Chapter

# Introductory Chapter: Banana Nutrition - Function and Processing Kinetics

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## 1. Introduction

Bananas (*Musa* spp.) are typical climacteric fruit with rich nutrient contents which are considered as a healthy fruit. They are one of the top 10 world food crops contributing to cash and food crop in the tropics and subtropics. Bananas are important in nutrition, therapeutics, traditional medicine and the pharmaceutical and food industries. The different chemical constituents like apigenin glycosides, myricetin-3-O-rutinoside, kaempferol-3-O-rutinoside, dopamine and serotonin have been reported in different parts and varieties of banana [1]. Pharmacological actions of bananas have been seen such as antiulcer, antimicrobial and antioxidant activities. Almost all the parts of this plant, i.e. fruit, leaves, flower bud, trunk, pseudo-stem can be utilized. The book highlights the extraction of banana pseudo-stem fibre and retting; as well as degumming of the fibre with the characteristics and potential application of banana pseudo-stem fibre, including morphological, physical, mechanical, durability, degradability, thermal, chemical, and anti-bacterial properties. Several potential applications of this fibre highlighted are the use of this fibre to fabricate rope, place mats, paper cardboard, string thread, tea bag, high quality textile materials, absorbent and polymer/fibre composites.

Pre- and postharvest technologies invariably affect the carbohydrates, minerals, vitamins and other composition like the bioactives of plant foods. To increase the postharvest shelf life and quality of banana fruit, appropriate postharvest handling procedure ensures the freshness of the produce considering effects of climate change on crops. The conversion into intermediate and other products ensures the versatility in value addition. Also, conversion into value added products can reduce huge amount of postharvest losses. The aspects of transgenic technology in banana complement the advances in banana biotechnology, giving rise to product development strategies. As highly perishable fruit, bananas require robust preservation processes (natural and artificial) including minimal processing, refrigeration and dehydration (both thermal and nonthermal drying processes). The models of drying kinetics in predicting the drying behaviour and in optimising the drying parameters of banana fruits are all important food engineering applications. Also, integrating digitalisation systems into banana value chain/processing will benefit the banana industry as Siemens recently created consistent automation with its digital enterprise. In addition, integrating text mining and network analysis of published articles on banana sensory characteristics reveal factors such as chemical additives, ontology and other intrinsic attributes needed by food processors in meeting the expectation of consumers. The food industries are poised to improve customers' health and expectation on nutritious food products. The advocacy by

some food professionals about the benefits of plant foods is seen in the focus of key food companies on health food and products. Recently in 2018, Cargill addressed health issues for food manufacturers at Gulfood Manufacturing: heart health, for example, its latest CoroWise® Plant Sterols and Prolía® Soy Flour are fast gaining popularity among food manufacturers. Most of these innovations are also backed by an FDA health claim.

Research investigations have continued on the nutritional benefits of banana; such that scientists have created 'vitamin-A rich fruit that could save hundreds of thousands of children's lives'. In the Newsweek of July 10, 2017 was the publication by Hannah Osborne 'vitamin-A rich GMO banana [2], which could fight malnutrition in Africa, ready for field trials'. Scientists in Australia have created golden-orange-fleshed bananas rich in pro-vitamin A that could save the lives of children who die from a deficiency of this vitamin every year. The 'biofortified' bananas were developed by taking genes from a species of banana from Papua New Guinea, which is high in provitamin A but only produces small bunches, and combined it with that of a the high-yielding specie, Cavendish banana. Provitamin A is converted by the body into vitamin A. In research findings published in Wiley's Plant Biotechnology Journal, the team presented results from proof of concept field trial in Australia, in which they had aimed to achieve a specific level of provitamin A within the fruits produced. They found they had exceeded the target with one line of bananas more than doubling it.

Environmental challenges sometimes regarded as climate change, such as persistent drought, and other conditions (poor soils, prevalent crop diseases and pests) are some of the reasons for genetic modification technology. It is known that four major diseases in bananas causing very serious concerns and losses are (i) *Fusarium* wilt tropical race 4 (TR4), (ii) black Sigatoka, (iii) banana bunchy top disease, and (iv) banana *Xanthomonas* wilt [3]. There are also larger number of diseases and pests of lesser importance, including yellow Sigatoka, freckle, banana bract mosaic, banana streak, Moko, blood disease, nematodes and weevils. These diseases impact on the nutrition and other commercial values or uses of banana fruit including the stem. Conventional breeding methods have limited success in combating these environmental challenges. The purpose of transgenicity includes (i) enhancement of fruit/quality and value-added traits; (ii) pharmaceutical/medicinal purpose; (iii) improvement in productivity and (iv) health and nutrition. Some target traits in transgenic manipulation in banana include drought tolerance, disease resistance, stress and insect resistance, vitamin A content, colour change and vaccine production.

Significant research in genetic engineering has resulted in nutritionally rewarding bananas. It is known that bananas were domesticated over the past 7000 years. The wild banana before GMO, usually contain big, hard seeds and have a little amount of flesh. They have been selectively bred to have tiny, non-fertile seeds. 'Without using selective breeding, bananas would have been almost inedible'. With all the benefits and ethical considerations of biotechnology/genetic engineering, it continues to advance every area of human nutrition. The question has been asked: Are GMO bananas the next 'superfood'; is there a need for a 'super banana'? The 'super banana' is set to start clinical trials in the United States. Scientists hope to start distributing it to African growers by 2020. Also, scientists from the Queensland University of Technology have created bio-fortified bananas having higher levels of vitamin A capable of preventing vitamin A deficiency (VAD) induced blindness and death among the millions of malnourished children. It is known that VAD is one of the most easily cured illnesses, and is treated with a

simple vitamin supplement. 'Good science can make a massive difference here by enriching staple crops such as Ugandan bananas with pro-vitamin A and providing poor and subsistence-farming populations with nutritionally rewarding food', said the project leader, Professor James Dale. The other areas of advances in plant biotechnology include 'Transgenic Cavendish bananas with resistance to *Fusarium* wilt tropical race 4'—published in *Nature Communications* [4]; 'Exogenous application of chemicals in combinations (1-methylcyclopropene—1-MCP and salicylic acid) with excellent effect on the postharvest physiology and quality of bananas such as inhibit the respiration rate, ethylene production, decay incidence, soluble sugar, and soluble solids content, delayed softness and colour change'—published 2018 in the *Journal of Food processing and Preservation*. There is still a need for conventional (traditional) banana breeding although most of the funding is now allocated to creation of transgenic bananas. However, many countries are against the use of genetically modified crops.

Banana cultivation is affected by various diseases; the most serious being the bunchy top disease caused by the banana bunchy top virus (BBTV) and *Fusarium* wilt caused by the virulent fungus, *Fusarium oxysporum* f. sp. *cubense* tropical race 4 (TR4). Bananas are difficult to genetically improve and significant research has been going on in plant. Gene-editing has helped create plants that produce higher yields to meet the growing demand along with higher nutritional content [5]. Transgenic Cavendish with resistance to TR4 exists. Several successful attempts have demonstrated the strength of transgenics in developing abiotic stress tolerance and disease resistant transgenic banana varieties. Many other similar investigations are currently ongoing that would lead to better production, nutritious and healthful bananas. Recent transgenic studies on bananas have shown that the following challenges and opportunities for future genetic improvement exist:

a. Control of diseases that are major constraint to banana cultivation and consumption worldwide.

b. Few of the GM bananas have qualified for field studies and some are currently undergoing nutritional human trials.

c. Improving the nutritional value of bananas is a prime target.

d. Increasing banana fruit shelf life.

e. Enhancing bananas as a technologically functional food, for instance, producing banana fruit with increased levels of minerals and vitamins, especially precursors of certain vitamins.

The principal aim of function and processing technologies is to develop safe, technologically functional and nutritious food, especially the staples by the best available and productive technology. The book 'Banana Nutrition—Function and Processing Kinetics', is one covering trend topics on banana plant and fruit. Various processing methods converting this fruit into value-added and healthful products are highlighted. All sections contain recent advances in banana biotechnology that will appeal to farmers, plant breeders, food industry, investors and consumers. Also, the information contained will be beneficial for researchers to further harness this crop in controlling many diseases and especially non-communicable nutrition-related human illnesses. The book therefore contains substantial scientific information written in a form that is easy to understand.

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