Therapeutic and Medicinal Effects of Different Parts of *Musa sapientum*

Piyush Dixit[a], Vivek Kumar[b]*, Rimi Shukla[a]
[a]*Department of Biochemistry, University College of Medical Sciences & GTB Hospital, University of Delhi, Dilshad Garden, Delhi, India.*
[b]*Department of Biotechnology, IMS Engineering College, Ghaziabad.*
*vivek.ucms@gmail.com

Abstract

Musa sapientum plant is a major fruit crop around the world. Medicinal properties of *Musa sapientum* are largely overlooked. All parts of this plant species possess medicinal activities which are helpful in curing many human ailments. Many traditional medicinal systems (Ayurveda and Chinese) discuss about the medicinal and healing properties of *Musa sapientum*. In present review we focused on various medicinal activities of *Musa sapientum*.

Keywords - *Musa sapientum*, Medicinal properties, Antidiabetic , Drugs, Antiulcerogenic

Introduction

Mankind has been continuously using plants for the treatment of various ailments since the ancient period. According to WHO, about 80% of the world's population relies on traditional medicine for their primary health care (Bannerman *et al.,* 1983). There are approximately 45,000 plant species in India, of which about 7,300 plant species are used in traditional healthcare systems and 1100 in Indian systems of medicine (Trivedi, 2009).

Allopathic drugs have brought revolution throughout the world; however the plant based drugs have their own significance due to their little or no side effects. Natural products and their derivatives represent more than 50% of the drugs in clinical use in the world (Cowan, 1999). In the present article we discuss the biological and medicinal potential of a well-known edible plant *Musa sapientum* Linn. (Common name Banana, family name Musaceae). *Musa sapientum* has various health benefits which are included in this article.

Habitat and Commercial Uses

Musa sapientum is major food crop grown globally and consumed in more than 100 countries through out tropics and subtropics (Cowan, 1999). In developing countries it is the fourth most important crop after rice, wheat and maize. Total world production of banana in 2005 was over 100 milllion tonnes. India is one of the major producer of *Musa sapientum*. In India *Musa sapientum* ie. banana grown mostly in humid and sub humid region in North . Commercially all *Musa sapientum* parts are used. Its fruit can be consumed raw, cooked (deep fried, dehydrated, baked in skin, steamed). Other parts of *Musa sapientum* like pseudostem is used for cooking, flower is consumed in Southeast Asia.

Botanical Description

Both *Musa sapientum* and plantain are large, herbaceous monocots, generally 6 to 15 ft tall, may reach up to 25 ft in some cultivars. The pseudostem is not a true stem, but only the clustered, cylindrical aggregation of leaf stalk bases. Leaves are among the largest of all plants, becoming up to 9 ft long and 2 ft wide. The perennial portion of the plant is the rhizome, which may weigh several pounds.

Phytochemistry of *Musa sapientum* Var. Paradisiaca

One medium *Musa sapientum* fruit contains 1.29 grams of protein, 105 calories and 3.1 grams of dietary fiber.

Potassium - 422 mg, Phosphorus - 26 mg, Magnesium - 32 mg, Calcium - 6 mg, Sodium - 1 mg Iron - 0.31 mg, Selenium 1.2 mcg, Manganese - 0.319 mg, Copper - 0.092 mg, Zinc - 0.18 mg Also contains small amounts of other minerals.

Vitamin A- 76 IU, Vitamin B1 (thiamine) - 0.037 mg, Vitamin B2 (riboflavin) - 0.086 mg Niacin - 0.785 mg, Folate - 24 mcg, Pantothenic Acid - 0.394 mg, Vitamin B6 - 0.433 mg Vitamin C - 10.3 mg, Vitamin E - 0.12 mg, Vitamin K - 0.6 mcg. It also contains some other vitamins in small amounts. (Deborah *et al.*, 2011)

Therapeutic and Medicinal Effect

Effect on gastrointestinal system

In a study by Best *et al.* (1984) various preparations of dried unripe plantain *Musa sapientum* were used in cure of aspirin-induced ulcerations in rats. Although ripe fruit were inactive. Moreover, the active fraction was water soluble and the antiulcerogenic action of *Musa sapientum* appeared to be due to its ability to stimulate the growth of gastric mucosa .The effects of different biological variables on the antiulcerogenic effect of *Musa sapientum* were also reported and this study indicated that this effect was present in primarily in the unripe, green plantain *Musa sapientum* and the antiulcerogenic principle appeared to be present in mature unripe fruits (Goel *et al.,* 1985). Mukhopadhyaya and co-workers also showed that orally administered pulp powder of *M. sapientum var. paradisiaca* had a significant antiulcerogenic activity in rats (Goel *et al.,* 1986; Mukhopadhyaya *et al.,* 1987).

When administered to rats and scored by ulcer length and area, *Musa sapientum* imparted appreciable (75%) protection against acid insult in a dose-dependent manner. These studies supported the concept of a gastric mucosal barrier (Hill and Kirwood, 1989).

Effects on blood glucose and cholesterol

Under-ripe *Musa sapientum* constitutes 80-90 % of starch which converts to free sugars on ripening. The increase in blood glucose in insulin dependent diabetics after different fruit meals including apple, banana and orange by comparing with an equal amount of glucose was investigated by Vaaler *et al.,* (1982). The postprandial blood glucose responses to glucose, apple and banana were almost identical. Therefore, it was concluded that these fruits contain considerable amounts of fructose To study the effect of ripening on the postprandial blood glucose and insulin responses to *Musa sapientum*, ten type-2 non-insulin dependent diabetic patients consumed three meals consisting of under-ripe *Musa sapientum* and over-ripe *Musa sapientum* fruit on separate days. Glycaemic indices of the under-ripe and over-ripe *Musa sapientum* fruit differed significantly (43 ± 10 and 74 ± 9, $p<0.01$, respectively) (Vaaler *et al.,* 1982).

The pulp of banana fruit *(Musa sapientum)* was examined for its cholesterol-lowering effect with male rats fed on a diet containing lard and cholesterol. Freeze-dried *Musa sapientum* fruit pulp showed a remarkable cholesterol-lowering effect. Both soluble and insoluble fibers fractionated from *Musa sapientum* fruit pulp had a cholesterol-lowering effect. The results obtained supported the conclusion that soluble and insoluble components of dietary fiber participate in the hypocholesterolaemic effect of *Musa sapientum* fruit pulp (Horigome *et al.,* 1992; Usha *et al.,* 1984). Dietary fiber isolated from unripe *Musa sapientum* fruit altered the concentration of aortic glycosaminoglycans in rats fed cholesterol-free and cholesterol diet. Concentration of hyaluronic acid, heparan sulphate, chondroitin-4-sulphate, chondroitin-6-sulfate, dermatan sulphate and heparin increased in aorta of the rats fed cholesterol-free diet. In rats fed cholesterol diet, concentration of heparan sulphate, chondritin sulphate and heparin increased while hyaluronic acid showed a decrease (Usha *et al.,* 1991). One of our recent study also reported antidiabetic effect of stem of *Musa sapientum.* (Dikshit *et al.,* 2011).

Effect on diarrhea

Diarrhea is among the foremost disorders responsible for high mortality and morbidity in children of third world countries. In a clinical study , *Musa sapientum* flakes were examined against 31 enterally fed

patients with diarrhea. *Musa sapientum* flakes was found to reduced the severity of diarrhea in critically ill tube-fed patients. Study concluded that *Musa sapientum* flakes can be used as a safe, cost-effective treatment for diarrhea (Emery *et al.,* 1997, Malik *et al.,* 1991).

Effect on urinary system

Influence of *Musa sapientum* stem extract of was studied on glycolic acid oxidase (GAO) and lactate dehydrogenase (LDH) enzymes in liver tissues of sodium glycolate-induced hiperoxaluric rats. Activity of GAO was significantly lowered in the extract-treated rats compared to that of the glycolate-fed rats. LHD increased significantly in glycolate administered rats when compared with the extract-treated rats (Kailash and Varalakshmi, 1992). In a similar study stem extract on urinary risk factors in an animal model of hyperoxaluria was performed on 30 male rats. In the rats treated with aqueous stem extract, urinary oxalate excretion was remarkably reduced as compared to controls. The extract reduced urinary oxalate, glycolic and glyoxylic acid and phosphorus excretion in the hyperoxaluric rats. Further, extract doesn't have any significant effect on urinary calcium secretion. Based on the results, it was concluded that the stem extract of *Musa sapientum* may be a useful agent in the treatment of patients with hyperoxaluric urolithiasis (Poonguzhali and Chegu, 1994)

Effect on muscular system

Lee *et al.*, (1980) studied *Musa sapientum* trunk juice as a neuromuscular blocker. They reported a non-depolarizing neuromuscular block and oxygenation of the extract enhances its potency (Lee *et al.,* 1980). Besides, stem juice was reported to induce twitch augmentation in skeletal muscles. The mechanism of this action was investigated in the mouse hemi-diaphragm preparation. Directly evoked twitches and potassium-induced contractures were both augmented by the extract. Nifedipine enhanced the augmenting effect of the extract on twitches but shortened the time course of this action. The results were consistent with an action of *Musa sapientum* tree juice on the molecule responsible for excitation-contraction coupling in skeletal muscle (Singh and Dryden, 1990). The trunk juice was assayed in the isolated phrenic nerve-diaphragm muscle preparation of the rat. Monopotassium oxalate was found to be the active compound and the effect of this compound on the muscle preparation was investigated. The findings in this work suggested that monopotassium oxalate could be responsible for the muscular paralysis caused by the juice of *Musa sapientum* trunk (Benitez *et al.,* 1991). Lyophilized, partially purified extracts of the juice augmented and then blocked both directly and indirectly evoked contractions of the mouse diaphragm. The active components were identified as potassium nitrate and magnesium nitrate. They had the same activity profile as authentic samples. Therefore, it was concluded that two active major principles in the *Musa sapientum* stem juice were potassium nitrate and magnesium nitrate (Singh *et al.,* 1993).

Effect against cancer and mutagenity

A study indicated a protective effect against *Musa sapientum* colorectal cancer based on questionnaires (Lohsoonthron and Danvivat, 1995). In a similar study dietary patterns were assessed in detail by use of a food frequency questionnaire on 61 food items. Nutrient residuals were calculated through regression analysis. The strongest protection was observed for *Musa sapientum* fruit intake (Deneo *et al.,* 1996). Indonesian plants were screened for their in vitro antitumor-promoting activities using the tumor promoter 12-0-hexadecanoylphorbol-13-acetate (HPA)-induced Epstein-Barr virus (EBV) activation test in Raji cells. A high potential of edible Southeast Asian plants including *Musa sapientum* for cancer chemoprevention was indicated (Murakami *et al.,* 1998). Considering differences in cancer incidence between Polinesians and Europeans living in New Zealand depending on their diet, 25 food plants that are typically eaten in different amounts by these two population groups were selected. Antimutagenic properties of three extracts from each of the selected plants were investigated using a preincubation mutagenity assay with *Salmonella typhimurium* strain (TA1538) against the mutagenity of the heterocyclic amine 2-amino-3-methylimidazol [4,5-f] quinoline (IQ). The data revealed strong

antimutagenic activites in several food plants including *Musa sapientum*. Possible active compounds in these extracts were reported to include chlorophylls, carotenoids, flavonoids, and coumarins, many of which are known anticarcinogens, (Botting *et al.,* 1999).

Effect on migraine

In a clinical trial in Italy, 43 patients aged from 7 to 18 suffering from migraine without aura (according to the classification of International Headache Society) were selected to establish the possible correlation between migraine and food intolerance. Each patient was 46 İlkay orhan challanged weekly in an open trial, introducing in the diet the different foods. They were controlled in a simple double blind study. Skin tests (Prick method), plasma levels of total and specific IgE (Prist and Rast method) and histamine plasma levels at the beginning and at the end of the diet. After the dietetic treatment, the food responsible of the migraine attacks recognized as cacao, banana, egg, and hazelnuts (Guariso *et al.,* 1993).

Effect on hypertension

The effect of *Musa sapientum* on cold stress induced hypertension, peak expiratory flow rate and plasma ACE activity in healthy human volunteers was tested. Systolic, diastolic and mean arterial blood pressure was significantly decreased during cold stress after banana treatment compared to controls subjected. There were no significant changes in heart rate and peak expiratory flow rate but only significant decrease in plasma ACE activity after banana treatment (Sarkar *et al.,* 1993).

Effect against bacterial growth

Extracts prepared from the peel and pulp of *Musa sapientum* in ripening stages was evaluated for their ability to modulate the growth of non-pathogenic and pathogenic bacteria. Extracts increased the growth of gram-negative bacterial strains *Escherichia coli, Shigella flexneri, Enterobacter cloacae and Salmonella typhimurium,* as well as two nonpathogenic E. coli strains. The growth of gram-positive bacteria was not altered by any of the extracts (Lyte, 1997). In an antibacterial assay performed by Ono *et al.,* (1998) in Japan, *Musa sapientum* showed antibacterial activity against *E. coli* and *Staphylococcus aureus*.

Effect on enzymes

The proteolysis of casein by trypsin, chymotrypsin and papain enzymes were inhibited by ripened and unripened banana cultivars named as bontha, poovan, nendran, cavendish and rasthali bananas in India. The inhibition of trypsin, chymotrypsin and papain by different ripened was much more than that of unripened cultivars. In this study, the probable role of unripened banana papain inhibitors in curing stomach ulcers and antinutritional role of ripened *Musa sapientum* trypsin inhibitors were indicated (Rao, 1991).

In a study by Pari and Maheshwari (2000), the extract prepared from *Musa sapientum* flowers (*M. sapientum*) caused a decrease in free radical formation in the rat tissues. The decrease in thiobarbituric acid reactive substances and the increase in reduced glutathione, glutathione peroxidase, superoxide dismutase and catalase showed the antioxidant properties of the flower extract.

Conclusions

Present review analyses the medicinal and therapeutic potential of *Musa sapientum*. Finding of several studies animal model suggest that *Musa sapientum* can cure or ameliorate many human disorders and ailments like hypertension, migraine, various human cancer, diarrhea, cholesterol, diabetes. Hence it can be concluded that various parts of *Musa sapientum* can act as novel drug candidate for treatment of common human disorders. Further studies should focus on identification ,isolation and characterization of bioactive compounds of *Musa sapientum*.

References

Ahmad, M., Khan, M.A., Qureshi, R.A. 2003. Ethno botanical study of some cultivated plants of Chhuch region (District of Attock). *Hamdard Medicus*, 4, 15-19.

Akihisha, T., Kimura, Y., Tamura, T. 1998. Cycloartane triterpenes from the fruit peels of *Musa sapientum*. *Phytochemistry*, 1107-1110.

Bannerman, R.H., Burton, J., Wen-Chieh, C. 1983. Introduction in Traditional Medicine and Health Care Coverage. *WHO*, Geneva.

Benitez, M.A., Navarro, E., Feria, M., Trujillo, J., Boada, J. 1991. Pharmacological study of the muscle paralyzing activity of the juice of the banana trunk. *Toxicon*, 29, 511-515.

Bennett, P.N., Brown, M.J. 2003. Clinical Pharmacology. *Churchill livingstone international edition*, Spain, 680.

Best, R., Lewis, D.A., Nasser, N. 1984. The anti-ulcerogenic activity of the unripe plantain Bnana. *British Journal of Pharmacology,* 107-116.

Cowan, M.M. 1999. Plants products as antimicrobial agents. *Clinical Microbiology Reviews*. 12, 564-582.

Deborah, K., Eldad, K., Guy, B. 2011. Banana Breeding Progress and Challenges. Eds, Pillay, M., Tenkouano, A., *CRC Press*, 120.

Deneo-Pellegrini, H., De Stefani, E., Ronco, A. 1996. Vegetables, fruits, and risk of colorectal cancer: a case-control study from Uruguay. *Nutrition and Cancer*, 25, 297-304.

Dikshit, P., Shukla, K., Tyagi, M.K., Gambhir, J.K., Shukla, R. 2012. Antidiabetic and antihyperlipidemic effect of stem of *Musa sapientum* Linn. in streptozotocin-induced diabetic rats. *Journal of Diabetes,* 1753-0407.

Emery, E.A., Ahmad, S., Koethe, J.D., Skipper, A., Perlmutter, S., Paskin, D.L. 1997. Banana flakes control diarrhea in enterally fed patients. *Nutrition in Clinical Practice*, 12, 72-75.

Ercan, N., Nuttall, F.Q., Gannon, M.C., Lane, J.T., Burmesiter, L.A., Westphal, S.A. 1993. Plasma glucose and insulin responses to bananas of varying ripeness in persons with noninsulin dependent diabetes mellitus. *American College of Nutrition*, 12, 703-709.

Ghoshal S. 1985. Steryl Glycosides and Acyl Steryl Glycosides from *Musa paradisiacal. Phytochem*. 1807-1810.

Goel, R.K., Chakrabarti, A., Sanyal, A.K. 1985. The effect of biological variables on the antiulcerogenic effect of vegetable plantain banana. *Planta Medica*, 2, 85-88.

Goel, R.K., Gupta, S., Shankar, R., Sanyal, A.K. 1986. Antiulcerogenic effect of banana powder (*Musa sapientum* var. paradisiaca) and its effect on mucosal resistance. *Journal of Ethnopharmacology*, 18, 33-44.

Goel, R.K., Tavares, I.A., Bennett, A. 1989. Stimulation of gastric and colonic mucosal eicosanoid synthesis by plantain banana. *Journal of Pharmacology and Pharmacotherapeutics,* 41, 747-750.

Guariso, G., Bertoli, S., Cernetti, R., Battistella, P.A., Setari, M., Zacchello, F. 1993. Migraine and food intolerance: a controlled study in pediatric patients. *Pediatr Medica Chirurgica,* 15, 57-61.

Hills, B.A., Kirwood, C.A. 1989. Surfactant approach to the gastric mucosal barrier: protection of rats by banana even when acidified. *Gastroenterology*, 97, 294-303.

Horigome, T., Sakaguchi, E., Kishimoto, C. 1992. Hypocholesterolaemic effect of banana (Musa sapientum L. var. cavendishii) pulp in the rat fed on a cholesterol-containing diet. *British Journal of Nutrition,* 68, 231-244.

K.J., Young, M.M., Pearson, A.E., Harris, P.J., Ferguson, L.R. 1999. Antimutagens in food plants eaten by Polynesians: micronutrients, phytochemicals and protection against bacterial mutagenicity of the heterocyclic amine 2-amino-3-methylimidazo[4,5] quinoline. *Food* and *Chemical Toxicology*, 37, 95-103.

Kailash, P., Varalakshmi, P. 1992. Effect of banana stem juice on biochemical changes in liver of normal and hyperoxaluric rats. *Indian Journal of Experimental Biology*, 30, 440-442.

Lee, S.K., Ng, L.L., Lee, S.I. 1980. Experiments with banana trunk juice as a neuromuscular blocker. *Australian Journal of Experimental Biology and Medical Science*, 58, 591-594.

Lewis, D.A., Fields, W.N., Shaw, G.P. 1999. A natural flavonoid present in unripe plantain banana pulp (*Musa sapientum* var. paradisiaca) protects the gastric mucosa from aspirininduced erosions. *Journal of Ethnopharmacology*, 65, 283-288.

Lohsoonthorn, P., Danvivat, D. 1995. Colorectal cancer risk factors: a case-control study in Bangkok. *Asia-Pacific Journal of Public Health*, 8, 118-122.

Lyte, M. 1997. Induction of gram-negative bacterial growth by neurochemical containing banana (Musa paradisiaca) extracts. *FEMS Microbiology Letters*, 154, 245-250.

Malik, LA., Azim, S., Good, M. J., Iqbal, M., Nawaz, M., Ashraf, L., Bukhtiari, N. 1991. Feeding practices for young Pakistani children: usual diet and diet during diarrhea. *Journal of Diarrhoeal Disease Research*, 9, 213-218.

Mukhopadhyaya, K., Bhattacharya, D., Chakraborty, A., Goel, R.K., Sanyal, A.K. 1987. Effect of banana powder (*Musa sapientum* var. paradisiaca) on gastric mucosal shedding. *Journal of Ethnopharmacology*, 21, 11-19.

Murakami, A., Morita, H., Safitri, R., Ramlan, A., Koshimizu, K., Ohigashi, H. 1998. Screening for in vitro antitumor-promoting activities of edible plants from Indonesia. *Cancer Detectection and Prevention*, 22, 516-525.

Nataraj, L., Dharmar, R., Sellamuthu, M. 2010. Antioxidant capacity and phenolic content of different solvent extracts from banana (*Musa paradisiaca*) and mustai (*Rivea hypocrateriformis*). *Food Science Biotechnology*, 5, 1251-12.

Ono, H., Tesaki, S., Tanabe, S., Watanebe, M. 1998. 6-Methylsulfinylhexyl isothiocyanate and its homologues as food-originated compounds with antibacterial activity against Escherichia coli and Staphylococcus aureus. *Bioscience. Biotechnology. and Biochemistry*, 62, 363-365.

Pari, L., Umamaheswari, J. 2000. Antihyperglycaemic activity of *Musa sapientum* flowers: effect on lipid peroxidation in alloxan diabetic rats. *Phytotherapy Research*, 14, 136-138.

Poonguzhali, P.K., Chegu, H. 1994. The influence of banana stem extract on urinary risk factors for stones in normal and hyperoxaluric rats. *British Journal of Urology,* 74, 23-25.

Rao, N.M. 1991. Protease inhibitors from ripened and unripened bananas. *International* Journal of *Biochemistry*, 24, 13-22.

Sarkar, C., Bairy, K.L., Rao, N.M., Udupa, E.G. 1999. Effect of banana on cold stress test & peak expiratory flow rate in healthy volunteers. *Indian Journal of Medical Research*, 110, 27-29.

Singh, Y.J.M., Dryden, W.F. 1990. The augmenting action of banana tree juice on skeletal muscle contraction. *Toxicon*, 28, 1229-1236.

Singh, Y.N., Inman, W.D., Johnson, A., Linnell, E. J. 1993. Studies on the muscle-paralyzing components of the juice of the banana plant. *Archives internationales de pharmacodynamie et de therapie,* 324, 105-113.

Trivedi, P.C. 2009. Indian Medicinal Plants. *Pointer Publisher*, Jaipur

Usha, V., Vijayammal, P.L., Kurup, P.A. 1984. Effect of dietary fiber from banana (Musa paradisiaca) on cholesterol metabolism. *Indian Journal of Experimental Biology*, 22, 550-554.

Usha, V., Vijayammal, P.L., Kurup, P.A. 1991. Aortic glycosaminoglycans in antiatherogenic action of dietary fiber from unripe banana (Musa paradisiaca). *Indian Journal of Medical Research*, 94, 143-146.

Vaaler, S., Wiseth, R., Aagenaes, O. 1982. Increase in blood glucose in insulin-dependent diabetics after intake of various fruits. *Acta medica Scandinavica*, 212, 281-283.

Vijay, K.S., Prassana, K.G., Vijayalaxami, N.R. 2008. Antioxidant activity of banana flavonoids. *Fitoterapia*, 4, 279-282.