Bamboo Shoot as a Superfood

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WORLD BAMBOO AMBASSADOR

Population explosion and Hunger

World population projected to reach 9.8 billion in 2050 shall be a threat to global food security

Annual production will need to rise about 3 billion tons from 2.1 billion today

Hunger and malnutrition persist and continue to rise in spite of food supply

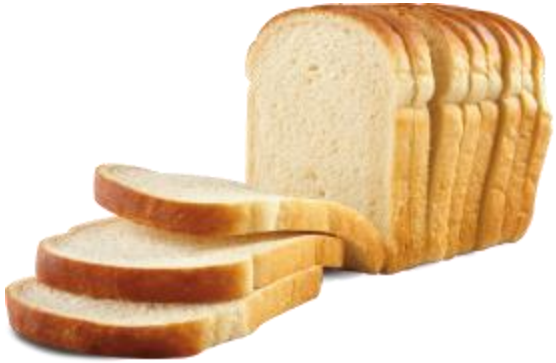
Policy makers consider the only solution is to increase the yield of staple crops and introduce underutilized plants in the food system.

Food assurance to every single individual is a Magna Carta for human development

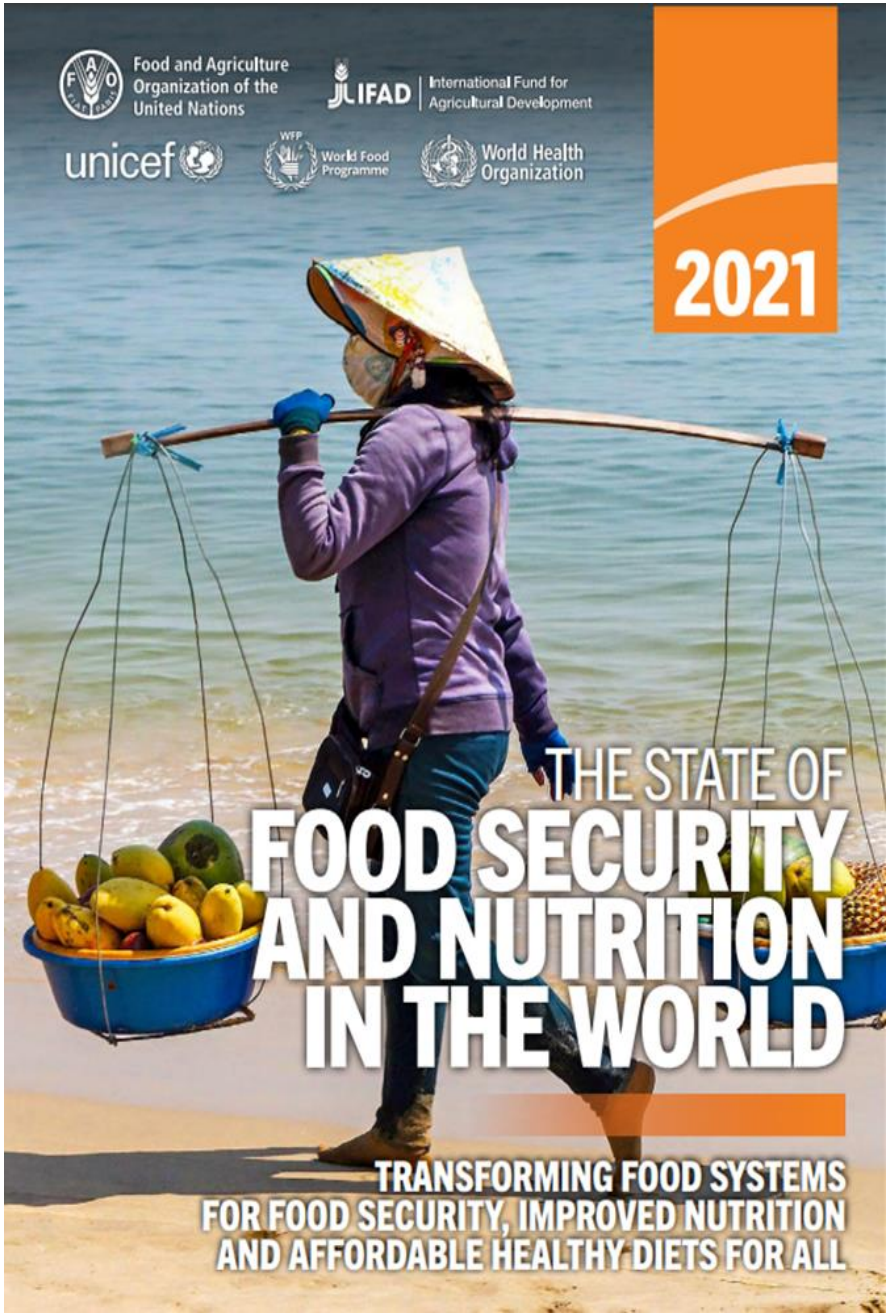
Malnutrition

Poor Health

Hidden Hunger



Currently, FAO estimates that around 800 million people suffer from food and nutrition insecurity, particularly in underprivileged population groups.



FAO, IFAD, UNICEF, WFP and WHO

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

IFAD INTERNATIONAL FUND FOR AGRICULTURAL DEVELOPMENT

WFP World Food Programme

WORLD HEALTH ORGANIZATION

The world is at a critical juncture

- Challenges to ending hunger, food insecurity and all forms of malnutrition
- Fragility of our food systems have been widely exposed by the pandemic
- Food systems have to be transformed
- Provide nutritious and affordable food for all
- Food diversification to enable more sustainable and resilient food systems

About 80000 plant species

Food

Fibre

Industrial

Medical

Edible plant species : 10000

More than 60% of human energy intake is supplied by

Rising population has increased food demand leading to specific intensification in agriculture practices leading to loss in crop diversity

Negative consequences are malnutrition and diet related diseases

Underutilized plants are rich in nutrients and health promoting bioactive compounds and diversifying the food chain to include these plants could be an effective tool to improve overall human nutrition and health

Bioversity International

Established in 1974

International Plant Genetic Resources Institute
IPGRI

1991 –International Plant Genetic Resources Institute

International Plant Genetic Resources Institute (IPGRI) is the world's largest international institute dedicated solely to the conservation and use of plant genetic resources.

Offices in more than 20 other countries worldwide.

Major Goal: Sustainable promotion of underutilized crops in order to contribute to economic development, well being of people as well as maintenance of genetic diversity and its associated local knowledge.

Specialized agency of the United Nations that leads international efforts to defeat hunger and improve Nutrition and Food security.

Headquarters: Rome, Italy, Established in October 1945, Quebec, Canada

FAO works in over 130 countries worldwide.

GOAL: To achieve food security for all and make sure that people have regular access to enough high quality food to lead an active and healthy life

Food and Agriculture Organization of the United Nations

Reduction in dietary diversification leads to serious effects on the nutrition and health of rural and urban populations

Malnutrition is a global public health problem having adverse effects on physical and mental development

Around 800 million people still suffer from Food and Nutritional insecurity

Providing safe, nutritious and wholesome food for undernourished population has been a major challenge

Expanding small-scale home gardening and underutilized indigenous crops can improve food security and rebuild food systems to be more resilient (FAO, 2020)

MALNUTRITION

A Hidden Hunger

What is hidden hunger?

Hidden hunger is a form of **undernutrition** that occurs when intake and absorption of vitamins and minerals are too low to sustain good health and development.

Nutrition for ZERO HUNGER

SUSTAINABLE DEVELOPMENT GOALS

End hunger, achieve food security and improved nutrition, maintain good health and promote sustainable agriculture

"Decent work and economic growth”

"Adopt urgent measures to combat climate change and its effects"

Making cities and human settlements inclusive, safe, resilient and sustainable"

Bamboo shoots: a nutritious healthy vegetable

A source of both food and medicine

Not only delicious but rich in nutrients and health promoting phytochemicals

Low in fat and sugars

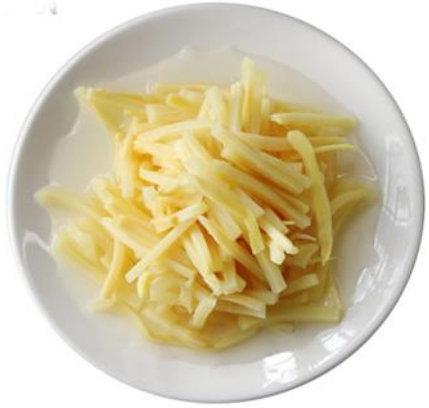
"King of Forest Vegetables."

Treasure dish - Tang Dynasty (618 to 907)
"there is no banquet without bamboo."

No longer "poor man's timber" but a "rich man's delicacy."

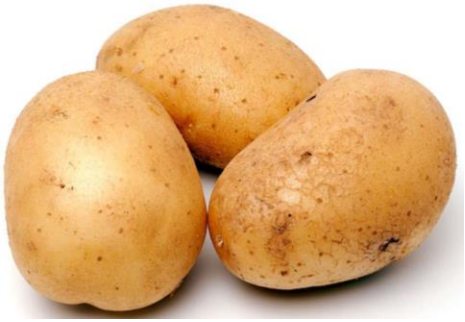
Nutritive value of bamboo shoots

- Juvenile shoots are
- Rich in proteins, carbohydrates, amino acids, minerals, vitamins
- High content of minerals like K, P, Mg, Na, Fe, Ca and Se.
- Rich in dietary fibers
- Low in fat and sugar.



Protein 1.8g/100g
Fiber 1.0g/100g

Protein 0.9g/100g
Fiber 1.2g/100g



Protein 1.6g/100g
Fiber 0.4g/100g

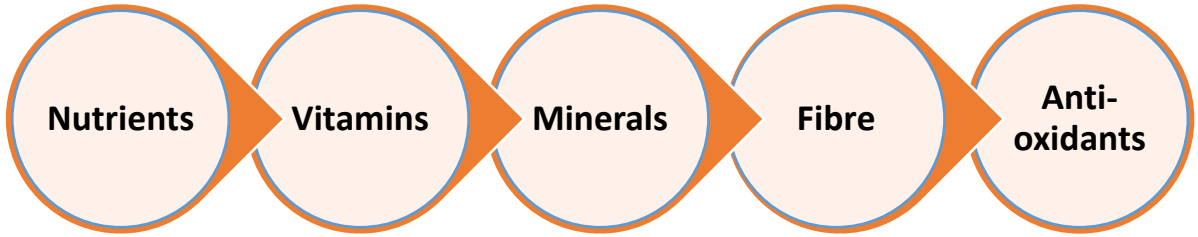
Protein 2.0g/100g
Fiber 2.0g/100g

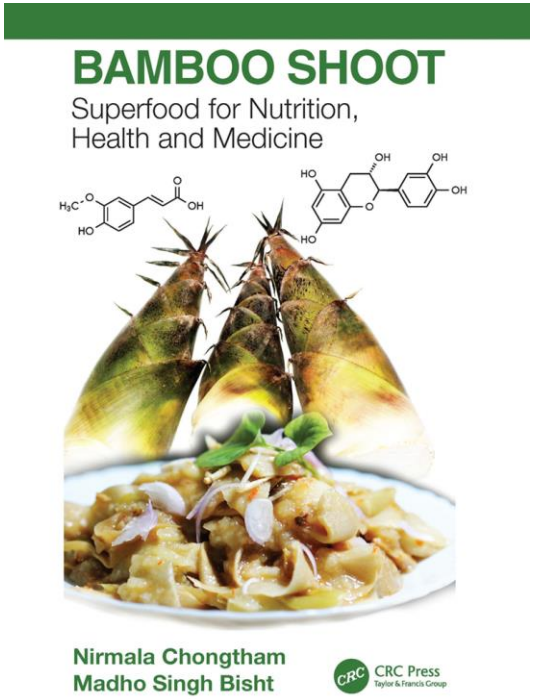
Protein: 3.92g/100g
Fiber : 3.90g/100g
Minerals : Pottasium, Iron, Silica
Vitamins: A, C and E
Bioactive compounds : Phenols and phytosterols

Bamboo shoots

Superfood

Bamboo shoots fulfil the most important criteria for being considered as a **Superfood**





Health beneficial properties include weight loss, improving digestion, lowering cholesterol level and preventing a number of diseases

Traditional knowledge has now been validated by scientific interventions

Bamboo shoots with all properties of a superfood can be used as a vegetable, food additive and as an ingredient for the pharmaceutical, nutraceutical and food industries.

Vitamins in Bamboo Shoots (mg/100g)

Species	Vitamin A	Vitamin C	Vitamin E
Bambusa balcooa	0.554 ± 0.001	2.63 ± 0.02	0.42 ± 0.03
B. nutans	0.561 ± 0.002	1.52 ± 0.03	0.49 ± 0.02
B. tulda	0.528 ± 0.001	1.42 ± 0.06	0.85 ± 0.13
B. vulgaris	0.539 ± 0.001	4.80 ± 0.10	0.52 ± 0.09
Dendrocalamus asper	0.553 ± 0.002	0.91 ± 0.13	0.95 ± 0.02
D. giganteus	0.514 ± 0.003	2.21 ± 0.02	0.56 ± 0.03
D. hamiltonii	0.542 ± 0.001	2.48 ± 0.07	0.68 ± 0.03
D. membranaceus	0.539 ± 0.002	1.83 ± 0.04	0.65 ± 0.03
Thyrsostachys siamensis	0.559 ± 0.001	2.80 ± 0.10	0.37 ± 0.06

Macro-Mineral Elements in Bamboo (mg/100g d.w.)

Species	K	P	Mg	Ca	S	Na	Cl	Si
Bambusa balcooa	4230	560	210	180	230	20	1220	150
B. bambos	5980	750	230	190	260	20	1530	130
B. nutans	5230	580	200	180	250	20	1230	160
B. tulda	5210	640	190	100	280	20	1680	120
Dendrocalamus giganteus	4590	540	190	210	270	40	590	120
D. hamiltonii	5230	560	200	150	220	40	870	190
D. membranaceus	6120	620	200	160	240	90	930	150
D. sikkimensis	5200	530	240	180	270	30	880	160
Melocanna baccifera	6480	620	300	210	340	30	1350	120
Phyllostachys mannii	6660	930	230	130	330	60	850	70

Micro-Mineral Elements in Bamboo (mg/100g d.w.)

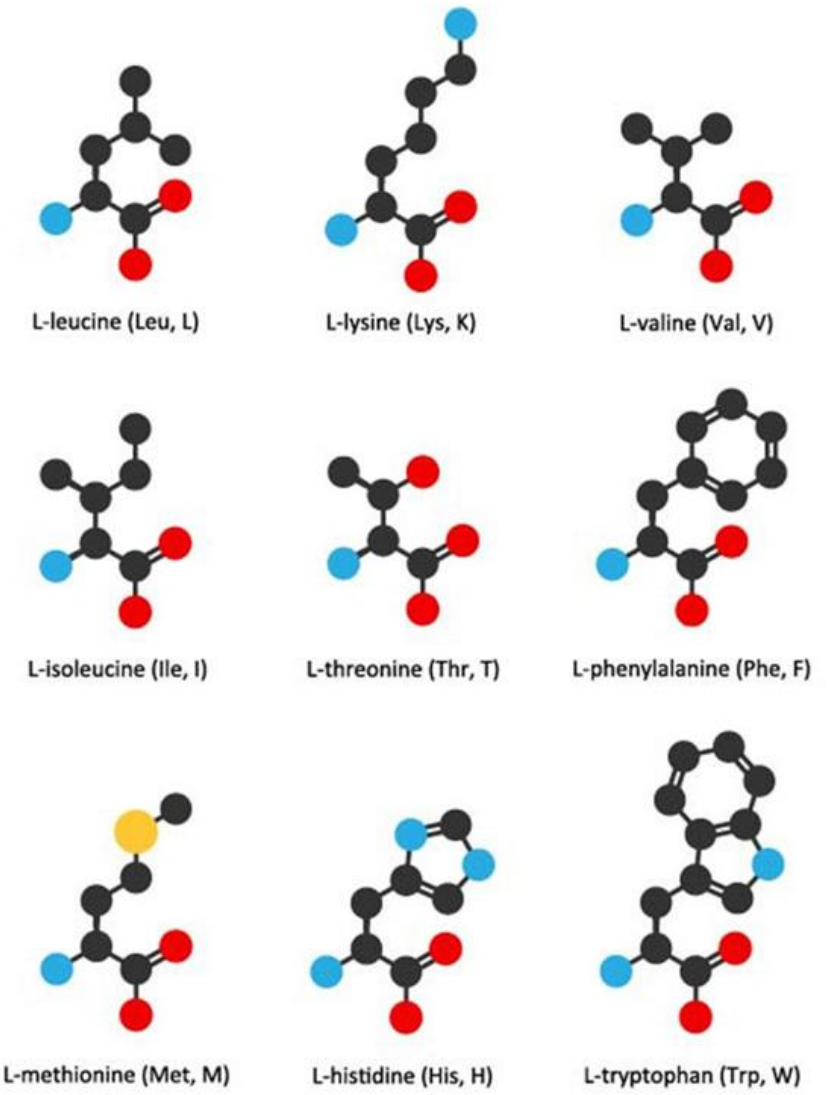
Species	Fe	Zn	Cu	Mn	Ni
Bambusa balcooa	8.2	6.8	2.6	2.5	0.9
B. bambos	8.0	10	2.5	3.6	0.7
B. nutans	8.8	9.5	1.9	9.7	0.8
B. tulda	7.0	7.7	2.4	2.5	0.7
Dendrocalamus giganteus	6.9	6.1	5.1	1.3	0.8
D. hamiltonii	7.4	6.8	2.6	1.2	0.7
D. membranaceus	6.8	8.5	2.2	1.5	0.9
D. sikkimensis	10	8.3	2.5	4.3	1.1
Melocanna baccifera	7.2	10	2.8	5.5	1.0
Phyllostachys mannii	9.1	10	2.6	9.0	0.8

Bamboo shoots contain all 9 essential amino acids

Amino acids are macronutrients in diet and prerequisites for protein synthesis and formation of secondary metabolites

Essential amino acids cannot be synthesized by the body

1. **Histidine**
2. **Isoleucine,**
3. **Leucine,**
4. **Lysine,**
5. **Methionine,**
6. **Phenylalanine,**
7. **Threonine,**
8. **Tryptophan**
9. **Valine.**



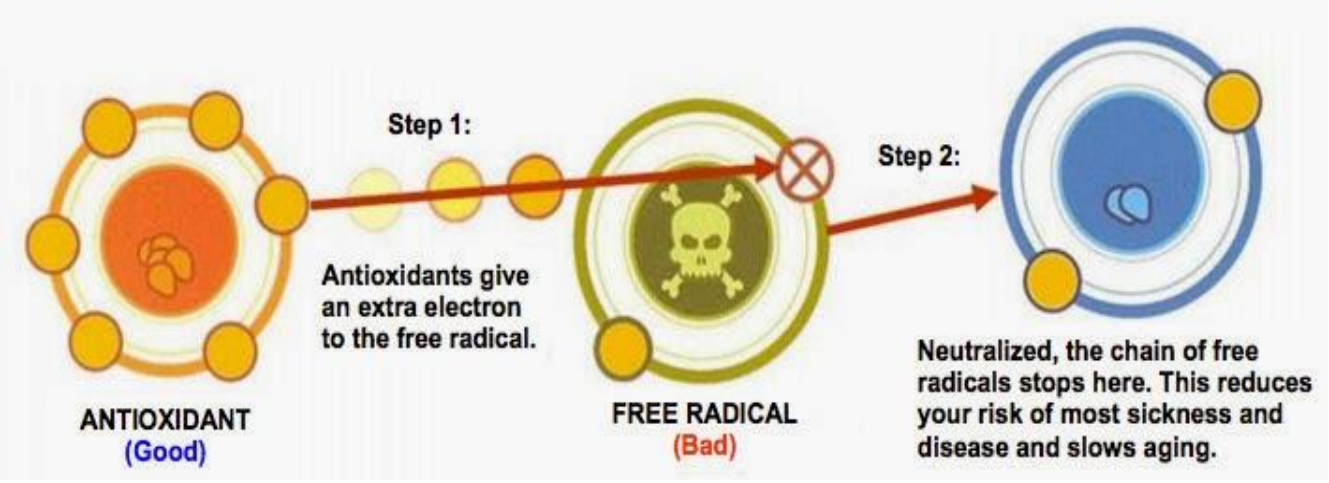
Antioxidants in Bamboo

Antioxidants are compounds which inhibit the oxidation of other molecules in our body and prevent the formation of free radicals

Promote cardiovascular health, inhibit growth of cancerous tumors, slow the aging process in the brain and nervous system and lessen the risk and severity of neurodegenerative disease

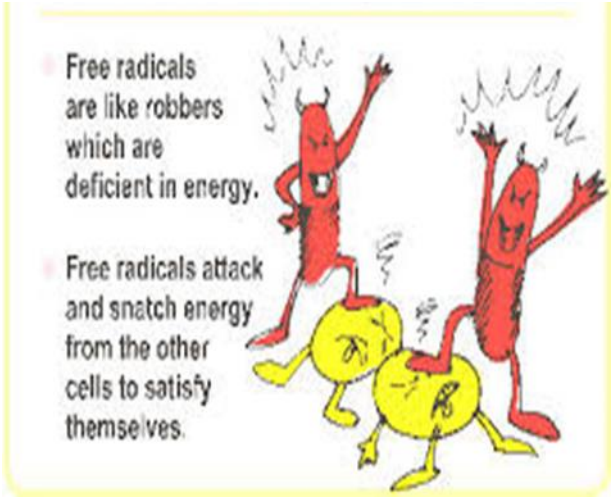
Dietary antioxidants in shoots are vitamin C, vitamin E, and phenols

Food and pharmaceutical industries: Used to prevent deterioration, rancidity and discoloration caused by oxidation during processing and storage



Free radicals are oxygen-containing molecules with an unpaired electron

They are highly reactive and easily react with other molecules



Prevent food rancidity & spoilage of medicine

Food

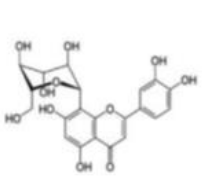
Prolong shelf-life

Pharmaceutical products

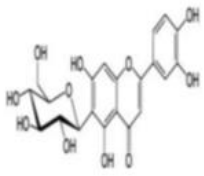
Enhance stability of therapeutic agents

Synthetic antioxidants have raised certain health issues

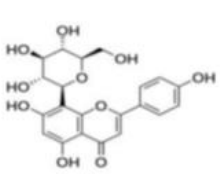
Search of natural antioxidants to replace synthetic ones



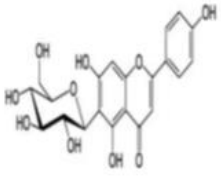
Orientin



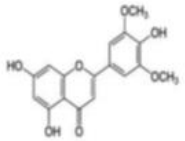
Isoorientin



Vitexin

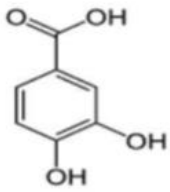


Homovitexin

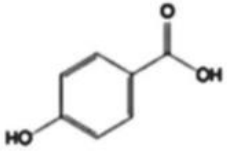


Tricin

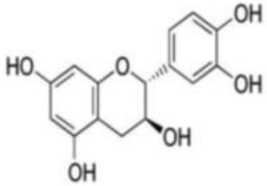
Flavanoids



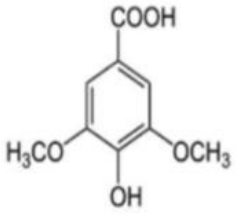
Protocatechuic acid



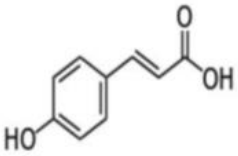
p-Hydroxybenzoic acid



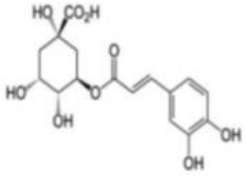
Catechin



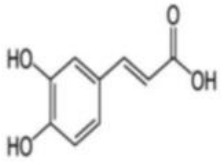
Syringic acid



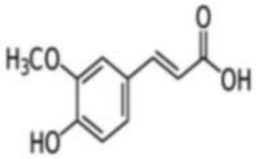
p-coumaric acid



Chlorogenic acid



Caffeic acid



Ferulic acid

Phenols

Mineral elements with antioxidant activities in bamboo shoots

Species	Selenium µg/100g	Zinc mg/100g	Copper mg/100g	Iron mg/100g	Manganese mg/100g
B. balcooa	-	-	-	1.02	-
B. pallida	-	-	-	1.11	-
B. polymorpha	-	-	-	1.53	-
B. tulda	0.4	0.72	0.44	3.19	0.70
D. hamiltonii	0.8	0.70	0.29	2.69	0.16
D. giganteus	-	-	-	1.06	-
D. strictus	-	-	-	2.917	-
M. bambusoides	-	-	-	0.879	-
Pl. amarus	-	5.379	2.454	18.642	-
P. aurea *	-	12.2-45.0	5.2-35.0	26.4-43.2	11.5-27.3
P. aureasulcata *	-	19.8-37.1	3.9-4.4	24.3-35.4	47.4-85.0
P. bissettii *	-	18.3-40.5	4.2-6.5	15.0-25.4	15.4-25.3
P. glauca *	-	15.8-30.1	4.8-5.6	20.3-31.8	13.5-17.8
P. nuda *	-	22.4-37.1	5.6-6.2	25.6-33.4	12.3-18.4
P. rubromarginata *	-	22.9-54.6	0.6-7.8	18.1-25.4	117.4-176.7

B = *Bambusa*; D = *Dendrocalamus*; M = *Melocanna*; Pl = *Pleoblastus*; P = *Phyllostachys* * µg/g

Functional Food and Nutraceutical

Bamboo shoots are ranked amongst the five most healthy food
(Institute of Geriatrics, World Health Organization)

Health Enhancing Properties of Bamboo Shoots

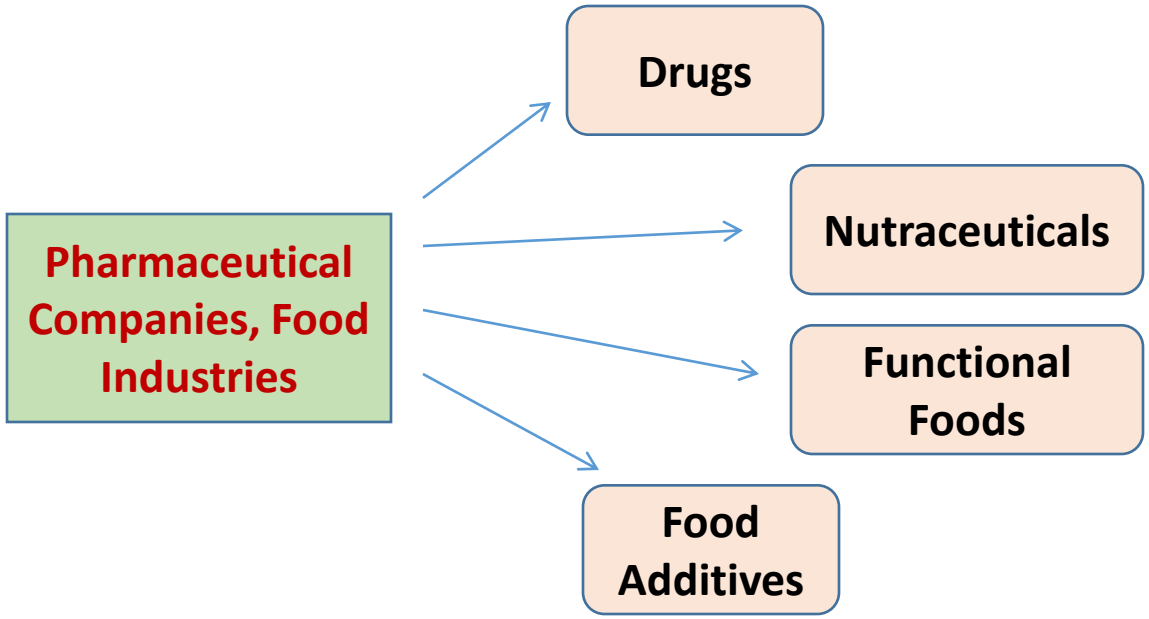
- **Rich in Nutrients**
- **High content of bioactive compounds**
- **Low in fat and calories**
- **Free from residual toxicity**

With their high nutritive value and bioactive compounds, bamboo shoots hold great promise for utilization as a functional food and nutraceuticals

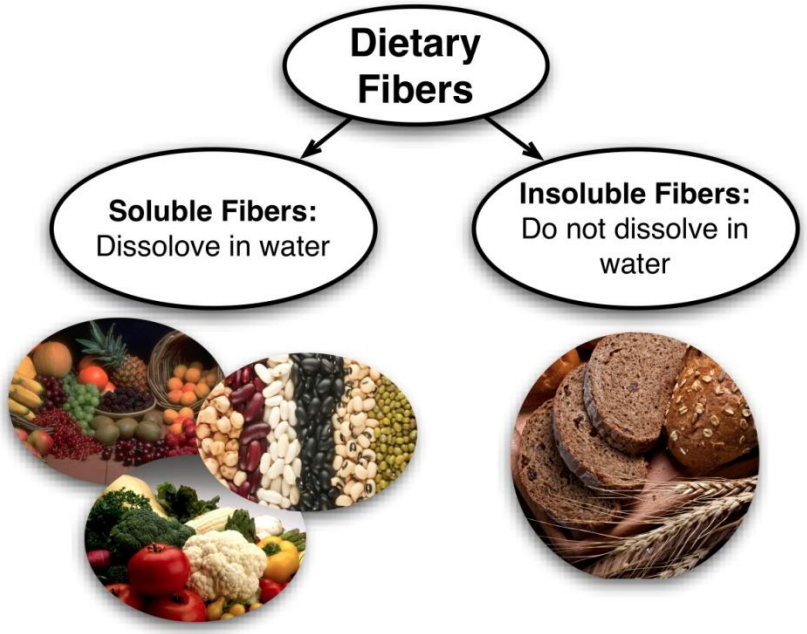
Bioactive compounds

Secondary metabolites known to elicit pharmacological and toxicological effects in humans and animals

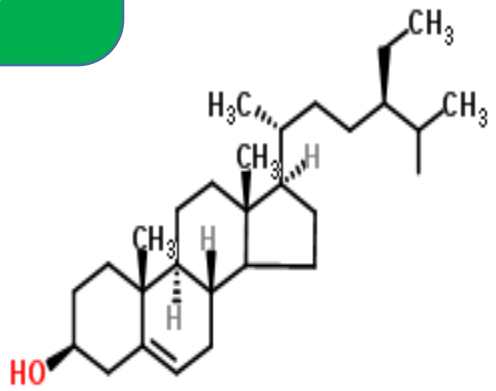
Extranutritional constituents in food occurring in small quantities that provide health benefits beyond the basic nutritional value of the product



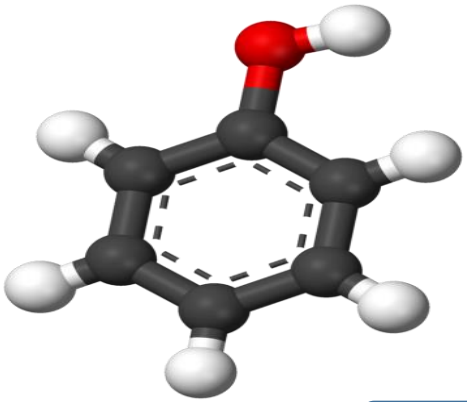
Health Promoting Bioactive compounds in Bamboos



Dietary fibers



Phytosterols



Phenols

Nutraceutical potentials of Bamboo

Cardiovascular diseases

Anticancer

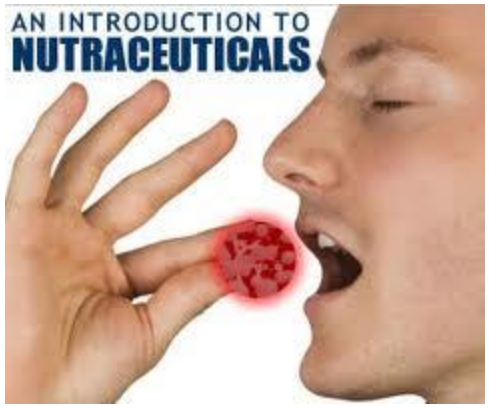
Antidiabetic

Antiinflammatory

Antiobesity

Antifatigue

Antimicrobial



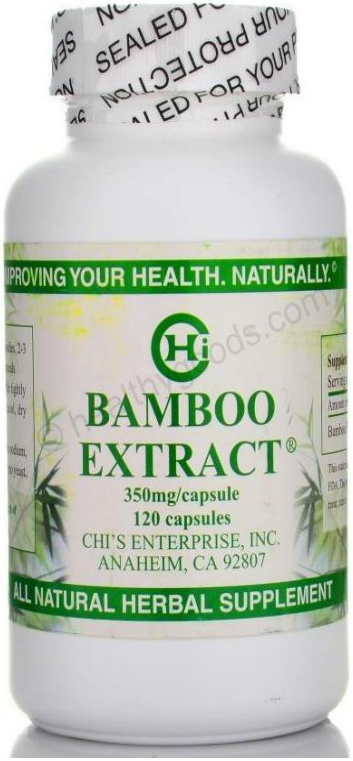
Derived from "Nutrition and "Pharmaceutical"

Dietary supplements that deliver a concentrated form of a
- bioactive agent from a food
- presented in a non-food matrix and
- used with the purpose of enhancing health in dosages that exceed those obtained from normal foods.

Products produced from food but sold in the medicinal form
- capsule, tablet, powder
- solution or potion

"A Nutraceutical a day may keep the doctor away"

Bamboo as a Nutraceutical



PHYTOSTEROLS

Bioactive components representing the major part of the nonsaponifiable fraction of lipids

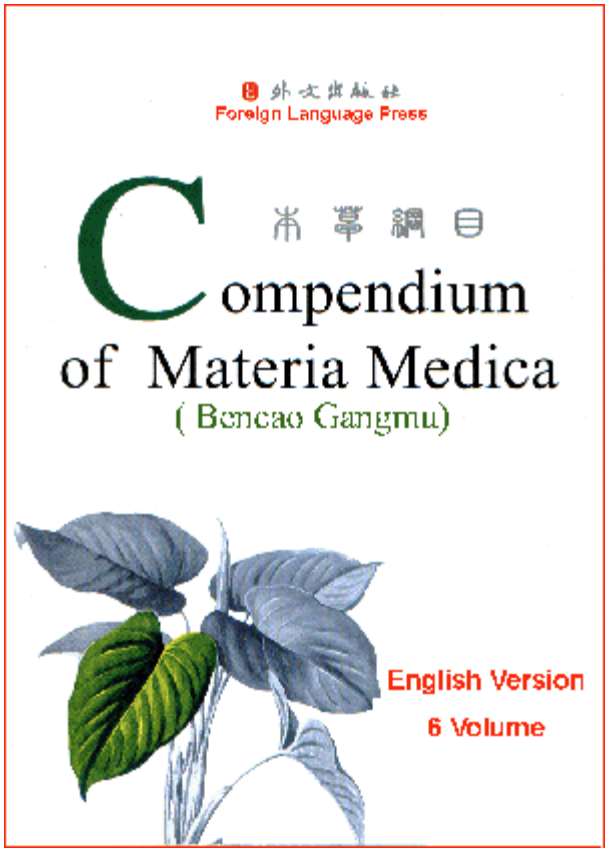
- Reduces or inhibits cholesterol absorption and synthesis
- Increases fecal excretion of neutral and acid sterols

Indicated to have anticancer properties

Precursors of pharmaceutically important steroidal products - corticosteroids, sex hormones and oral contraceptives

Bamboo shoots which are easily available in large amounts can be used as a source of phytosterols

Bamboo plays a significant role in traditional Asian medicine and therapeutic applications being mentioned around 500 AD



"It's slightly cold, sweet, nontoxic, and it quenches thirst, benefits the liquid circulatory system and can be served as a daily dish"

"Ben Chao Qui Zheng"

"Ben Jing Feng Yuan"

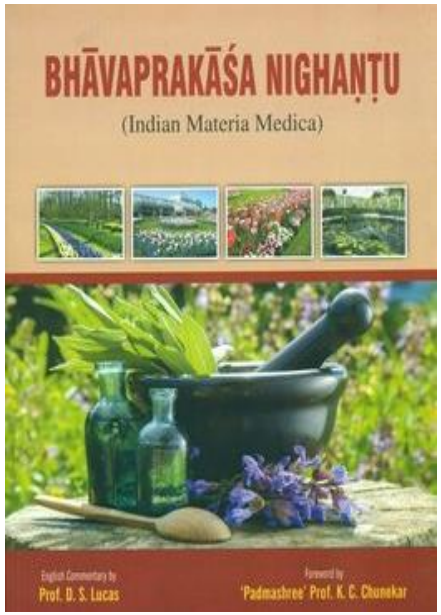
"Yao Pin Hua Yi"

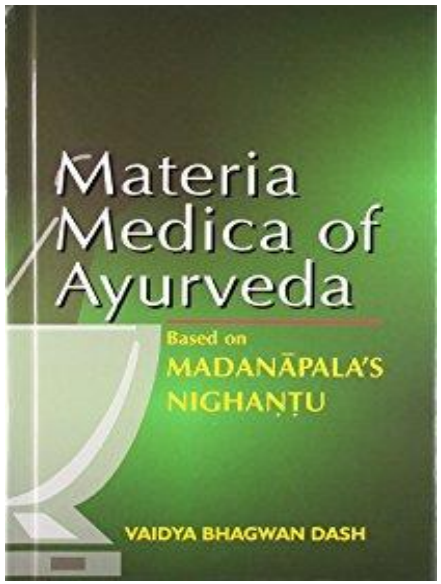
"Jing Yue",

Promote peristalsis of the of the stomach and intestine, Digestion
Relieve hypertension
Prevent cardiovascular disease and cancer
Promote the excretion of urine

Ming Dynasty (1368 to 1644)

Ayurveda – Traditional system of Indian medicine





Ancient Ayurvedic, Indo-Persian and Tibetan system of Medicine recommend bamboo and its products for treatment of various ailments

“Bamboo by nature is laxative, frigid seminal curative, palatable, bladder purifier and full of astringent juice. It splits cough, subsides bile and cures leprosy, flux, wounds and swellings”

Bamboo medicinal applications were first mentioned in India around 10,000 years

“Tabasheer” “Banslochan” “Bamboo mana” has been used since ancient times as a cooling tonic and aphrodisiac and in asthma, cough and other debilitating diseases.

It is a siliceous secretion found in the culms of bamboos.

In vivo animal studies

BALB/c Mice

Fresh shoots

Brine treated

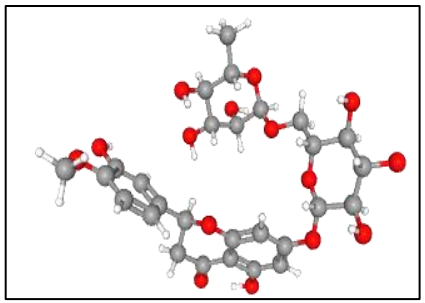
Boiled

Fermented

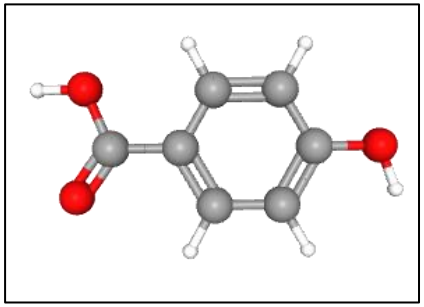
Anti-diabetic properties of bamboo

Sl. No	Species	Effect	Reference
1.	*Bambusa arundinacea*	Reduced sugar level, serum triglyceride level, and total cholesterol level, improved insulin secretion by β-cells	Menaria, 2016; Jayarambabu et al., 2021
2.	*B. tulda*	Reduced sugar level, serum triglyceride level, total cholesterol level; promote glucose uptake, inhibit gluconeogenesis in liver, enhance insulin secretion	Dey et al., 2018; Senthilkumar et al., 2011; Goyal et al., 2017
3.	*B. vulgaris*	Improved glucose absorption, reduce blood glucose level,	Haque et al., 2015; Usha and Middha, 2012
4.	*Chimnobambusa quadrangularis*	Increased glucose absorption capacity and inhibited α-amylase activity	Tang et al., 2022
5.	*Leleba oldhami*	Improved body weight loss and insulin loss due to diabetic condition	Zhang et al., 2016
6.	*Phyllostachys bambusoides*	Increased adipocyte volume and triglyceride	Gho et al., 2019
7.	*P. edulis*	Lowered hepatic fat content, inhibit hyperinsulemia, improve glucose tolerance, increased glucose utilization	Koide et al., 2011; Li and Zhang, 2016; Panee, 2009
8.	*Sasa borealis*	Reversed chronic endothelial toxicity, increase insulin secretion, stimulate glucose uptake, secrete proinflammatory cytokines	Choi et al., 2018; Ko et al., 2006; Yang et al., 2010

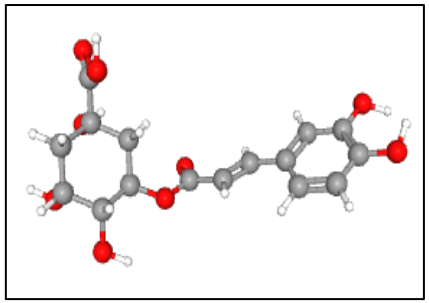
Bioactive compounds in bamboo that have anti-hyperglycemic properties



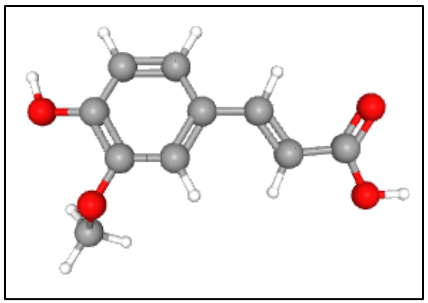
p-hydroxybenzoic acid



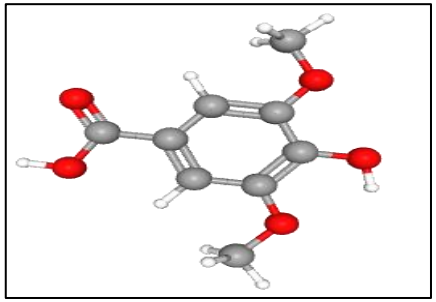
Chlorogenic acid



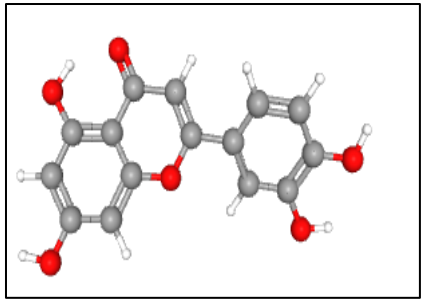
Hesperidin



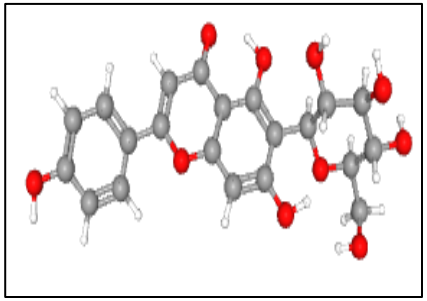
Ferulic acid



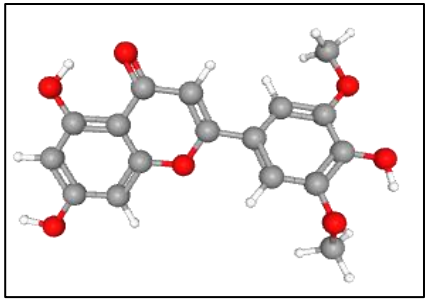
Syringic acid



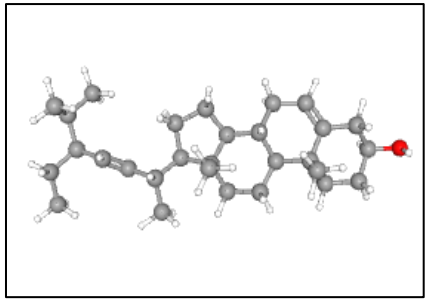
Luteolin



Isovitexin



Tricin

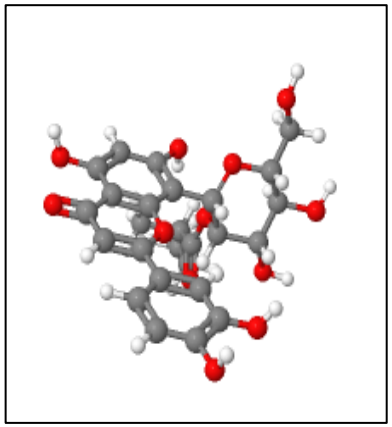


Stigmasterol

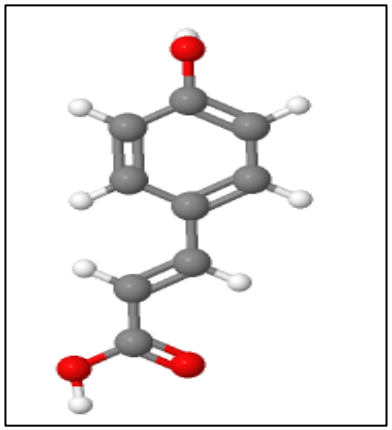
Wound healing properties of bamboo

S.No.	Species	Effect	Reference
1.	*Bambusa vulgaris*	Increased rate of wound contraction and enhanced epithelialisation	Davane and Nagoba, 2016
2.	*B. vulgaris*	Increased tissue regeneration and strength	Lodhi et al., 2016
3.	*B. vulgaris*	Improved collagen synthesis and increased mean blood vessel diameter	Ghanbarinasab et al., 2021
4.	*Dendrocalamus hamiltonii*	Decreased pro-inflammatory cytokines and increased collagen deposition, increased re-epithelialization and vasculogenesis	Singla et al., 2017
5.	*Phyllostachys edulis*	Improved wound closure and prevent inflammation in persistent inflammatory condition	Wedler et al., 2014

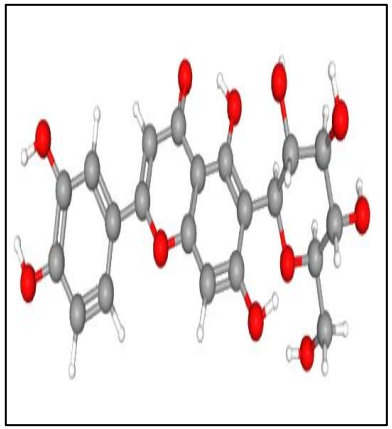
Bioactive compounds having wound healing properties



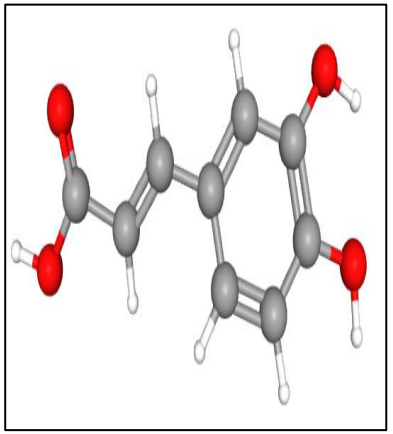
Orientin



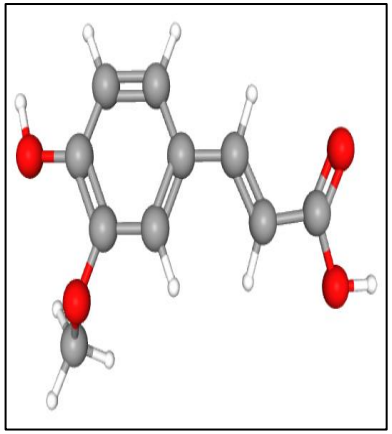
p-coumaric acid



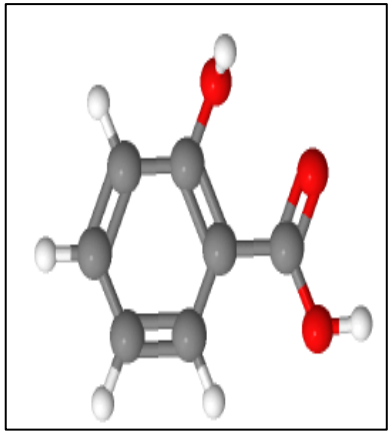
Isoorientin



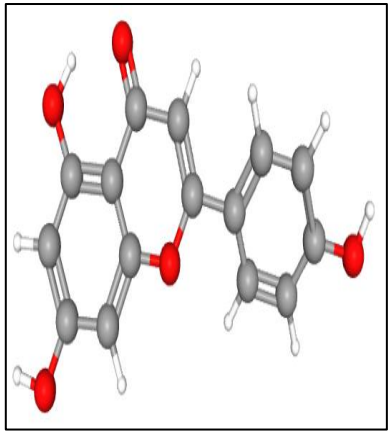
Caffeic acid



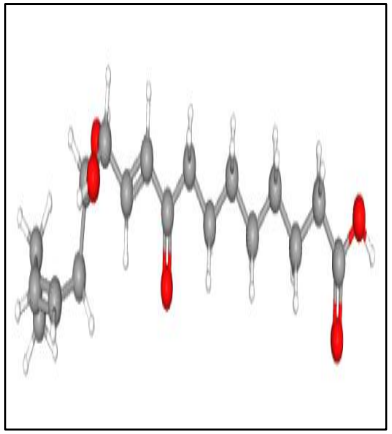
Ferulic acid



Salicylic acid

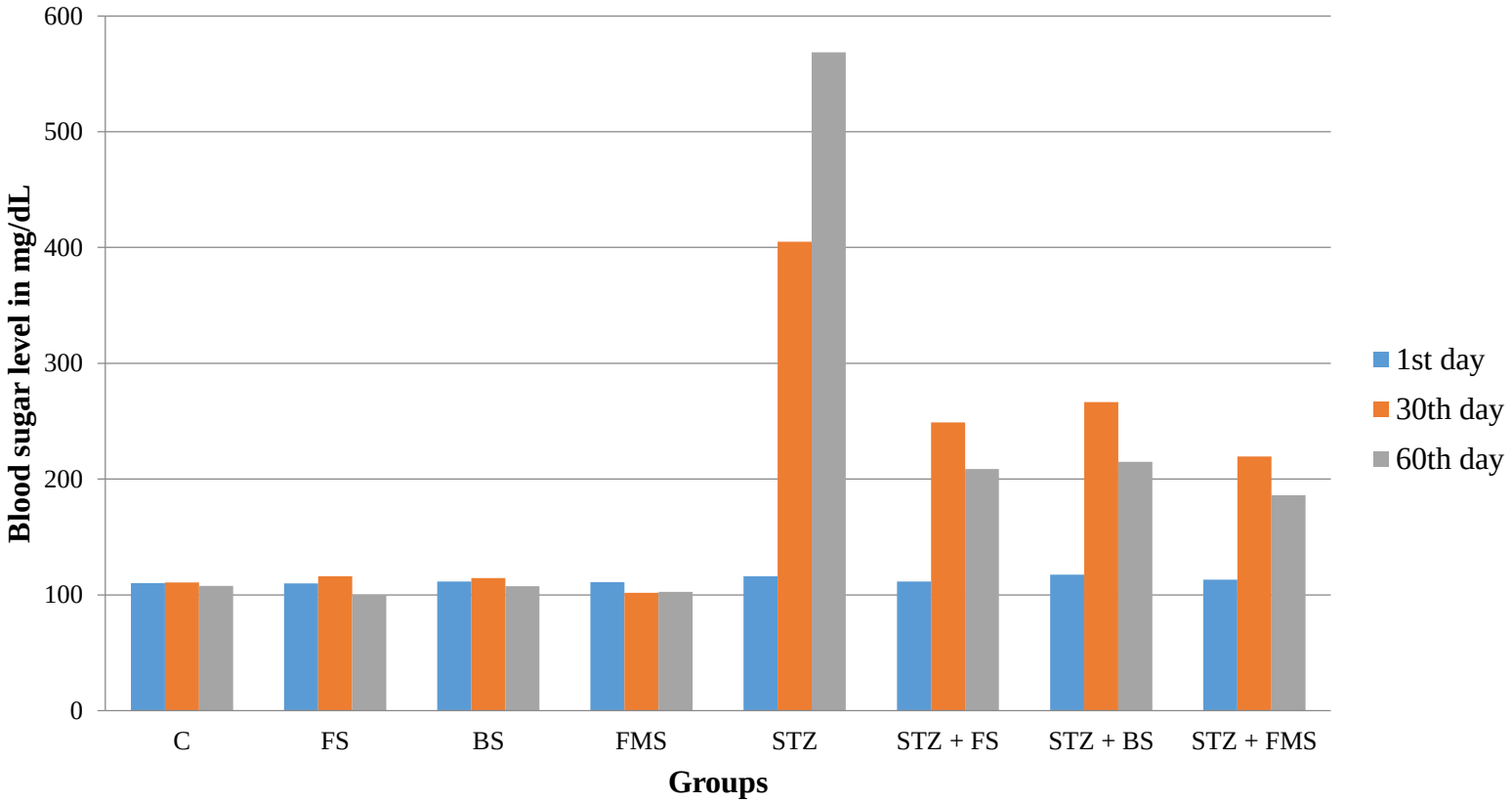


Apigenin



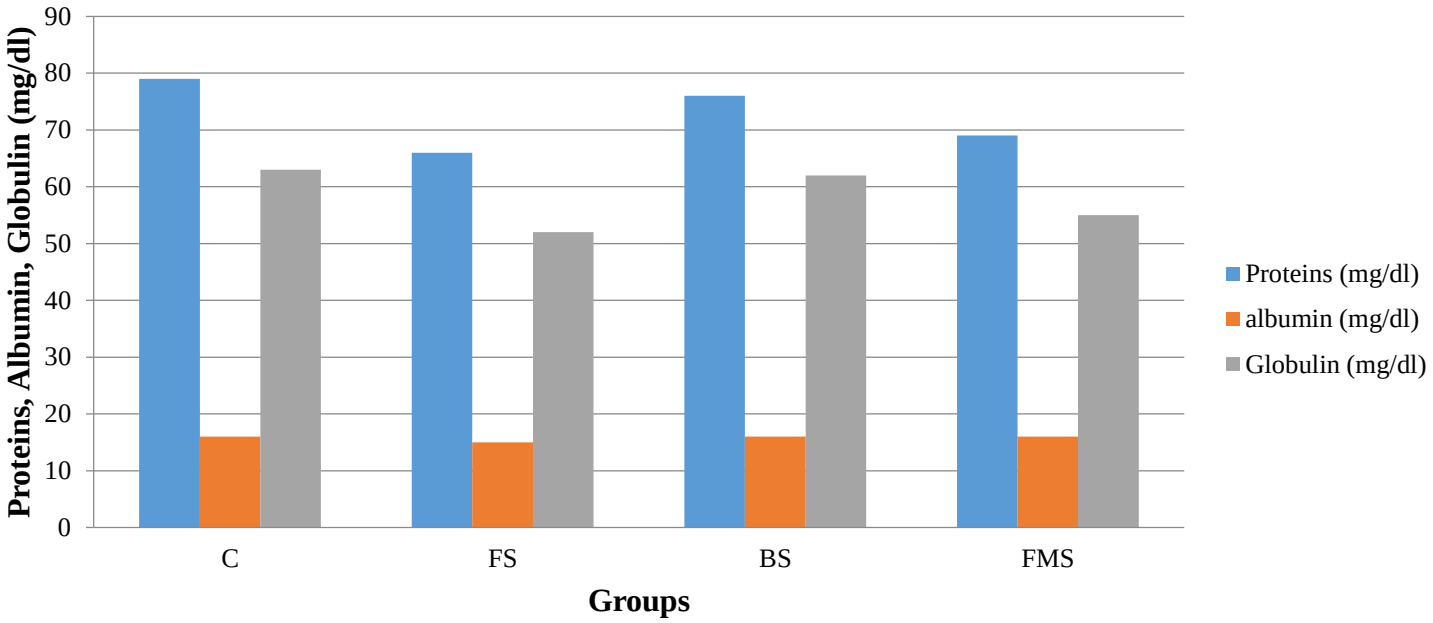
Oxo-dihydroxy-octadecadienoic acid

Effect of bamboo shoot in blood sugar level of mice



- Groups: **C**: Control; **FS**: Fresh shoot; **BS**: Boiled shoot; **FMS**: Fermented shoot; **STZ**: Streptozotocin

Effect of bamboo shoot on liver function



Estimations	C	FS	BS	FMS
Proteins (mg/dl)	79	66	76	69
Albumin (mg/dl)	16	15	16	16
Globulin (mg/dl)	63	52	62	55

C: Control; **FS**: Fresh shoot; **BS**: Boiled shoot; **FMS**: Fermented shoot

Effect of shoots on body and organ weight of Balb/c mice

Weight (g)	Control		Fresh shoots		Fermented shoots		Brine treated shoots		Boiled shoots	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Initial body weight	30	2.06	36	0.72	34	0.41	32	0.56	29	1.29
1st week	34	1.14	37	0.07	35	0.65	33	0.93	31	0.08
2nd week	35	0.98	38	0.72	37	0.05	37	0.55	35	1.51
3rd week	36	1.00	38	1.06	36	0.71	37	0.61	36	0.74
4th week	36	1.21	38	0.05	33	1.31	36	0.42	35	0.04
5th week	37	0.82	38	0.26	33	1.13	36	1.34	36	0.68
6th week	**37**	1.03	37	0.08	**32**	2.07	36	0.90	36	0.29
Liver weight	1.37	0.21	1.42	0.17	0.948	0.09	1.50	0.14	1.17	0.23
Kidney weight	0.247	0.04	0.295	0.03	0.228	0.05	0.270	0.06	0.269	0.04

Effect of fresh and processed shoot extract on glucose, lipid profile and lipid peroxidation level

Parameter	Group I		Group II		Group III		Group IV		Group V	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Glucose (mg/dl)	68	2.92	76	2.35	107	2.24	79	3.85	84	2.54
Lipid profile (mg/dl)										
Total cholesterol	118	3.67	106	4.25	82	3.22	100	1.13	97	2.23
HDL	90	0.94	94	0.53	97	1.13	93	1.33	91	0.61
LDL	**21**	3.44	16	1.52	**8**	0.74	13	2.84	10	2.73
Triglycerides	**228**	0.81	131	1.35	**119**	1.87	211	3.84	176	1.45
MDA (nmoles /min/mg protein)	**3.19**	0.12	0.897	0.06	**2.63**	0.11	1.09	0.21	1.56	0.22

Values are expressed as mean ± SD (N = 5);

Group I: Control, Group II: Fresh shoots; Group III: Fermented shoots; Group IV: Brine treated shoots; Group V: Boiled shoots

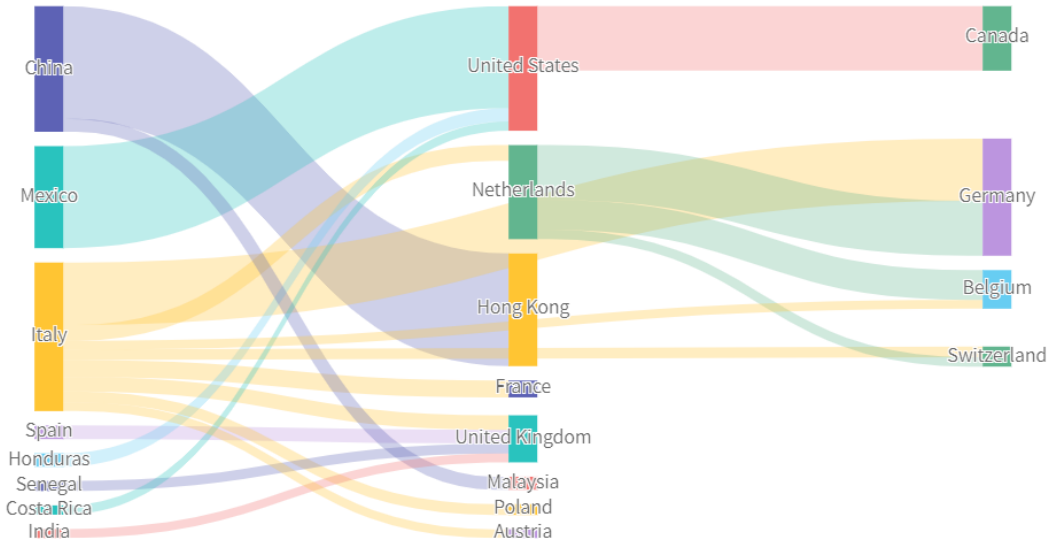
Global perspective of Bamboo shoots

China is the top exporter of bamboo shoots, accounting for 87% of the entire export market

Japan, USA and EU are the topmost importing countries, collectively making up around 95% of the total global import.

The top export flow in 2020 was from China to Hong Kong, with an export value of USD 261.64M.

Trade Flow	Export Value
China to Hong Kong	$261.64M
Mexico to United States	$236.96M
United States to Canada	$149.90M
Italy to Germany	$144.76M
Netherlands to Germany	$127.35M
Netherlands to Belgium	$69.22M
Italy to France	$39.20M
Italy to Netherlands	$36.84M
India to UK	$20.84M



Source-https://www.tridge.com/intelligences/bamboo-shoots/export

Traditional bamboo shoot consumption

Consumption of bamboo shoot is mainly concentrated in Asian countries but has been popularized of Chinese and Thai restaurants worldwide

In India, it is though most popular in North East regions, it is also a part of the traditional cuisine of Odisha, Karnataka, Kerala and Andaman and Nicobar

Fresh crispy and crunchy shoots are used to make soups, salads, spring rolls, stews and stir fried dishes

Processed forms – Dried, soaked, fermented, salted and canned

Indian cuisines

Ngakra-soijin-thongba

Fermented bamboo shoots cooked with fish, oil and spices.

Itting-oying

Fresh bamboo shoots cut into small pieces and boiled and prepared with vegetable, chicken or pork

Rawtuai- kan

Shoots fried in oil and spices with meat or vegetables

Rawtuai-bai

Fresh shoots of bamboo chopped, soaked in water and boiled with some rice, vegetable with a pinch of sodium- bicarbonate

International cuisines

Masak-lemak-rebung (Malaysia)

Bamboo shoot with coconut milk and other vegetables

Chilpozo (Mexico)

Bamboo shoots with pork and mushroom

Guinisang labong (Philippines)

Bamboo shoots sauted with raisins and chilli

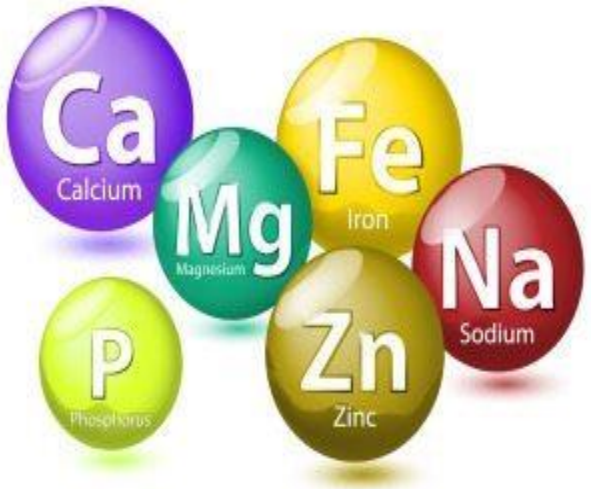
International Cuisines

Mexico

Equador

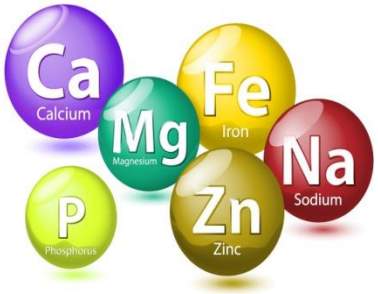
Costa Rica

Brazil



Bamboo shoots with high nutrient content and bioactive compounds are potential ingredients for food fortification and pharmaceuticals

Food to Food Fortification with Bamboo shoots

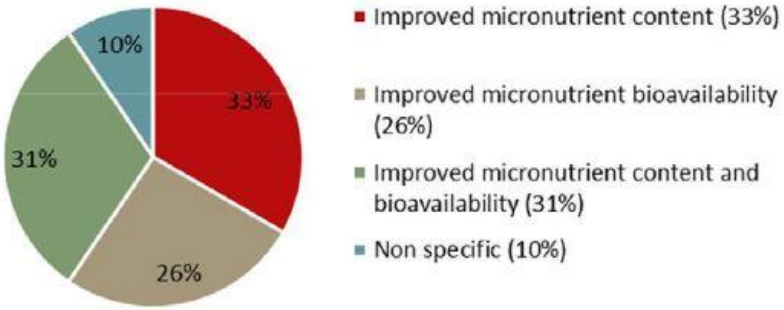


Fortification is adding vitamins and minerals to staple **foods** to prevent nutritional deficiencies.

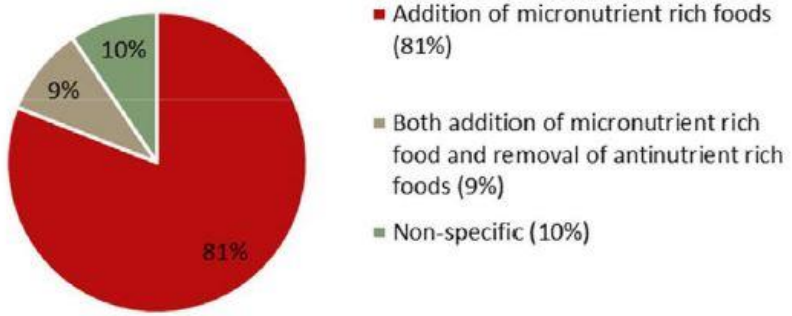
Food-to-food fortification (FtFF): an emerging component of food-based strategies, where micronutrient-dense foods are added to food recipes and importantly also food formulations at a commercial level to increase their micronutrient quality

Promote the production, access, and intake of micronutrient rich foods with the aim of enhancing the content and/or bioavailability of target nutrients, especially micronutrients

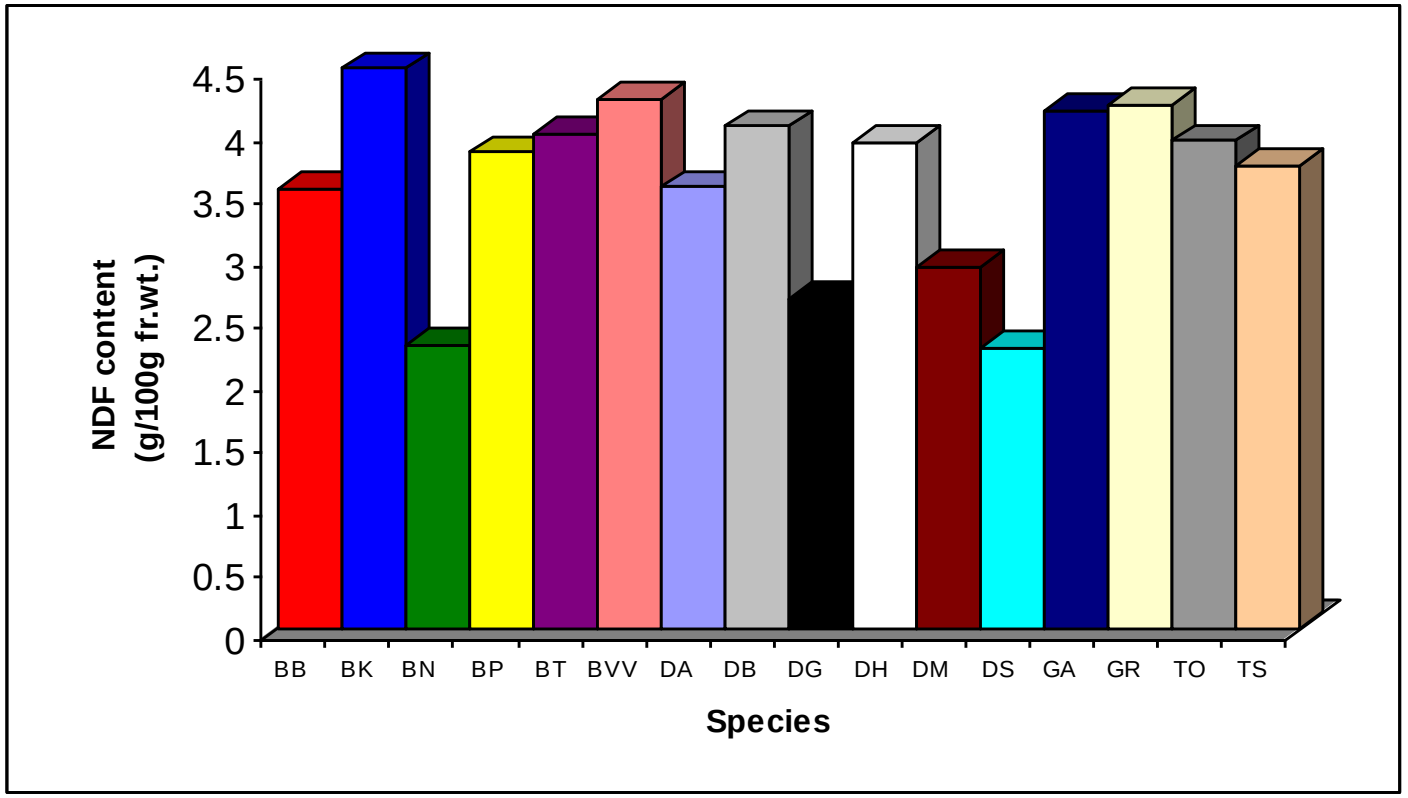
c Objective of FtFF



d Technique of FtFF

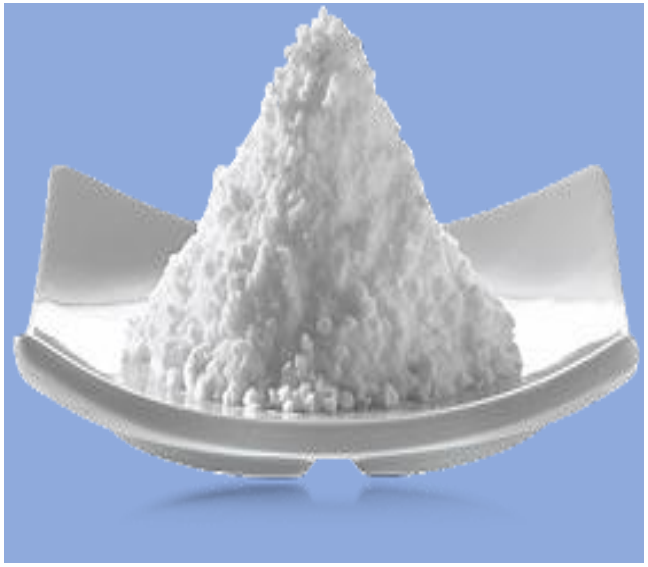


Dietary fiber content in juvenile shoots



SANACEL® bamboo

Nutritional value combined with beneficial technological properties



SANACEL® bamboo are insoluble dietary fibres useful for the improvement of the technological and nutritional properties of a Product

Fibers regulate the intestinal flora and support the human digestion.

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InterFiber™
GET INSPIRED, NATURALLY

(CFF Corp., Chestertown, Md USA)

Unicell Bamboo Fiber BF

Natural insoluble bamboo fibers obtained from the fiber rich parts of mature bamboo plants.

They combine the strength of bamboo with the benefits of dietary fiber to provide a unique natural fiber for many food applications.

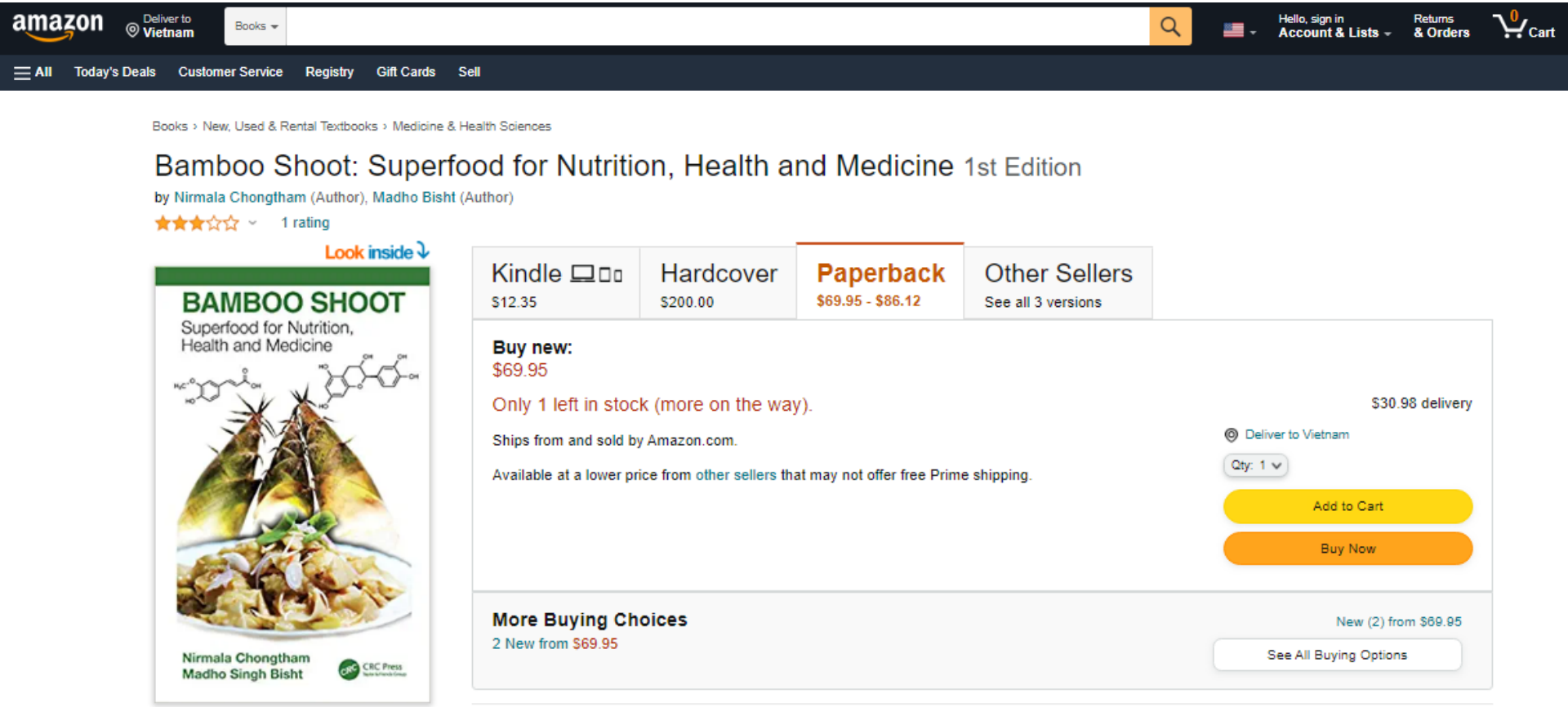
Extensively used to increase the freshness of meat and fish products as well as to increase dough yield in baked goods.

It is also used in powdered mixes and beverages

Application of bamboo fiber in the food industry

Food items	Benefit
Bakery Products Fragile dry bakery products like pretzels, ice cream cones and cookies, cakes, wafers, baked and fried tortilla chips. Noncaloric health bars.	Improves dough yield and consistency due to water binding capacity. Decrease of product breakage or crumbling; controls moisture loss Fiber enrichment health nutrition bars.
Dairy products Milk, yogurt, ice cream, shredded cheeses.	Noncaloric fiber enrichment. Viscosity and consistency improvement, stabilizer. Creamy mouth-feel.
Meat and aquatic products	Excellent water retention capacity. Texture improvement and binding. Longer freshness and less fat absorption in product
Health beverages	Noncaloric fiber enrichment. Viscosity and consistency improvement, stabilizer Creamy mouth-feel.
Miscellanous Sauces, dressings, juices, ketchup, mustard, low-calorie dressings, pasta , nuggets	Noncaloric fiber enrichment. Viscosity and consistency improvement, stabilizer Creamy mouth-feel.

https://www.amazon.com/Bamboo-Shoot-Superfood-Nutrition-Medicine/dp/0367467410



Compilation of 20 Years of Research

Special thanks

Ned Jaquith
FOUNDATION

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Bamboo Shoot: Food & Medicine

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Introduction

Bamboo is an enduring plant blessed with a plethora of functional components that make it incredibly useful for the development of multiple products especially the young tender shoots are considered as superfood. It has served as food and medicine since ancient times and commercially available in the markets of different countries as canned and fermented shoots, pickle, shoot powder, bamboo juice and water, beverages, and bamboo shoot fortified food products. The young shoots are rich in nutrients such as proteins, carbohydrates, minerals, vitamins and bioactive compounds. Consumption of shoots is gaining popularity worldwide due to its nutritive value and health benefits (Table 1; Fig. 1 & Fig. 4)). The health benefits of the young shoots are attributed to the presence of bioactive compounds mainly phenols, phytosterols, dietary fibers and minerals like potassium and silica which play a vital role in health promotion and providing protection against, any chronic and degenerative diseases (Fig2.

Fig. 1 Bamboo shoot

Health enhancing properties of bamboo shoots

- *Rich in nutrients: Proteins, Carbohydrates, Amino acids, Minerals, and Vitamins.*
- *Good profile of minerals: Ka, Ca, P, Fe, Mg and Se.*
- *High content of dietary fiber.*
- *Rich in phenols that have antioxidant properties.*
- *High phytosterol content.*
- *Low Fat and Sugar.*

Fig. 2 Phenolic compounds isolated from bamboo shoot

Fig. 3 Phytosterols isolated from bamboo shoot

Table. 1 Traditional bamboo shoot dishes of different countries

Country	Local name of bamboo dish
India	*Khorisa, Tuaithur, Byapu, Papu sududanji, Usoi-Ooti, Usoi-kangsu, Soibum thongba, Soibum eronba, Tenga, Lung-seij, Jhur, Jingtah, Rawtui-bai, Rhuchak, Veyen, Handua, Pu-erh, Sabji, Mia-gudhog*
China	*Ulanzi*
Japan	*Menma, Takenoko gohan, Takenoko-kagamini*
Thailand	*Ma khua proh, Dom jud naomi, Naw-mai-dong, Kaeng kae, Naw-mai-moo-nam*
Philippines	*Ginataang labong, Diendeng na labong*
Indonesia	*Gulai rebung, Sayur ladeh, Lumpia*
Vietnam	*Sup mang cua, Canh mang*
Korea	*Jooksun*
Mexico	*Chilpoza*
Colombia	*Huevos-revueltos-con-brotes-de-bambu*
Nepal and Bhutan	*Alu tama, Mesu*

Reference: Santosh, O., Bajwa, H. K., Bisht, M. S., & Nirmala, C. (2021). Application of Bamboo in the Food and Pharmaceutical Industry in Biotechnological Advances in Bamboo: The "Green Gold" on the Earth, Ahmad, Zishan, Ding, Yulong, Shahzad, Anwar (Eds.). Springer, Singapore, Springer Nature Singapore Pte Ltd. 2021, ISBN 978-981-16-1310-4

Soibum eronba, India

Usoi-Ooti, India

Takenoko-kagamini, Japan

Naw-mai-moo-nam, Thailand

Ginataang-labong, Philippines

Canh măng, Vietnam

Chilpozo, Mexico

Huevos-revueltos-con-brotes-de-bambu, Colombia

Fig. 4 Bamboo shoot recipes of different countries (Source: Nirmala and Bisht 2021)

Table. 2 Health benefits of bamboo shoots

Bamboo shoots are a rich source of bioactive compounds with various dietary fiber components, phytosterols which is a precursor of many pharmaceutical steroids and phenols that act as free radical terminators, metal chelators, and singlet oxygen quenchers. There are several health benefits of phytosterols such as anticancer, cholesterol-lowering, anti-inflammatory, and anti-atherogenicity properties (Table. 2 & Table. 3). In the pharmaceutical and nutraceutical industry bamboo shoot can be a good source of phytosterol which is used for manufacturing steroids. A high amount of dietary fiber in bamboo shoot is associated with several health benefits that include reducing the risk of cardiovascular diseases, hypertension, obesity, cancer, and certain gastrointestinal disorders. It also controls or lowers the level of sugar in the blood, promotes regularity and prevents constipation, lowers blood cholesterol levels, and helps in weight control.

Sl.	Benefits
1.	Helps in Losing Weight
2.	Heart Health
3.	Controls Cholesterol
4.	Fights Cancer
5.	Strengthens the Immune System
6.	Enhance digestive system
7.	Anti-Inflammatory Properties
8.	Prevents Stomach Disorders
9.	Anti-microbial Properties
10.	Lowers Blood Pressure

Table. 3 Nutraceutical Products from Bamboo

No.	Product Name	Health benefits
1	Biotin Bamboo Extract	Promotes and maintains skin tissue
2	Swanson Bamboo Extract	Silica supplement for hair, skin and nails.
3	BioFinest Bamboo Extract	Weight control, improve digestion, boost immune system
4	NutriStart Bamboo Silica	Skin, ligaments, tendons and bones supplement
5	Boo Bamboo Suncare Natural Sunscreen	Protection frombroad spectrum UVA / UVB.
6	Enerex Bamboo Silica	Anti-aging, strengthens arteries, joints, nail, hair, skin and bones.
7	Silicon Mix Bamboo Extract	Hair and skin supplement
8	Shudhanta Herbal Bamboo Capsule	Aids Digestion, Immune Booster, Antibiotic and Anti-Inflammatory
9	Herbal Papaya Bamboo Leaf Extract Liquid	Improving blood circulation.
10	Bamboo Nutra	Anti-ageing, Anti-obesity
11	Bamboo flex	Anti-inflammatory, remineralization and development of bone structure
12	Bonusan forte	Anti-fatigue, supports energy metabolism, good for nervous system
13	Guozen bamboo leaf essence	Purifies blood and strengthens bones
14	Hawlik Cappillary capsules	Improves hair health
15	Lambert silica capsules	Contributes to structure and resilience of connective tissue, synthesis of bone collagen and cartilage
16	Sanacel	Improves digestion
17	Silice de Bambou	Prevents premature ageing, preserves skin youthfulness, promotes strong hair, healthy bones and teeth
18	Solary bamboo capsules	Stimulates collagen synthesis in bone and connective tissue

Reference: Santosh et al. 2021

Conclusions

Bamboo shoots are gaining worldwide importance as health food being a rich repository of nutrients and health-promoting bioactive compounds. It has always been an herbal component of the traditional medicinal system since ancient times for the treatment of several diseases. Scientific reports of nutrient richness and proven health benefits have led to the emergence of bamboo as a highly potent ingredient for the development of novel functional foods and pharmaceutical products. Thus, bamboo shoots with a good source of nutrients and natural bioactive compounds are aptly considered as a superfood and can play a vital role in the food and pharmaceutical industries.

Acknowledgements

The Authors acknowledge Ned Jaquith Foundation, USA for providing financial assistance to conduct this research work.