cell growth by inducing apoptosis, according to an additional in vitro investigation by Roobha and Aravindhan [16]. The murine monocyte macrophages cell line is resistant to the harmful effects of the *M. acuminata* flowering stalk. Normal human cells are unaffected by the banana peel's toxicity. *Musa acuminata* lectin protein, it is claimed, has anticancer capabilities against a variety of human malignancies and slows the growth of tumors by interacting with angiogenesis and apoptosis [51]. For this study activated charcoal in *Musa acuminata* fruit peel shows anticancer effect and activated charcoal has the ability to control the cancer cell activity [5].

The antioxidant capabilities of anthocyanins have been studied for their power to benefit prevent cancer. In this study,

human breast cancer cell lines were used to explore the anti-cancer effects of anthocyanin produced from *Musa acuminata* bract (MCF-7). The findings demonstrated that anthocyanin from *Musa acuminata* bract extracts exhibited strong antiproliferative effect against MCF-7 cell lines even at low doses. These findings provide support for the use of the bioactive components as potential chemo preventive medicines for human breast cancer [16]. Rusmiati *et al.* [42] state that ROS, the source of oxidative stress, contributes to the dissemination of cancer cells. And we are using Doxorubicin (DOX) chemotherapy agent, it has some side effects on healthy organs.

Musa flower extract for its potential to inhibit cancer growth in HeLa cells, a cervical cancer cell type. The antiproliferative effects are measured using the MTT test. *Musa acuminata*, a plant with significant economic value, has been shown to have anticancer effects in a number of studies [12]. *Musa paradisiaca* has anticancer efficacy against HT29 colon cancer cells, as reported by Arun *et al.* [4]. DNA damage is

generated, the cell cycle is stopped in the G2/M phase, and the levels of the pro-apoptotic Bcl2 and anti-apoptotic Bax proteins are both raised. The expression of a mutant protein led to the death of HT29 cells. Traditional medication known as *musa basjoo*. Its ability to fight human colon cancer has been shown (HT29 and HCT116). Cyclin D1, cyclin E, cdk2, and cdk4 protein levels are reduced [27].

CONCLUSION

Bioactive substances in *Musa acuminata* are necessary for proper development and growth. Food and medicine are two of the many uses for them. It has some hematopoietic properties, antioxidant and anticancer activities. The different genes show cancer properties. *Musa acuminata* exhibits anticancer properties and it effectively reacts with cancer cells. The study results suggest that greater investigation into the therapeutic potential of *Musa acuminata* is necessary to validate its traditional medicinal use.

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