



12th
NSHPSN 2026

12th NATIONAL SUMMIT OF HEALTH AND POPULATION SCIENTISTS IN NEPAL

“Health Research Governance for Evidence Informed Decision Making and Implementation in Nepal”

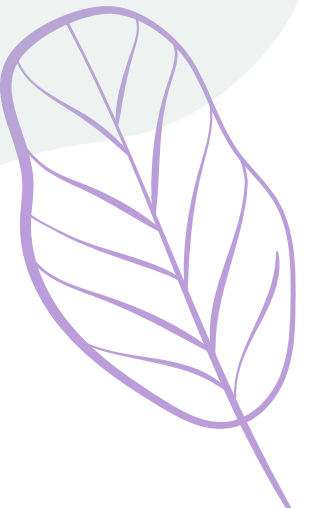
10th-12th April 2026, Kathmandu, Nepal

Organized by:
Government of Nepal
Nepal Health Research Council (NHRC)

“Microbial Biotransformation of Plant-Derived Bioactive Compounds: A Probiotic Strategy for Functional Foods and Improved Health”



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BIOACTIVE INGREDIENTS FROM PLANTS

Plants and their constituents have a key position in the progression of **modern studies** and **knowledge on biological activity or active substance**.



What are Bioactive Phytochemicals?

“Bioactive phytochemicals”

Naturally occurring chemical compounds found in plants that can have a positive impact on human health.

“Bioactive”

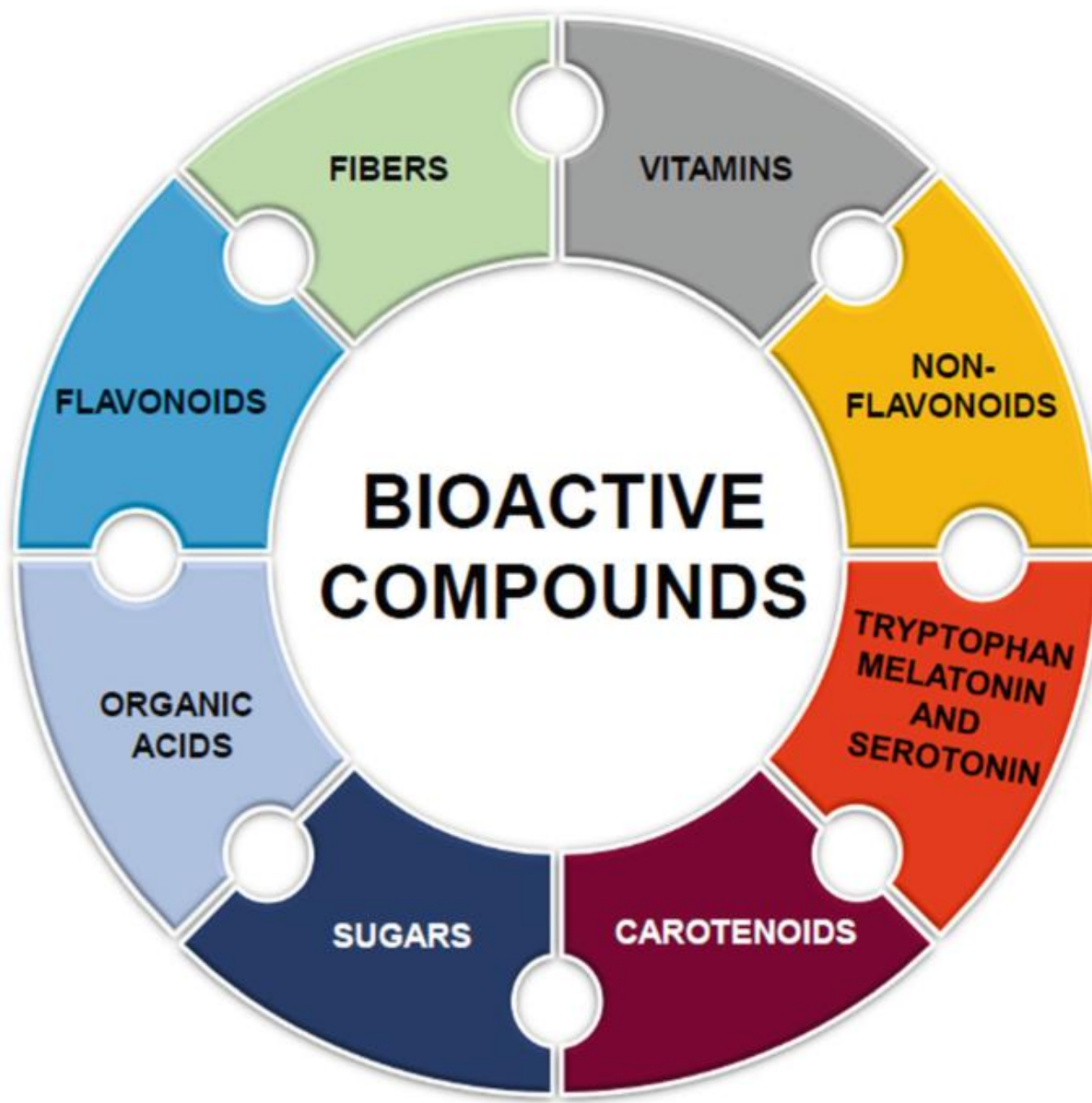
Interact with biological systems in the body and potentially provide health benefits.

Bioactive phytochemicals are not considered essential nutrients like vitamins and minerals, **Contribute to the overall health-promoting properties of a diet rich in fruits, vegetables, and other plant-based foods.**

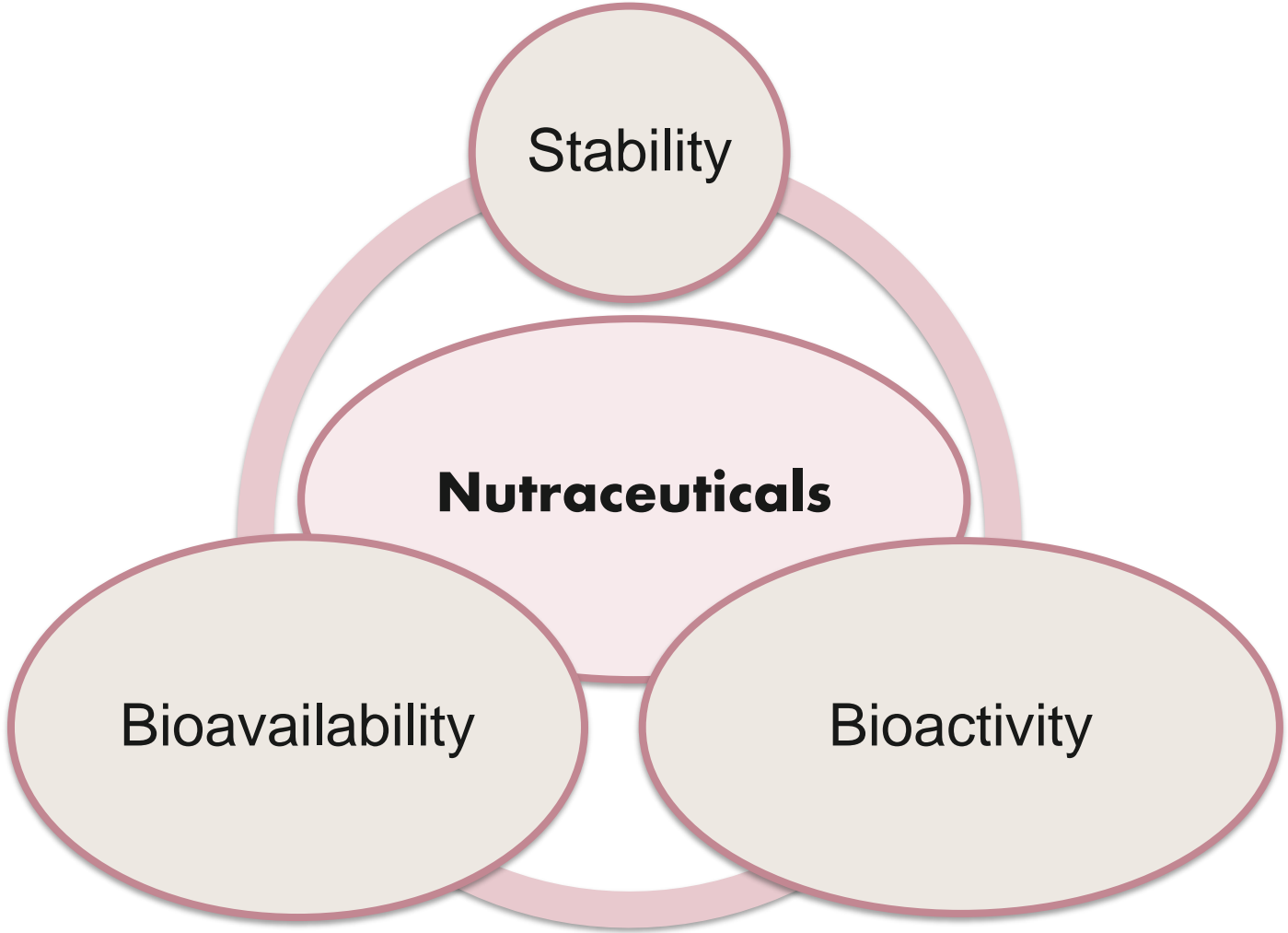


BIOACTIVE COMPOUNDS





Nutraceuticals products in Preventing diseases depends on



Why to Study Bioactive Phytochemicals?

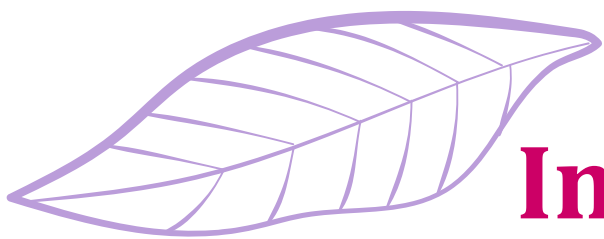


Sr. No.	Phytochemicals	Sources	Health benefits	References
1	Carotenoids	Carrots, tomatoes, parsley, orange and green leafy vegetables, chenopods, fenugreek, spinach, cabbage, radish, turnips	Antioxidants protect against uterine, prostate, colorectal, lung, and digestive tract cancers	Agarwal and Rao (2000); Britton (1995); Johnson (2002); Elliott (2005); Ribaya-Mercado and Blumberg (2004); Prakash et al. (2004); Astrog (1997); Bertram (1999); Paiva and Russell (1999)
2	Phytosterols	Vegetables, nuts, fruits, seeds	Suppress the growth of diverse tumors cell lines via initiation of apoptosis and concomitant arrest of cells in the G1 phase of the cell cycle	John et al. (2007); von Bergmann et al. (2005); Dillard and German (2000)
3	Limonoids	Citrus fruits	Inhibiting phase I enzymes and inducing phase II detoxification enzymes in liver, provide protection to lung tissue. Detoxify enzymes	Ozaki et al. (1995); Lam et al. (1994); Willcox et al. (2004)

4	Polyphenols ➤ Flavonoids ➤ Isoflavonoids ➤ Anthocyanidins	Fruits, vegetables, cereals, beverages, legumes, chocolates, oilseeds	Action against free radicals, free radicals mediated cellular signaling, inflammation, allergies, platelet aggregation, and hepatotoxins	Kaul and Kapoor (2001); Scalbert et al. (2005); Cieslik et al. (2006); Prakash and Kumar (2011); Packer and Weber (2001); Gee and Johnson (2001); Willcox et al. (2004); Arts and Hollman (2005); Kris-Etherton et al. (2002); Dore (2005); Croteau et al. (2000); Ko et al. (2010); Patel et al. (2001).
5	Glucosinolates	Cruciferous vegetables	Protection against cancer of colon, rectum, and stomach	Conaway et al. (2001); Cartea and Velasco (2008); Hayes et al. (2008); Vig et al. (2009); Traka and Mithen (2009)
6	Phytoestrogen	Legumes, berries, whole grains, cereals, red wine, peanuts, red grapes	Protection against bone loss and heart disease, cardiovascular diseases, breast and uterine cancers	Morabito et al. (2002); Prakash and Gupta (2011); Sakamoto et al. (2010); Dip et al. (2009); Mense et al. (2008); Fremont (2000); Cos et al. (2003)



7	Terpenoids (Isoprenoids)	Mosses, liverworts, algae, lichens, mushrooms	Antimicrobial, antiparasitic, antiviral, antiallergic, antiinflammatory, chemotherapeutic, antihyperglycemic, antispasmodic	Tholl (2006); Langenheim (1994); Lee et al. (2003); Paduch et al. (2007); Hammer et al. (2003); Singh et al. (1999); Prakash and Kumar (2011); Prakash and Gupta (2009); Ikeda et al. (2002)
8	Fibers	Fruits and vegetables (green leafy), oats	Reduces blood cholesterol, cardiovascular disease	Narasinga Rao (1988, 2003); Schneeman (1989); Dillard and German (2000); Packer and Weber (2001)
9	Polysaccharides	Fruits and vegetables	Antimicrobial, antiparasitic, antiviral, antiallergic, antiinflammatory, lowering serum, enhances defense mechanisms	Bnouham et al. (2006); Lopez (2007); Atherton (2002); Schmidgall et al. (2000)
10	Saponins	Oats, leaves, flowers, and green fruits of tomato	Protection against pathogens, antimicrobial, antiinflammatory, antiulcer agent	Hostettmann and Marston (1995); Morrissey and Osbourn (1999); Price et al. (1987); Mert-Turk (2006)



Innovative/Functional Foods



Traditional concept of nutrition: The primary role of the diet is to provide adequate quantities of nutrients to meet metabolic requirements and maintain optimal health.

Epidemiological, Experimental and Clinical studies: Certain types of food and specific food components can affect a variety of body functions and provide specific health benefits.

A food can be regarded as Functional: If it is satisfactorily demonstrated to affect beneficially one or more target functions in the body, beyond adequate nutritional effects, in a way that is relevant to either-

Improved stage of health and well-being and/or reduction of risk disease.



Functional foods are also known as:

- A. Nutraceuticals
- B. Designer Foods
- C. Medicinal Foods
- D. Therapeutic Foods
- E. Superfoods
- F. Foodiceticals
- G. And Medifoods



Functional Foods



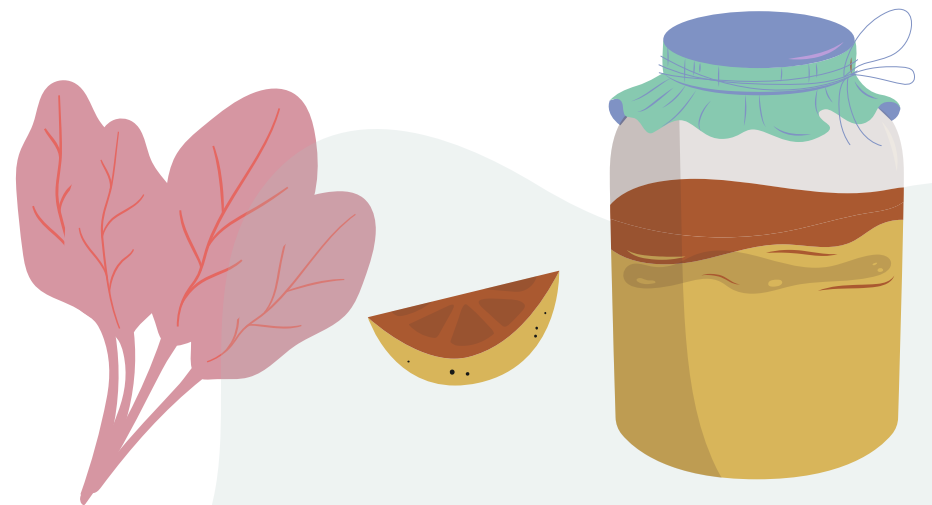
A functional food must remain food and it must demonstrate its effects in amounts that can normally be expected to be consumed in the diet: it is not a pill or a capsule, but part of normal food pattern.

FOOD FOR SPECIFIED HEALTH USES (FOSHU)



FOSHU refers to foods containing ingredient with functions for health and officially approved to claim its physiological effects on the human body.

FOSHU is intended to be consumed for the maintenance/promotion of health or special health uses by people who wish to control health conditions, including blood pressure or blood cholesterol.



FOOD FOR SPECIFIED HEALTH USES (FOSHU) & GENERAL FOODS



Quasi-drugs are products that fall in between cosmetics and pharmaceuticals. In other countries, a similar term would be cosmeceuticals.

Approved FOSHU Products (Japanese Only)

Specified Health Uses

Principal Ingredients (ingredients exhibiting health functions)

Foods to modify gastrointestinal conditions

Oligosaccharides, lactose, bifidobacteria, lactic acid bacteria, dietary fiber 8 ingestible dextrin, polydextrol, guar gum, psyllium seed coat, etc.)

Foods related to blood cholesterol level

Chitosan, soybean protein, degraded sodium alginate

Foods related to blood sugar levels

Indigestible dextrin, wheat albumin, guava tea polyphenol, L-arabiose, etc.

Foods related to blood pressure

Lactotripeptide, casein dodecanepptide, tochu leaf glycoside (geniposidic acid), sardine peptide, etc.

Foods related to dental hygiene

Paratinose, maltitiose, erythrytol, etc.

Cholesterol plus gastrointestinal conditions, triacylglycerol plus cholesterol

Degraded sodium alginate, dietary fiber from psyllium seed husk, etc.

Foods related to mineral absorption

Calcium citrated malate, casein phosphopeptide, hem iron, fracuto-oligosaccharide, etc.

Foods related to osteogenesis

Soybeen isoflavone, MBP (Milk basic protein), etc.

Foods related to triacylglycerol

Middle chain fatty acid, etc.

FOSHU Products

- More than 569 products have been approved as FOSHU as on December 9, 2005. About 45 % of the FOSHU products claim maintaining gastrointestinal condition.
- Oligosaccharides, *lactobacillus*, *bifidobacteria* and dietary fibre are major ingredients for the activities in this category. The category for the gastrointestinal condition was followed by about 21 % of those with health claims, that the product is good for those concerning about high serum cholesterol / triglycerides. Various products are soy proteins, peptides, dietary fibre, diactlycerol and plant sterol / stanol.
- Among 569 FOSHU products listed up to December 2005, majority of them (44.6 % of products *i.e.* 254) are related with improving intestinal conditions by improving balance of *enterobacterium* and / or promoting regular bowel moment. For these purposes, mostly probiotics organisms like *Lactobacilli* and *Bifidobacteria* spp. and non-digestible oligosaccharides (NDO) are recommended as main target ingredients.
- Apart form this, cholesterol / triglycerides is the second largest category contributing 20.6 % share *i.e.* 117 products having claims regarding lowering of serum cholesterol / triglycerides and mostly soy protein, chitosan, low molecular sodium alginate, peptides plants sterol / stanol are mentioned as key ingredients.
- While for remaining products (around 34 % share) the claims are related for lowering blood sugar and blood pressure, improved teeth as well as bone health and increased iron supply.



Labels of Leading Product Formats for FOSHU Claims





Classification of Approved Foods for Specified Health Uses by Health Effects

Content of Labeled Health Effects	Representative Ingredients	Number Approved	Percentage to total approved products (820 products)
Improves stomach condition, improve bowel function, etc.	Various oligosaccharides, lactulose, bifidobacteria, various lactic acid bacteria, dietary fiber (indigestible dextrin, polydextrose, guar gum, psyllium seed coat, etc.)	301	36.7
Blood glucose levels	Indigestible dextrin, wheat albumin, guava leaf polyphenol, L-arabinose, etc.	119	14.5
Blood pressure	Lactotripeptide, caseindodecapeptide, eucommia leaf glycoside (geniposidic acid), sardine peptide, etc.	102	12.4
Cholesterol	Chitosan, soy bean protein, low-molecular sodium alginate	95	11.6
Teeth	Paratinose, multitose, erythritol, etc.	65	7.9
Fat	Diacylglycerol, globin protein resolvent, etc.	60	7.3
Cholesterol and stomach condition, cholesterol and fat, etc.	Low-molecular sodium alginate, psyllium seed coat dietary fiber, etc.	33	4.0
Bones	Soy isoflavon, myelin basic protein (MBP), etc.	30	3.7
Mineral absorption	Calcium citrate malate, caseinphosphopeptides, heme iron, fructooligosaccharide, etc.	6	0.7

As of November 19, 2008

Source: <https://www.mhlw.go.jp/english/topics/foodsafety/fhc/02.html>

Coca-Cola With Dietary Fiber

02-10-2017

Coca-Cola Plus is the latest brand to join Coca-Cola Japan's portfolio of Food of Specified Health Use (FOSHU) drinks – a large and growing segment of the country's competitive beverage market. The first-ever Coca-Cola approved as FOSHU by the Japanese government will roll out nationwide next month in eye-catching white packaging after more than a decade of research and development.

The no-calorie beverage contains five grams of indigestible dextrin – a source of dietary fiber – per 470-ml bottle. Coca-Cola Japan is marketing Coca-Cola Plus, which features great Coca-Cola taste plus functional benefits, to health- and taste-conscious consumers 40 and older as a beverage to enjoy with food.

Drinking one Coca-Cola Plus per day with food will help suppress fat absorption and help moderate the levels of triglycerides in the blood after eating.



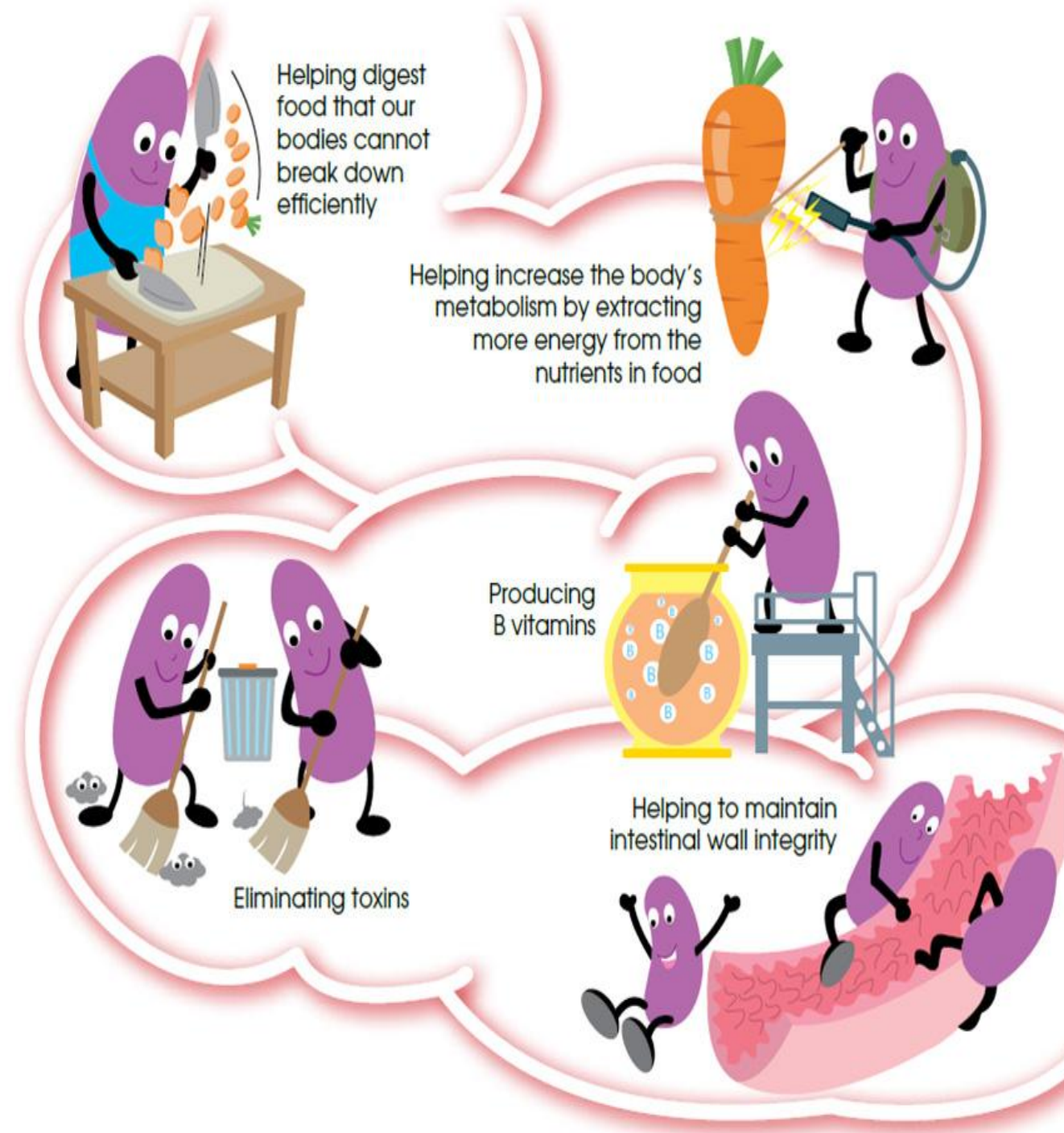
Disease	Functional food/ ingredient
Cancer prevention	Diindolylemethane (found in broccoli-family vegetables), Fish oil (found in salmon and other cold-water fish), Flaxseed (contains lignans), Folate, Garlic, Green tea, I3C (found in broccoli-family vegetables), IP6 (found in nuts, seeds, beans, whole grains, cantaloupe, and citrus fruits), Lycopene (found in tomatoes), Resveratrol (found in grape skin), Selenium, Soy foods, Turmeric, Vitamin C, Vitamin E
Cataracts	Lutein (found in dark-green vegetables)
Cavities	Xylitol (added to chewing gum and candy)
Colds and flu	Echinacea (herbal tea), Garlic
Diabetes	Chromium (whole grains, brewer's yeast, fortified nutritional yeast, liver), Evening primrose oil
Diarrhoea	Probiotics (Friendly bacteria) (found in yogurt)
Digestive problems	Probiotics
Ear infections	Xylitol (added to chewing gum and candy)
Easy bruising	Bioflavonoids (found in citrus fruits, buckwheat, and most fruits and vegetables)
Eczema	Probiotics
General nutrition	Fortified grains and beverages
Heart disease prevention	α -linolenic acid (found in flaxseed oil), Calcium (added to beverages; found in milk and other dairy products), Garlic, Fish oil, Potassium (found in orange juice, bananas, and other foods), Soy products, Stanols/Sterols (added to margarine and other spreads), Fibre (oats, etc.), Wine and other alcoholic beverages (in moderation)
High cholesterol	Fibre (found in whole grains and fruits, legumes, and vegetables), Garlic, Krill Oil, Soy products, Stanols (added to margarine and other spreads)
Menopausal symptoms	Soy products
Nausea	Ginger (beverages)
Osteoporosis	Calcium (added to beverages; found in milk and other dairy products), Vitamin D (added to butter, milk, and other beverages), Soy foods
PMS	Calcium (added to beverages; found in milk and other dairy products), Krill Oil
Ulcerative colitis	Probiotics
Urinary tract infections	Cranberry juice
Vaginal infection	Probiotics

PROBIOTICS



Definition

We usually think of bacteria as something that causes diseases. But the body is full of bacteria, both good and bad. **Probiotics** are often called "good" or "helpful" bacteria because they help keep your gut healthy.



Probiotics Benefits

Immunity Boost
& Decrease in
Inflammation



Food Allergy
Protection



Digestive
Health



May Improve
Non-Alcoholic
Fatty Liver Disease



May Treat
Serious Diseases
in Infants



May Improve
Mental Illness



Decrease in
Antibiotic
Resistance



Healthy Skin



Lowering
Blood Pressure



Diabetes
Treatment



Probiotic strains

❑ *Lactobacillus* species

- *L. acidophilus*
- *L. plantarum*
- *L. casei* subspecies *rhamnosus*
- *L. brevis*
- *L. delbreuckii* subspecies *bulgaricus*

❑ Other species

- *Streptococcus salivarius* ssp. *thermophilus*
- *Lactococcus lactis* ssp. *lactis*
- *Lactococcus lactis* ssp. *cremoris*
- *Enterococcus faecium*
- *Leuconostoc mesenteroides* ssp. *dextranicum*
- *Propionibacterium freudenreichii*
- *Pediococcus acidilactici*
- *Saccharomyces boulardii*

❑ *Bifidobacterium* species

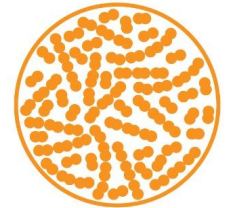
- *B. adolescentis*
- *B. bifidum*
- *B. longum*
- *B. infantis*
- *B. breve*



BIFIDOBACTERIUM



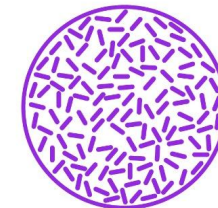
LACTOBACILLUS



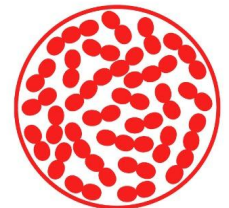
STREPTOCOCCUS
THERMOPHILUS



BULGARICUS



PROPIONIBACTERIUM

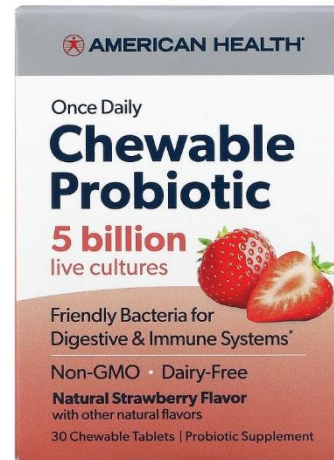
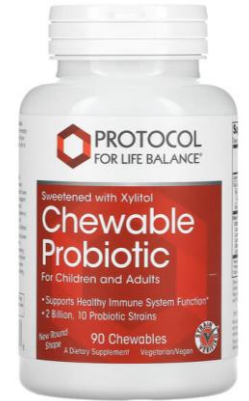
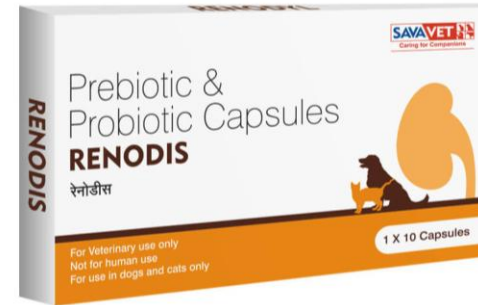


LACTOCOCCUS

Dosage Forms of Probiotics Available in Market

Standard forms:

- Capsules
- Sticks
- Powder blends
- Chewable tablets
- Sachets



Probiotic Food Products Available in Market



Probiotic foods

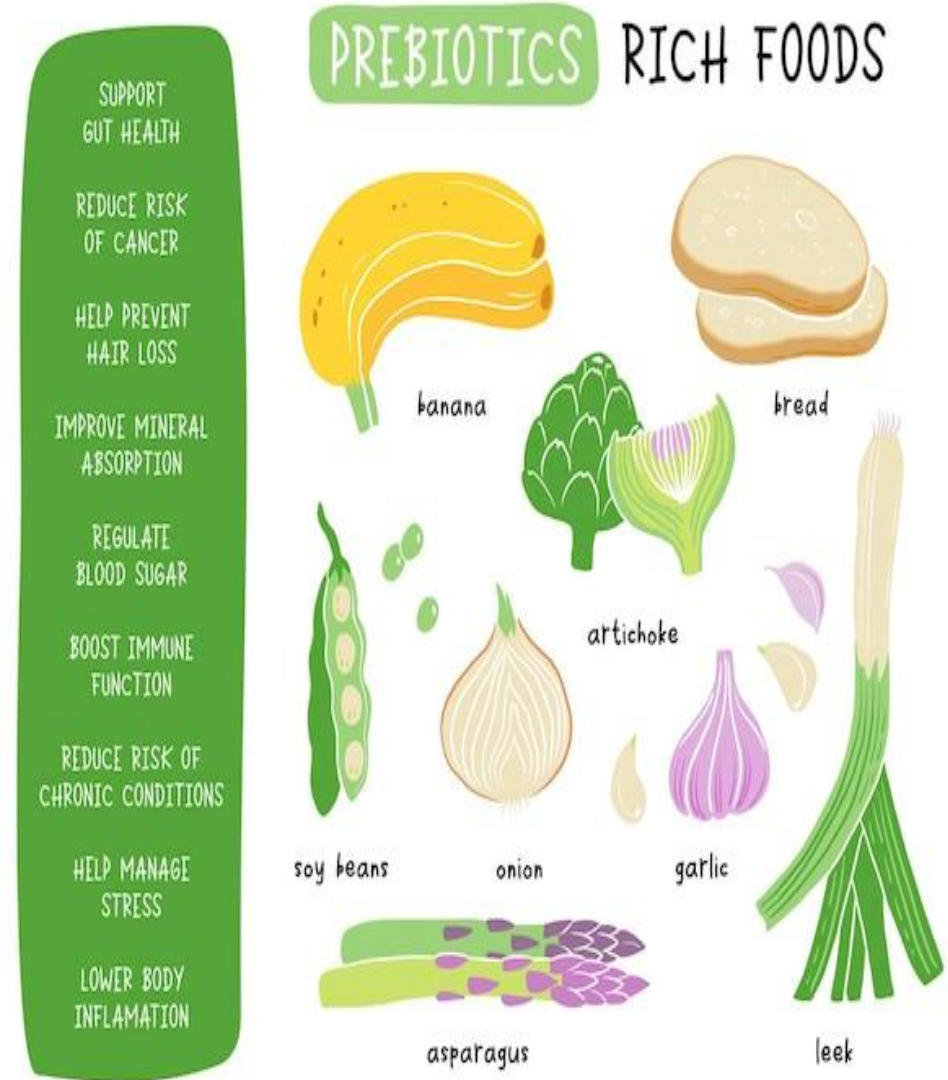
Some fermented products containing similar lactic acid bacteria include:

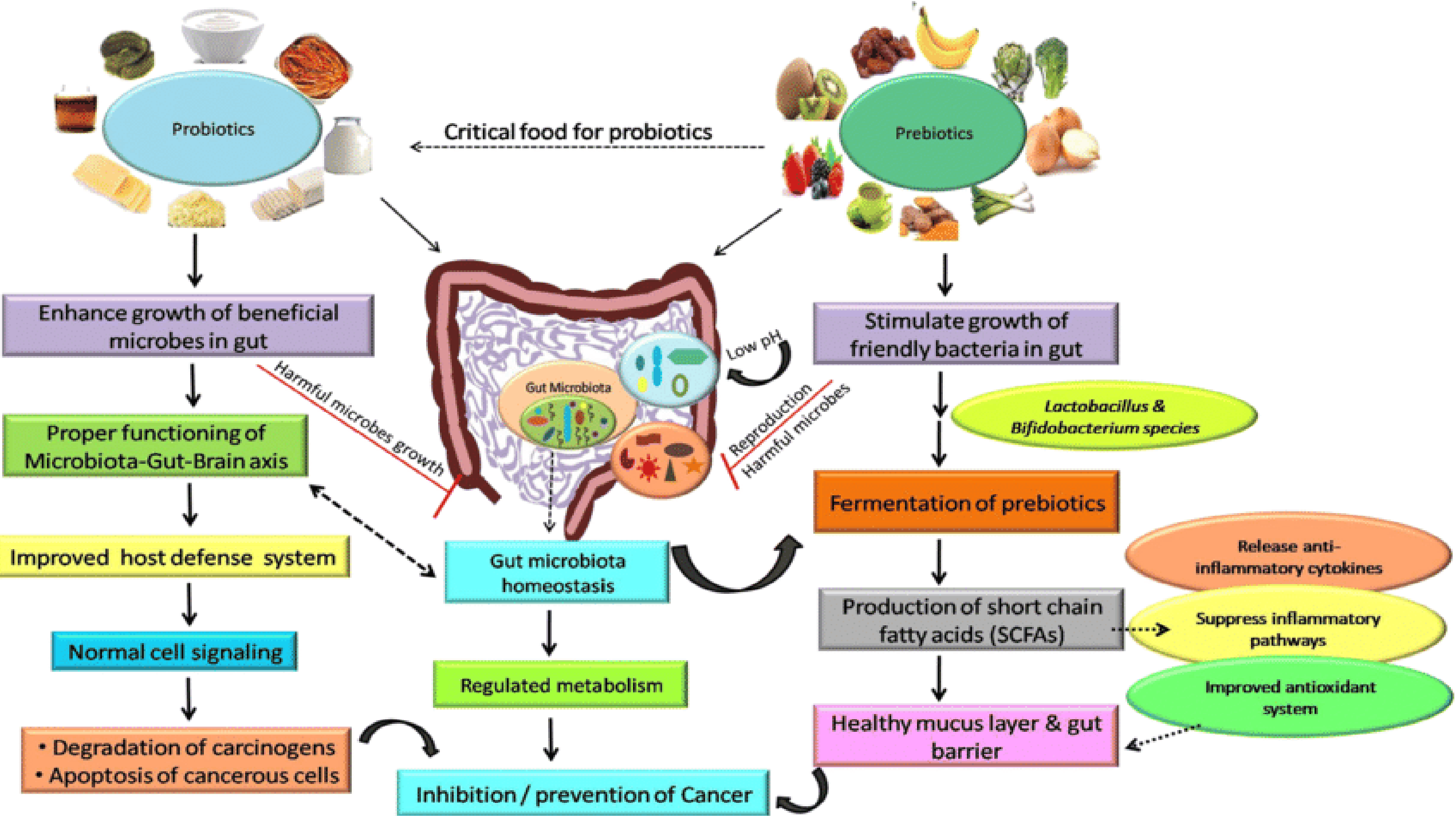
- Pickled vegetables
- Fermented bean paste such as tempeh,
- Miso and doenjang
- Kefir
- Buttermilk or Karnemelk
- Kimchi
- Pao cai
- Sauerkraut
- Soy sauce
- Zha cai



What is a Prebiotic?

- Non-digestible food ingredients that beneficially affect the host by selectively stimulating the growth and/or activity of one or a limited number of bacteria in the colon, and thus improve host health”
- First identified in 1995
- Typically oligosaccharides: galactooligosaccharides (GOS), fructo-OS (FOS), xylo-OS (XOS), Inulin
- Found in: Breastmilk, Jerusalem artichoke, chicory root, raw dandelion greens, leeks, onions, garlic, asparagus, whole grains, beans, banana





PREBIOTIC vs PROBIOTIC

What's the difference?

Both offer a wide range of health benefits.

PREBIOTIC

- Plant-based fibers
- Come from your diet
- Act as a food source for healthy gut bacteria
- Found in bananas, oats, onions, artichokes and garlic

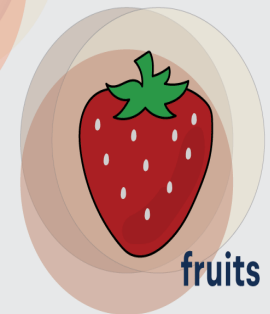
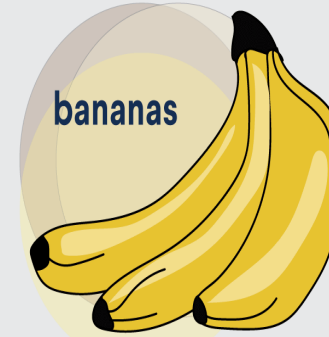
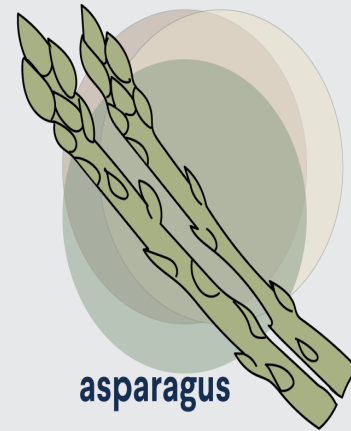


PROBIOTIC

- Live bacteria in the digestive system
- Needed to support our digestive and immune systems.
- Can be found in yogurt, miso and kimchi

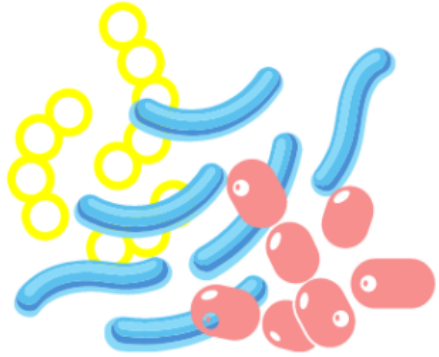


Prebiotic Foods



WHAT IS A SYNBIOTIC?

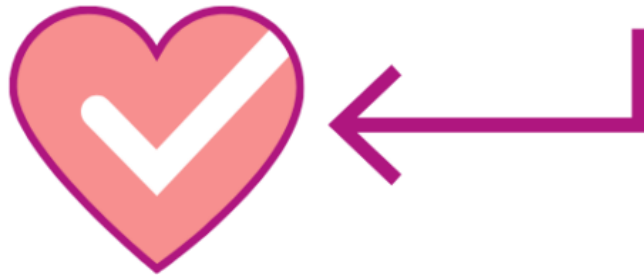
A mixture made of



PROBIOTICS (LIVE MICROBES)



PREBIOTICS OR SUBSTANCES USED BY HOST MICROORGANISMS



that leads to health benefits.

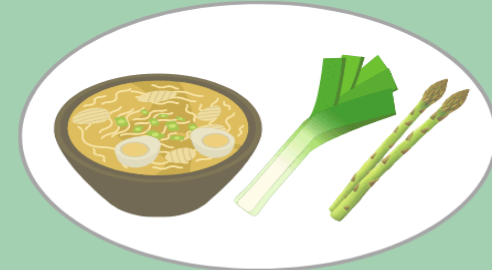
THEY MAY BE 'SYNERGISTIC' OR 'COMPLIMENTARY'.

NATURAL SYNBIOTIC FOOD COMBINATIONS

YOGURT (probiotic)
topped with bananas
(prebiotic)



MISO-based broth
soup (probiotic) with
asparagus and leeks
(prebiotics)



KIMCHI (probiotic)
over top of a
Buddha/grain bowl
(prebiotic)

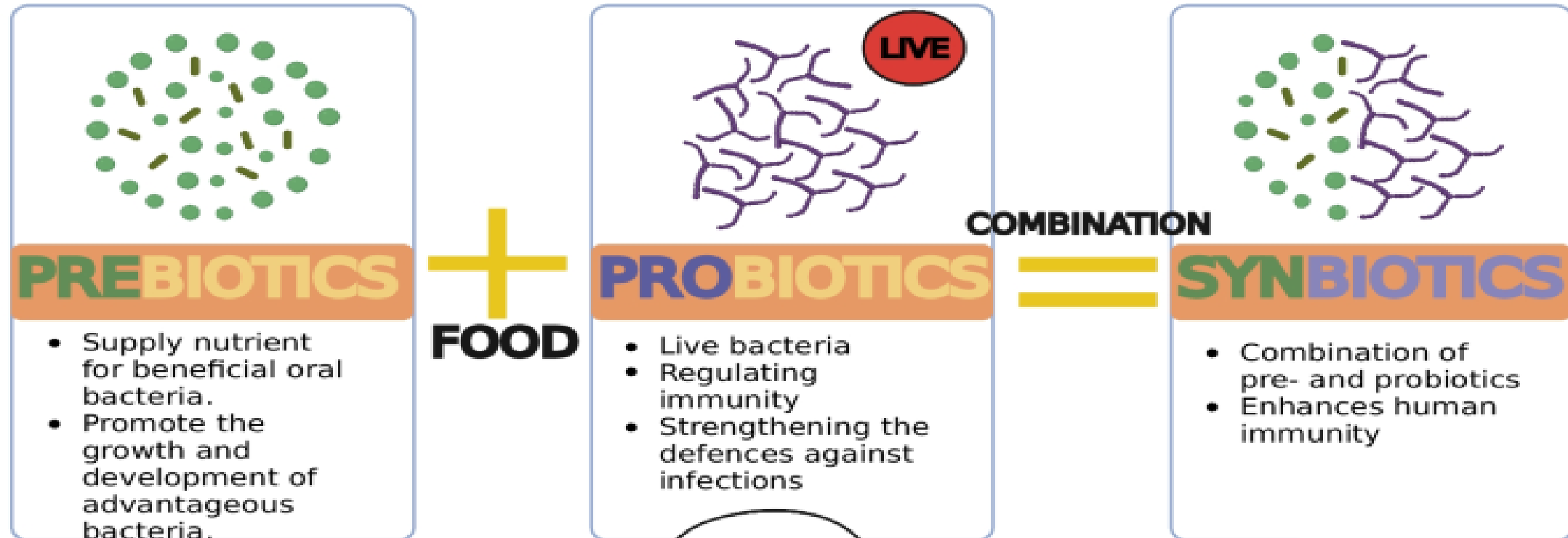


Examples of Symbiotics/ Previous studies on Symbiotics

- Polyphenol-based synbiotics may also be mediated by indirect metabolism in the gut, as recently proposed Sharma and Padwad (2020).
- Polyphenolic-rich foods, including red wine (Moreno-Indias et al., 2016), olive oil (Martín-Peláez et al., 2016), pomegranates (Cortés-Martín et al., 2021), and berries (Jamar et al., 2020) have been suggested to enrich for bifidobacteria.
- **Thus, the polyphenolic substrate could be transformed directly into bioactive molecules that confer a health benefit on the host or indirectly into metabolites used by other microbes to produce beneficial end-products.**



Probiotics, Prebiotics and Synbiotics

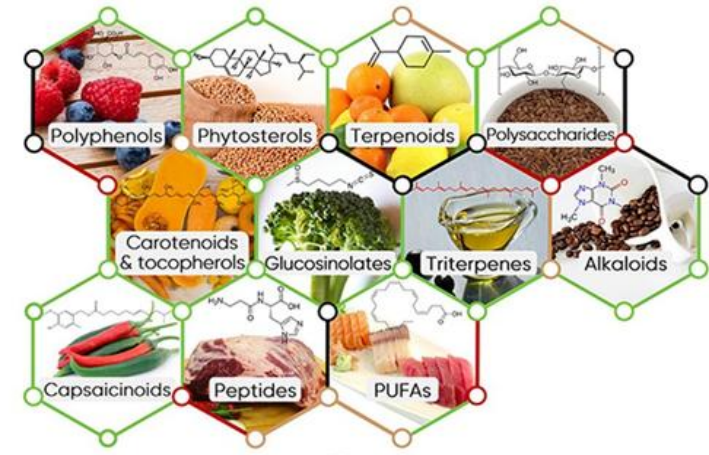


By-product

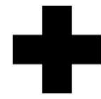


Synergistic Effects of Probiotics and Bioactive Compounds

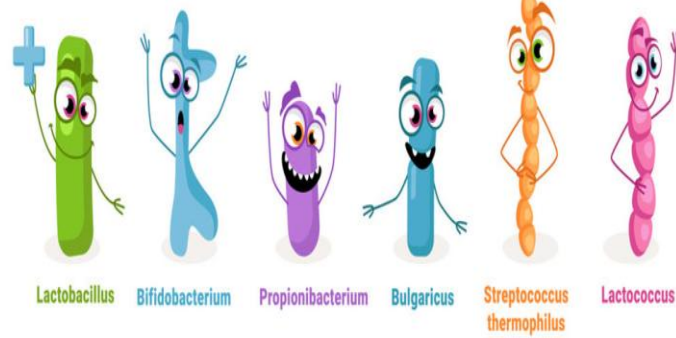
- ✓ The development of functional foods that promotes health beyond providing basic nutrition is on the rise, as food manufactures increases their offer to consumers needs.
- ✓ Most functionals research has focused on nutritional composition of the food and, to a lesser extent.
- ✓ On the product quality and effect of adding food texture enhancers.
- ✓ Functional ingredients, such as purified bioactive compounds or concentrated extract from **natural sources**, can be successfully **incorporated into foods**, providing **novel functional products categories and commercial opportunities**



Bioactive compounds



PROBIOTICS



Probiotics



Food



Novel Functional Foods

Novel Functional products categories have great commercial opportunities in world

Biotransformation of bioactive compounds by Probiotic and development of innovative foods

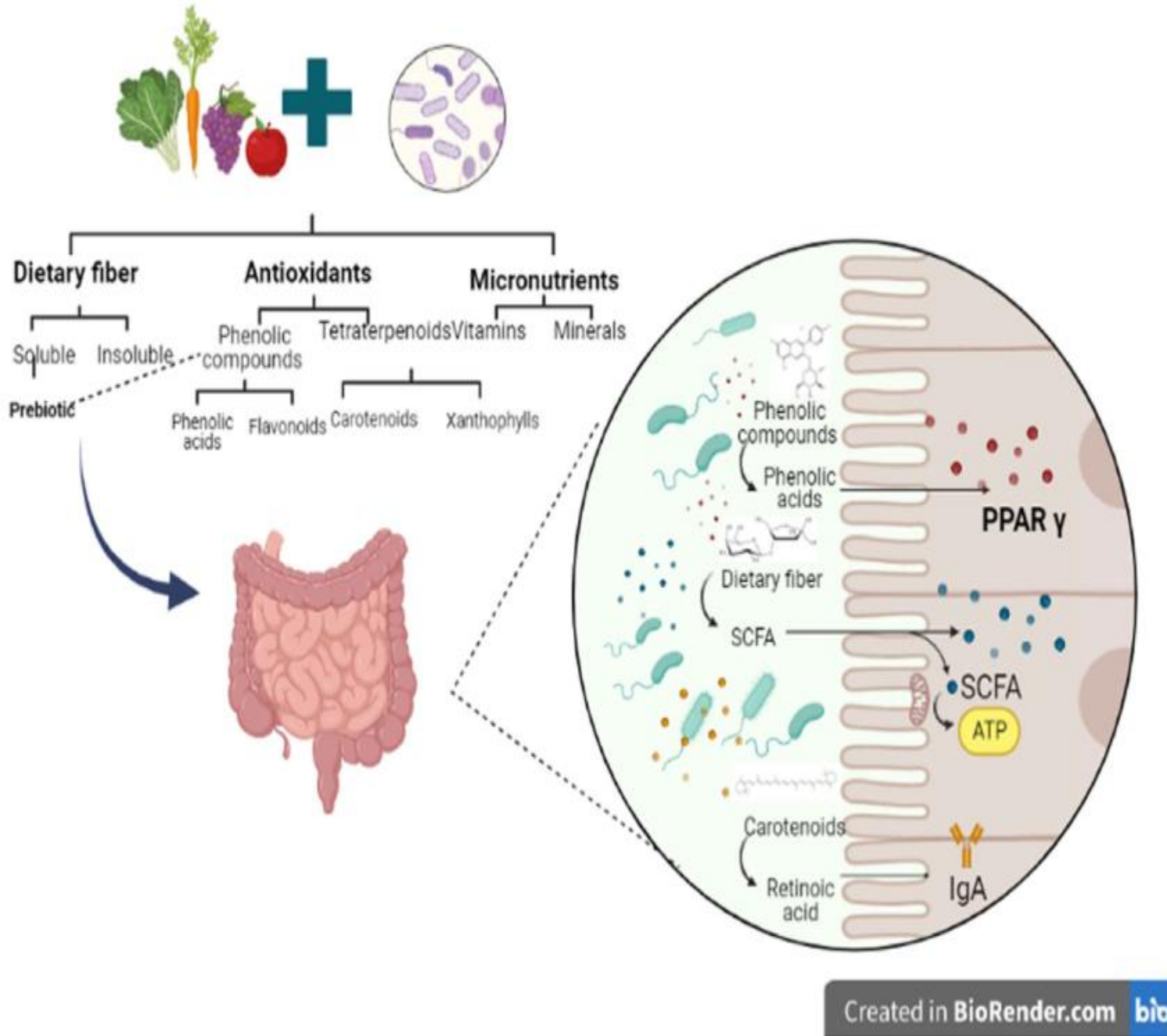
✓ **Fruit and vegetable juices** are challenging food matrices and can influence probiotic viability because they are a rich source of natural sugars, vitamins, minerals, fiber, and phytochemical compounds (**Fernandes Pereira & Rodrigues, 2018**).

✓ In addition, fruit juices are digested faster in the stomach than milk, meaning probiotics spend less time in the stomach's acidic environment, thereby increasing their viability. (**Fernandes Pereira & Rodrigues, 2018**).

✓ Lactic acid bacteria can improve the organoleptic qualities of juice by producing aromatic compounds and bio-transforming flavonoids, polyphenols, and triterpenes that can reduce bitterness and astringency (**Gao et al., 2019; Wu et al., 2020**).

Continue....

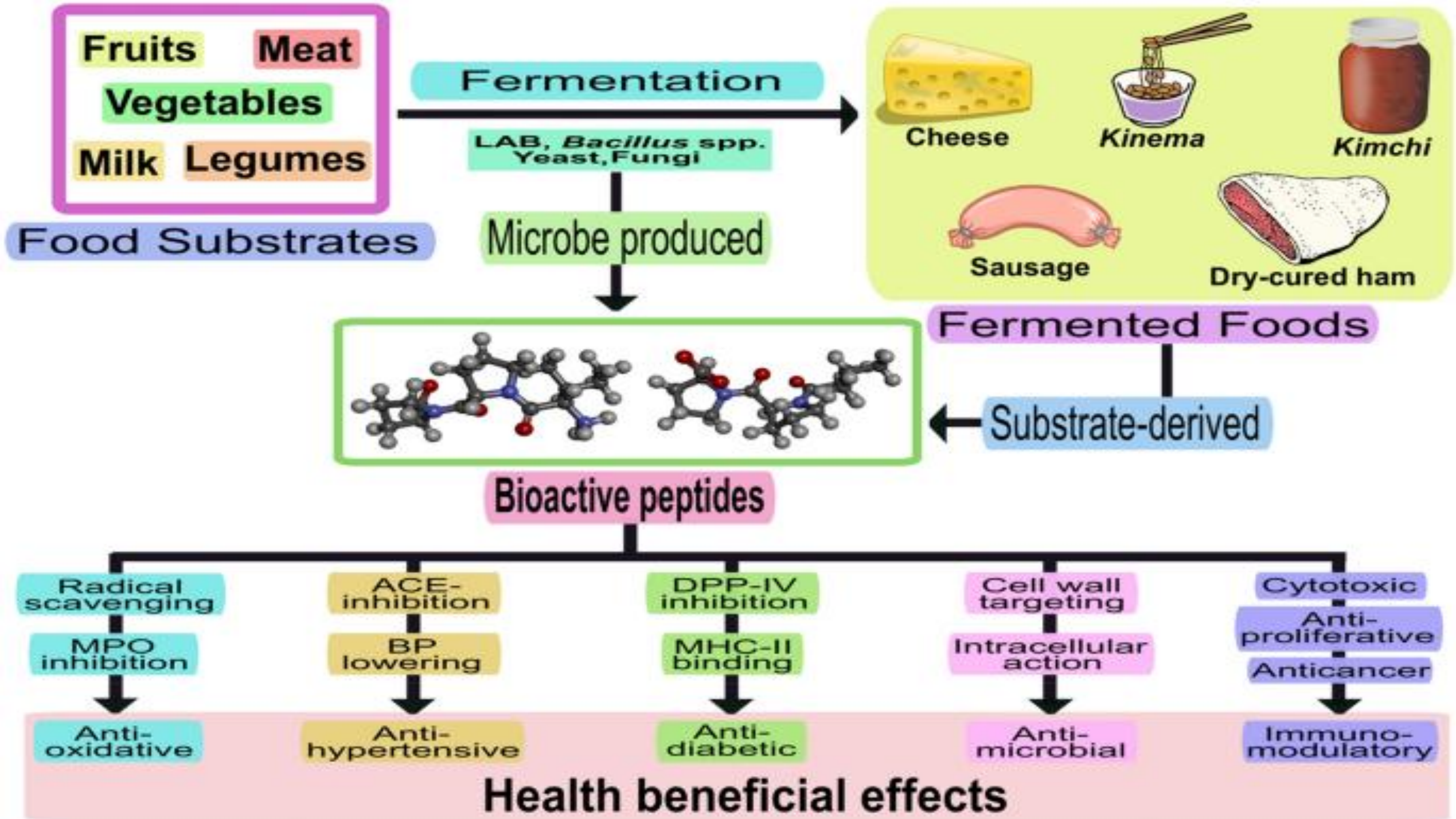
- ✓ Probiotic fermentation also enhances the levels of phytochemicals such as phenolic compounds, lycopene, and total carotenoids, as well as the antioxidant activities of fruit juices by transforming complex phenolics into free forms and releasing conjugated phenolic compounds or carotenoids from the plant cell wall (Liu et al., 2018; Mantzourani et al., 2020).
- ✓ In addition, probiotic fermented juice has been reported to have cholesterol-lowering effects (Jeon, Lee, & Chang, 2019).
- ✓ Generally, *Lactobacillus paracasei* is a suitable probiotic strain that can be used to ferment fruit juices as it is able to withstand the low pH of the juice matrix (Sheehan, Ross, & Fitzgerald, 2007). Interestingly, the fermentation of fruit juices by *L. paracasei* has increased antioxidant activities and bioactive compounds such as phenolic acids, flavonoids, and alkaloids (Mantzourani et al., 2020).



Biologically plausible reasons for the protective association of **phytochemicals** are their antioxidant and antimicrobial activity (Yahia et al. 2019).

In addition, numerous studies revealed that phytochemicals entering the intestinal system could beneficially alter the composition of microbial ecology by acting as prebiotics and antimicrobial agents against pathogenic gut microbiota.

Therefore, further investigations should focus on examining the therapeutic potential of phytochemicals and explaining the specific influence of each bioactive compound in modulating the gut microbiota (Santhiravel et al. 2022).

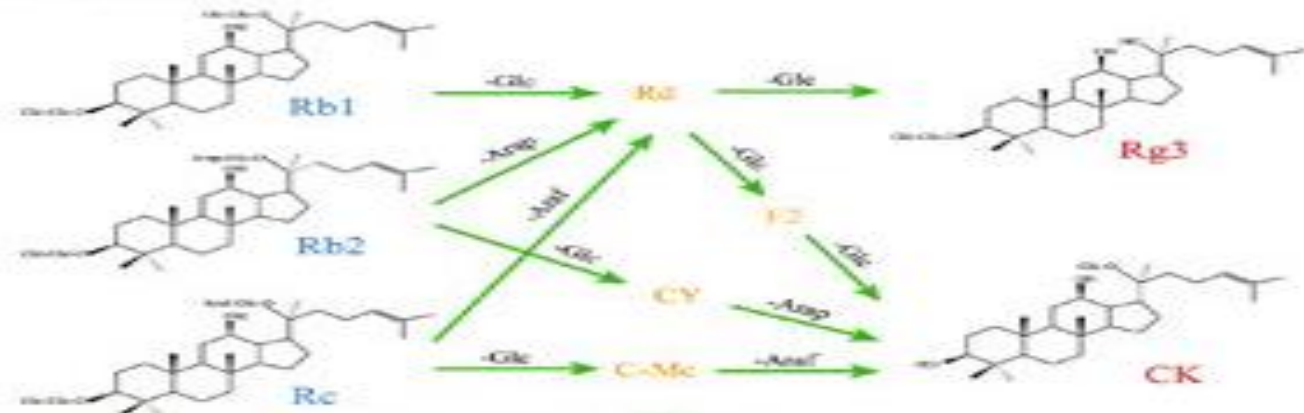


Functional Foods in Biomedicine

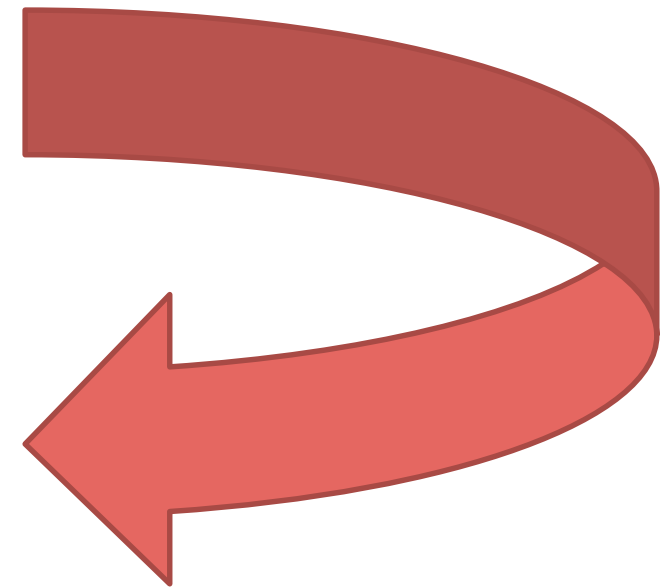
Probiotic Biotransformation Guava *Psidium guava* for Development of Innovative Food



Biotransformation



Applications



Guava (*Psidium guajava*) is a tropical fruit of India



Fermentation with
Lactobacillus plantarum, and
Lactobacillus fermentum



Fermented guava pulp extracts analysis
for inaccessibility study

PHYTOCHEMICAL ANALYSIS
ANTIMICROBIAL ACTIVITY
ANTIOXIDANT ACTIVITY
ANTICANCER ACTIVITY

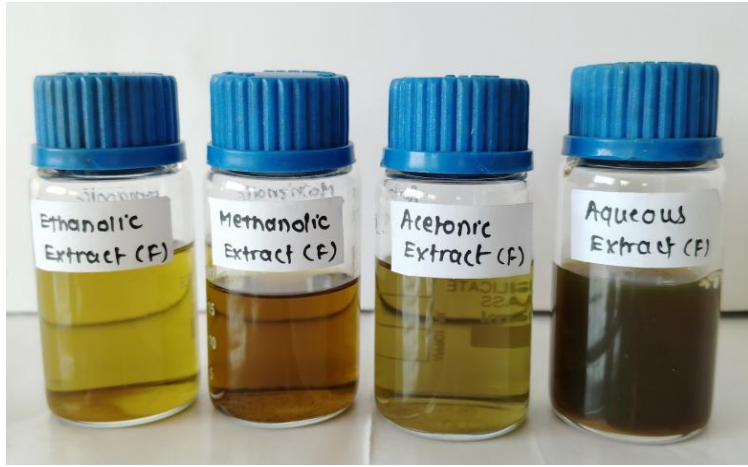
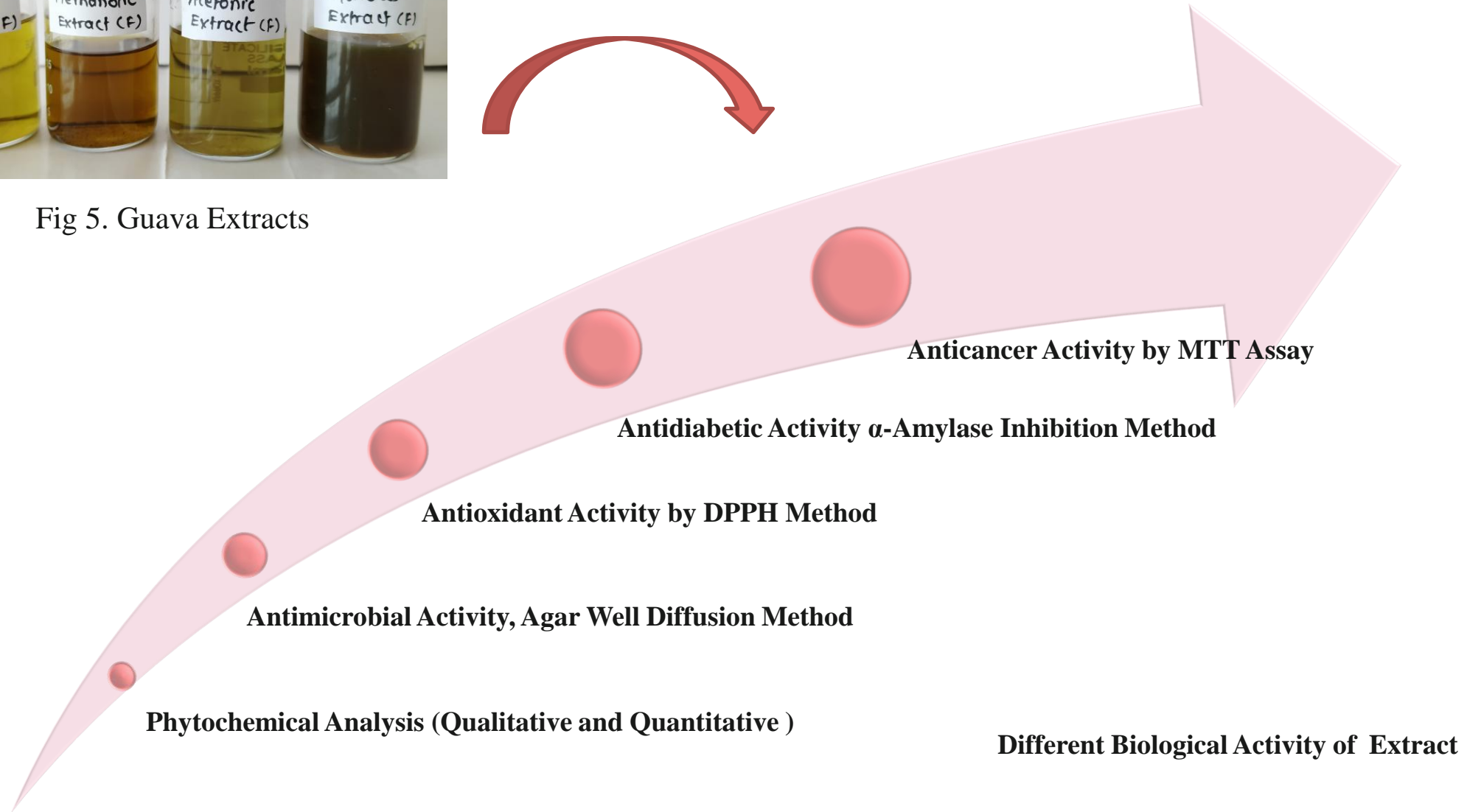


Fig 5. Guava Extracts



Phytochemical Analysis (Qualitative and Quantitative)

Antimicrobial Activity, Agar Well Diffusion Method

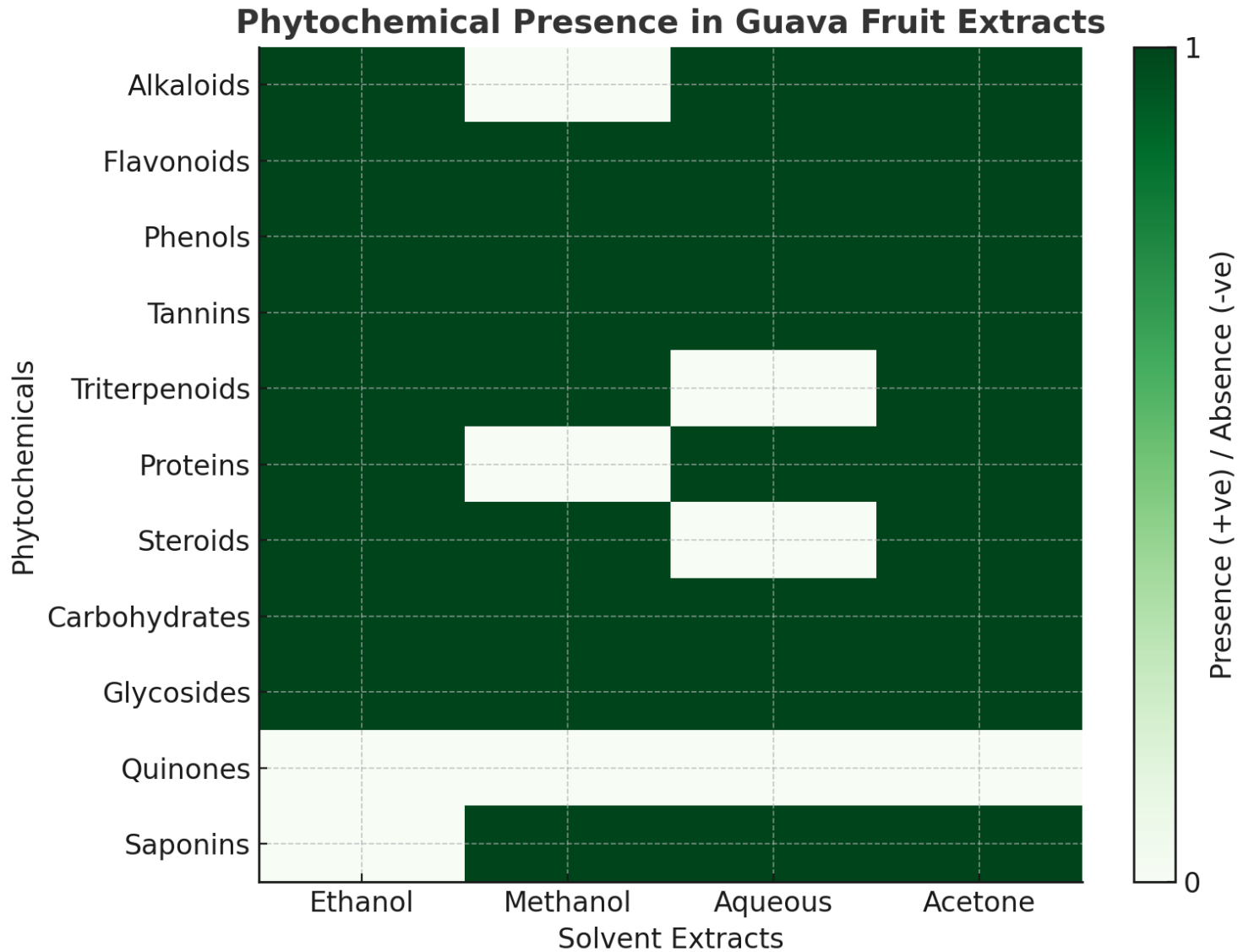
Antioxidant Activity by DPPH Method

Antidiabetic Activity α -Amylase Inhibition Method

Anticancer Activity by MTT Assay

Different Biological Activity of Extract

PHYTOCHEMICAL ANALYSIS OF FERMENTED GUAVA



1) Qualitative Analysis:

The fermented guava fruit juice extract highlights that:

- **Flavonoids, phenols, tannins, carbohydrates, and glycosides** are universally present across all extracts.
- **Ethanol and acetone** extracts show the richest phytochemical diversity.
- **Quinones** are absent in all extracts.

Fig. no. Heatmap showing the phytochemical distribution in guava fruit extracts.

PHYTOCHEMICAL ANALYSIS OF FERMENTED GUAVA JUICE

2) Quantitative Analysis :

The result shows the total phenol activity (measured by absorbance at 580 nm) of *Psidium guajava*. Methanol Extract consistently had the highest absorbance of all plant components and solvents, indicating the highest phenolic content.

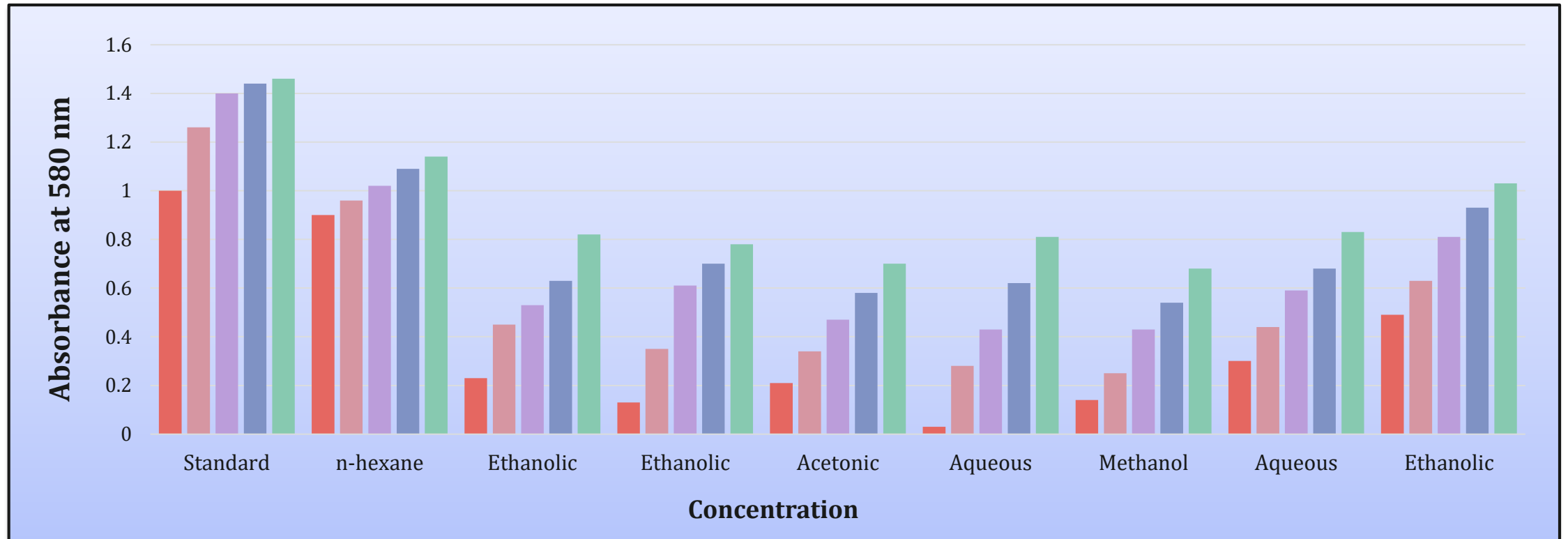


Figure no. 1. Graphical Representation of Total Phenol Activity of Guava Extract

Bioconversion of the Guava-Derived Bioactive Compounds Fermented by *L. fermentum* and *L. plantarum*

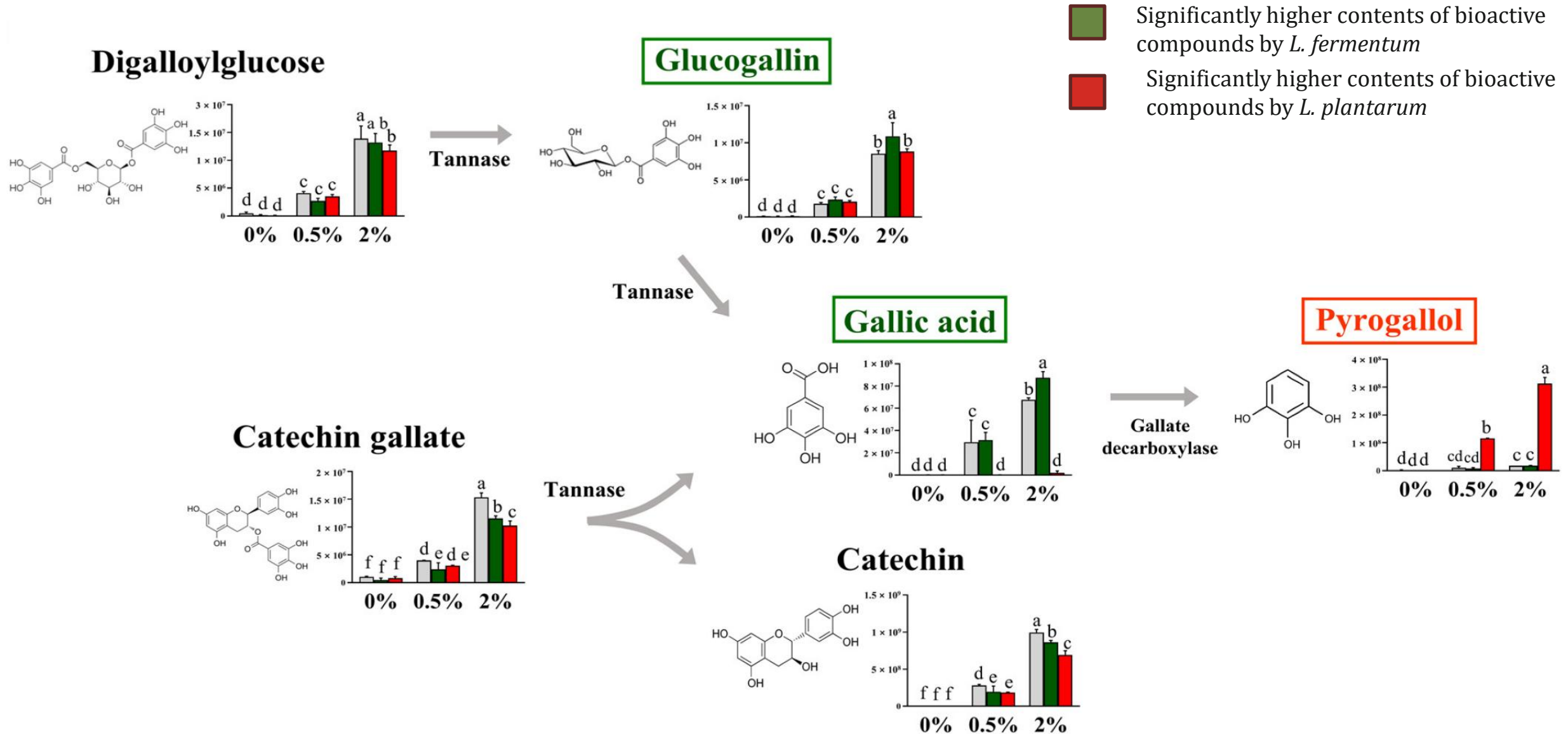


Fig. no. Proposed bioconversion pathways of (A) digalloyl glucose and catechin gallate

Bioconversion of the Guava-Derived Bioactive Compounds Fermented by *L. fermentum* and *L. plantarum*

(B)

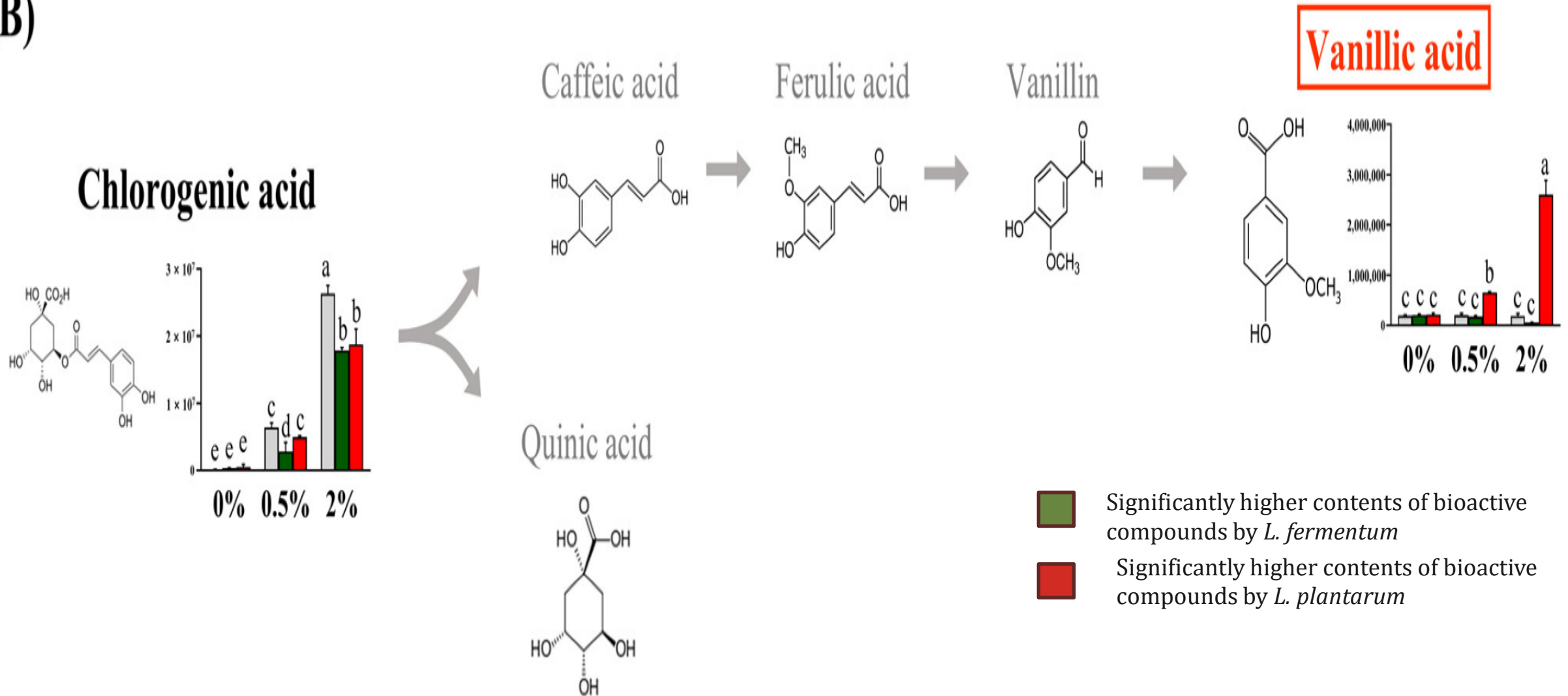


Fig. no. Proposed bioconversion pathways of (B) chlorogenic acid

Antimicrobial Activity of Fermented and Non-Fermented Guava Fruit Extract

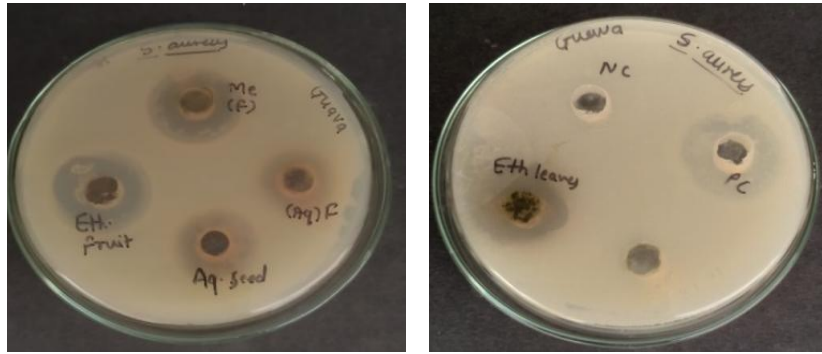
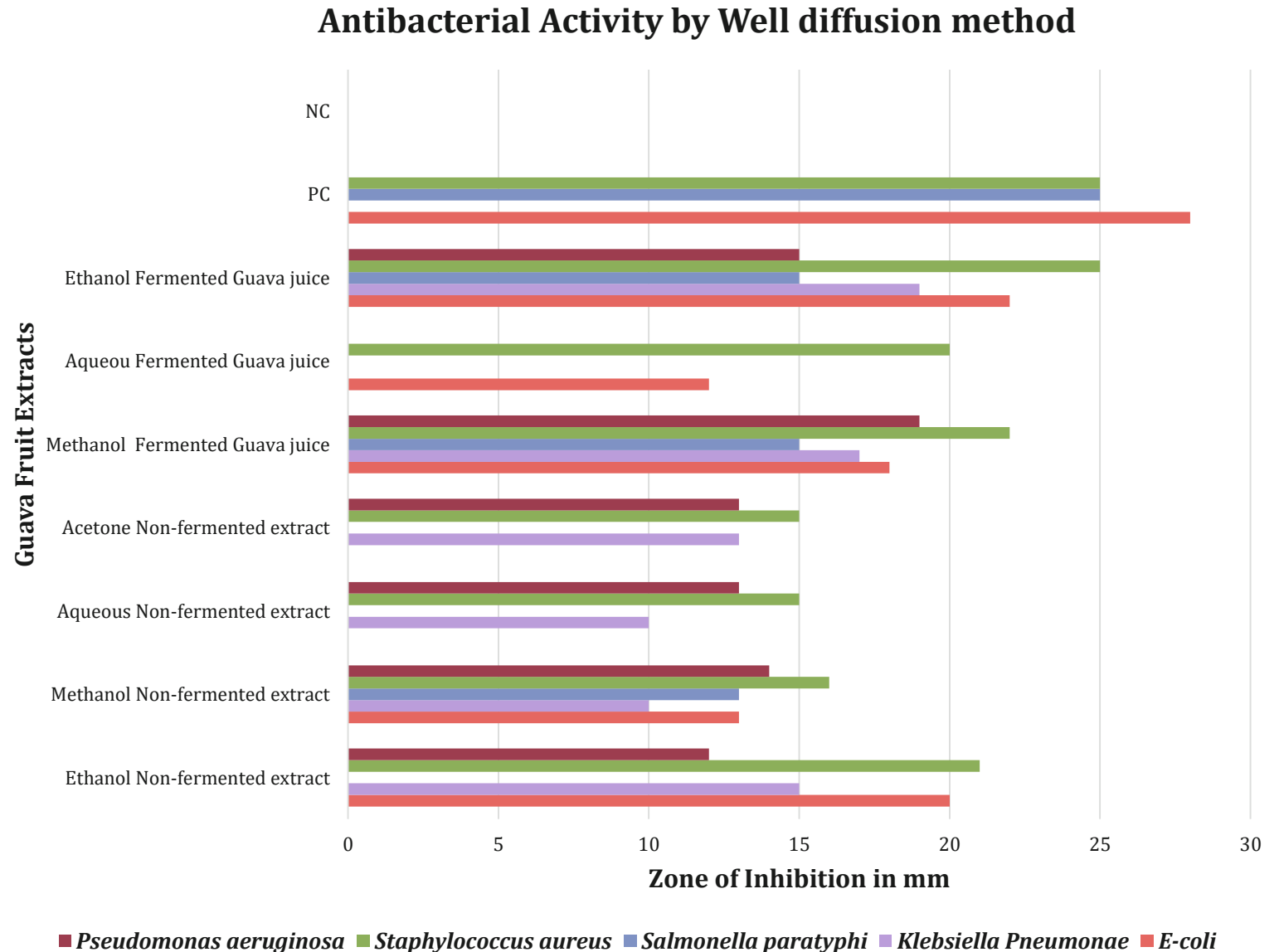


Fig. no. Antibacterial Activity of Fermented Guava fruit extracts

Table No. : Pathogens used for Antibacterial Activity with their MTCC No.

SN	Name of pathogen	MTCC No.
1	<i>Pseudomonas aeruginosa</i>	741
2	<i>Klebshiella pneumoniae</i>	109
3	<i>Staphylococcus aureus</i>	737
4	<i>E.coli</i>	443
5	<i>Salmonella typhi</i>	733



ANTIOXIDANT ACTIVITY

Table : IC50 values of guava extract

Fermented Pulp of *Psidium guajava*

Extract	Standar d	Methanol	Acetone	Ethanol	Aqueo us	n- hexane
IC50 Value	458.75	285.80	415.54	579.78	652.04	575

The methanol extract (285.80 $\mu\text{g/mL}$) of *Psidium guajava* has the highest antioxidant activity, surpassing the standard (458.75 $\mu\text{g/mL}$). The acetone extract (416.54 $\mu\text{g/mL}$) has moderate antioxidant activity.

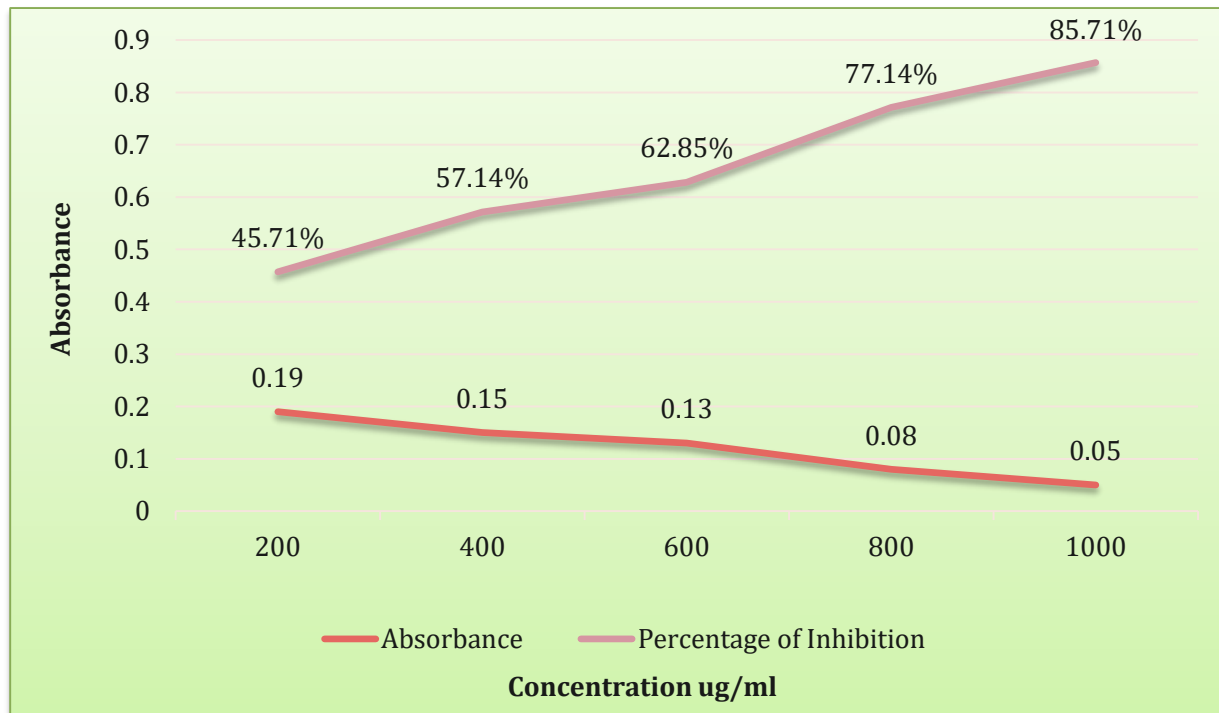


Fig. no. Concentration Vs Absorbance

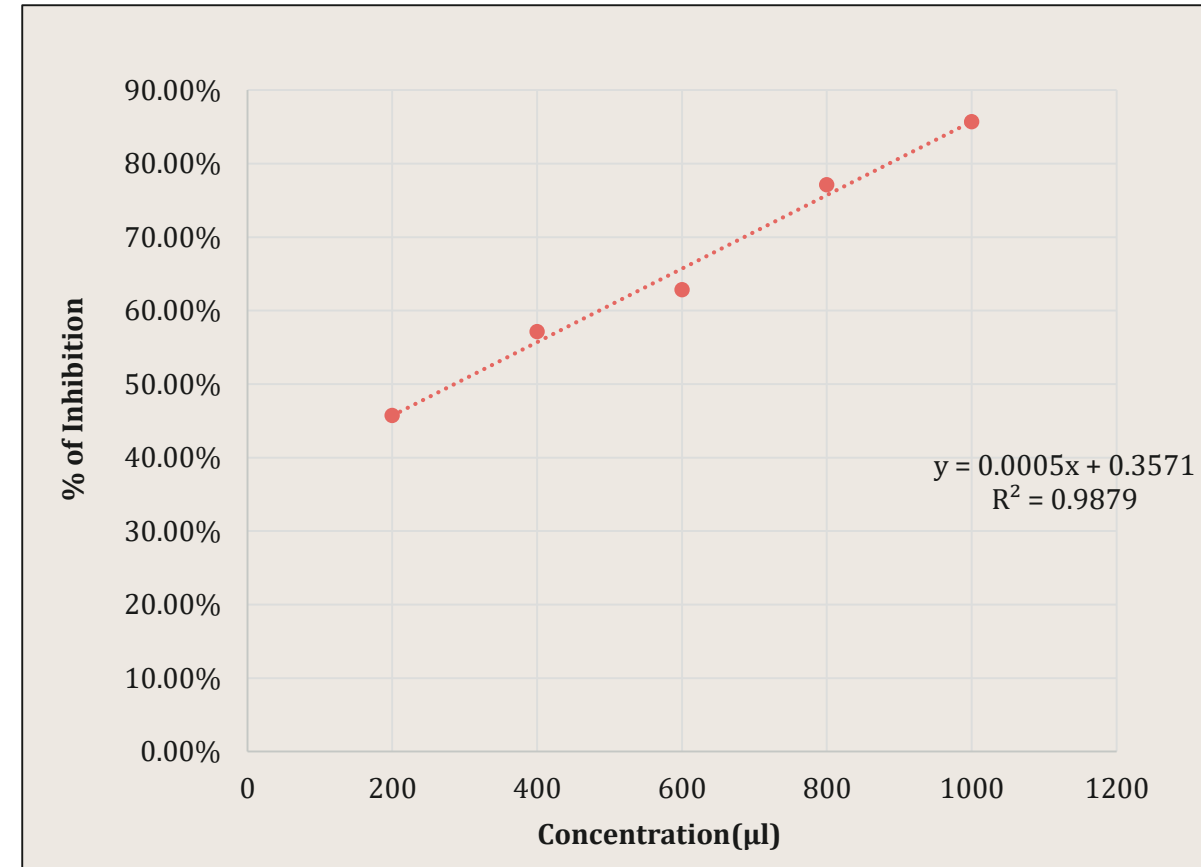


Fig. no. Concentration Vs % Inhibition (IC50 value)

ANTIDIABETIC ACTIVITY

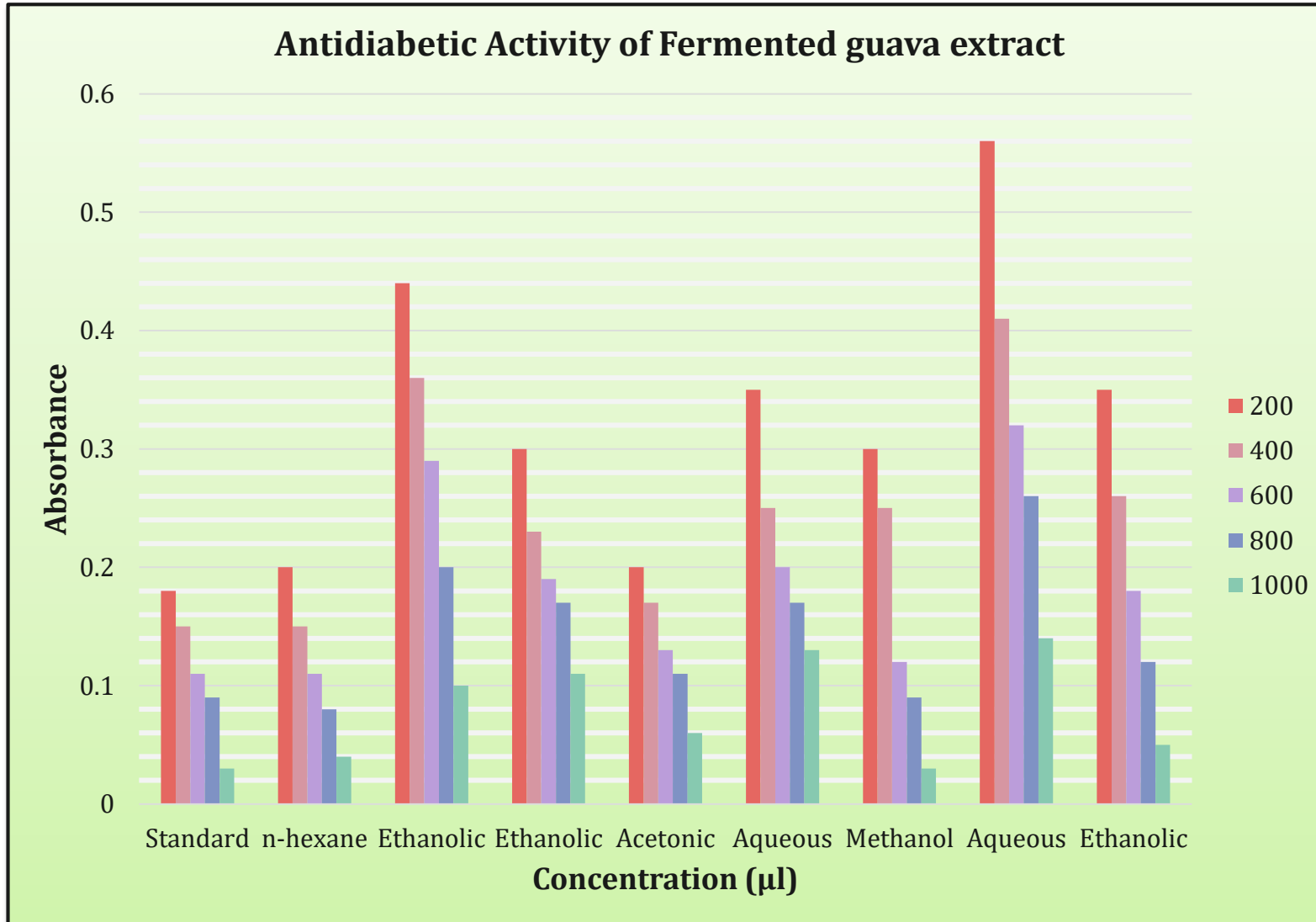


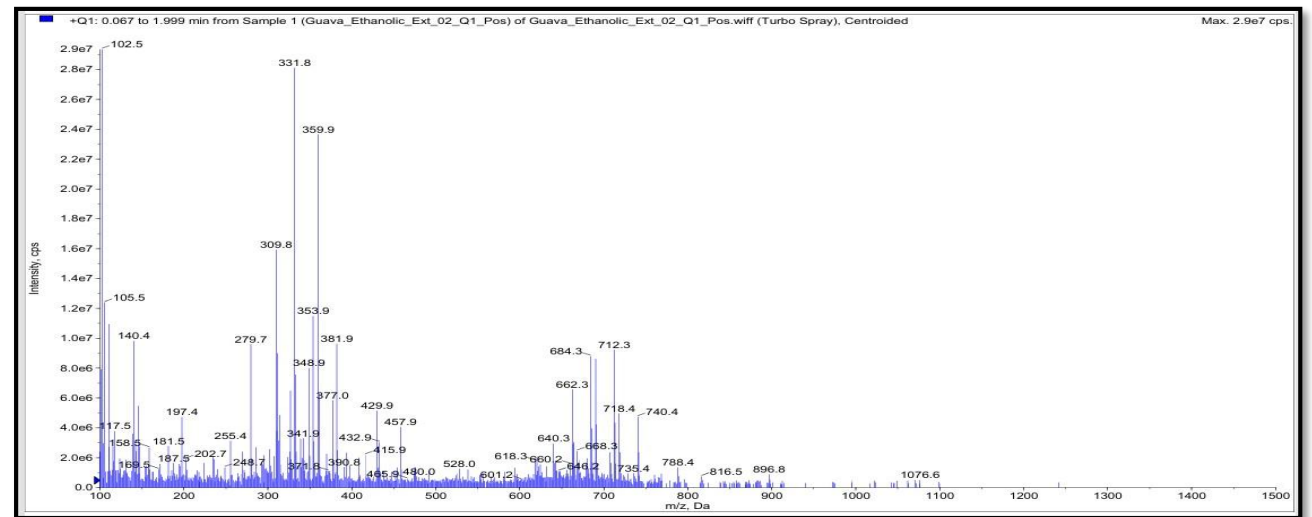
Fig. no. Antidiabetic activity of Fermented Guava juice extract



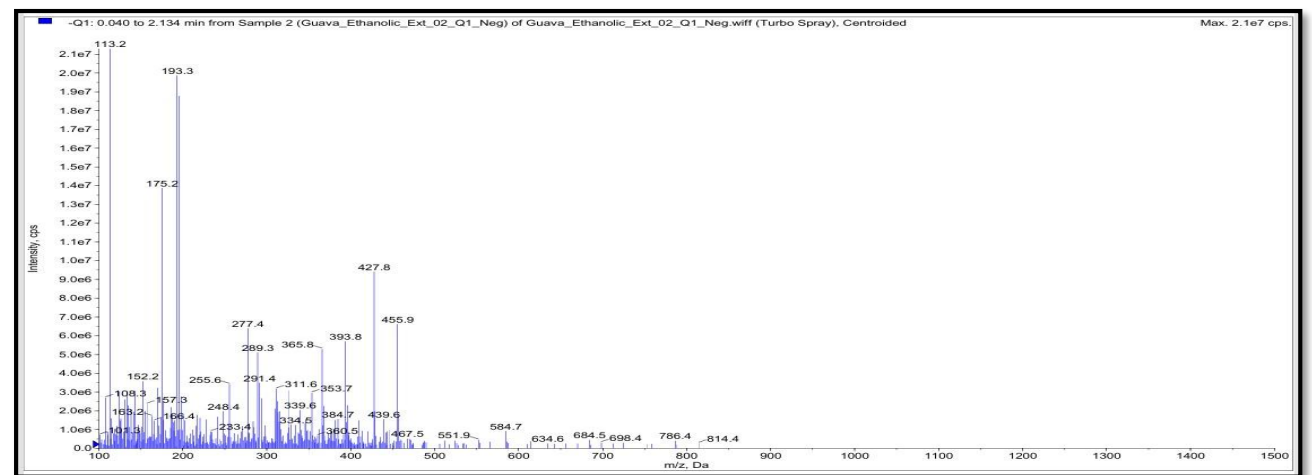
Fig. no. Antidiabetic activity by α -Amylase Inhibition Method

PHYTOCHEMICAL ANALYSIS BY LC-MS METHOD

Extract	Phytochemical Analysis by LC-MS
Ethanol guava Extract	Quercetin, Kaempferol, Morin, Gallic Acid, Lutein Myricetin, Schottenol, Myricetin, Ferulate, Esculin, Ellagic Acid, Ferulic Acid, Sinapic Acid, Benzophenone, Ellagitannin, Quercetin-3-O- glucoside, Urosolic Acid, Olenolic Acid, Dihydrochalcones
Acetone Extract	Kaemferol, Lutein Quercetin, Gallic Acid, Ellagic Acid, Urosolic Acid, Olenolic Acid, Betulinic Acid, Betulinic Acid
N-Hexane Extract	β -Oplopenone, α -Copane, Isoeuganol α -Terpinol, Isoeuganol, β -Carophyllene Oxide, α -Patchoulene, Eicosane, Hexadecane



Graph: Positive Polarity of Ethanol Extract Guava



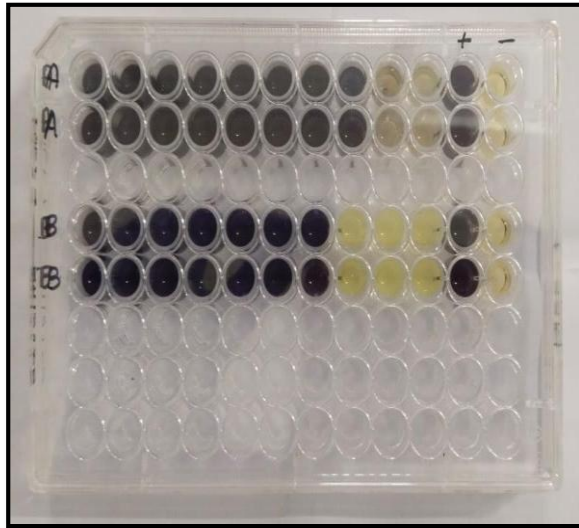
Graph: Negative Polarity of Ethanol Extract Guava

ANTICANCER ACTIVITY

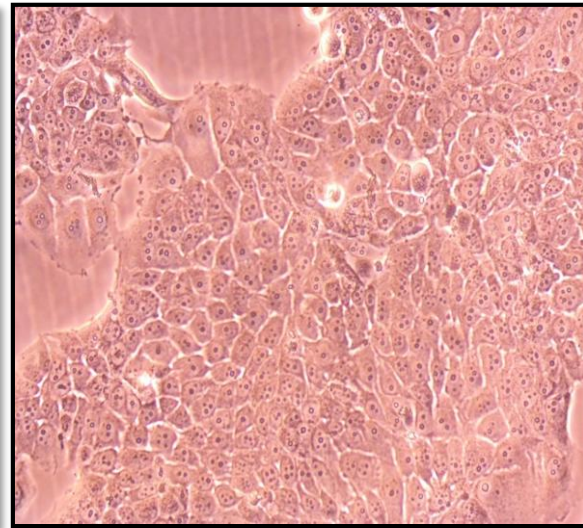
Table : IC-50 Values of Acetone fruit extract

Samples	IC50 ($\mu\text{g}/\text{mL}$)
Acetone fruit extract	225.8

The IC50 value for pulp extract was determined to be 225.8 $\mu\text{g}/\text{mL}$, indicating moderate to strong cytotoxic activity against the tested cell line. Compounds with IC50 values in this range are often considered promising for further development, as they show effective inhibition at relatively low concentrations.



MTT Assay



MCF-7 Cell line

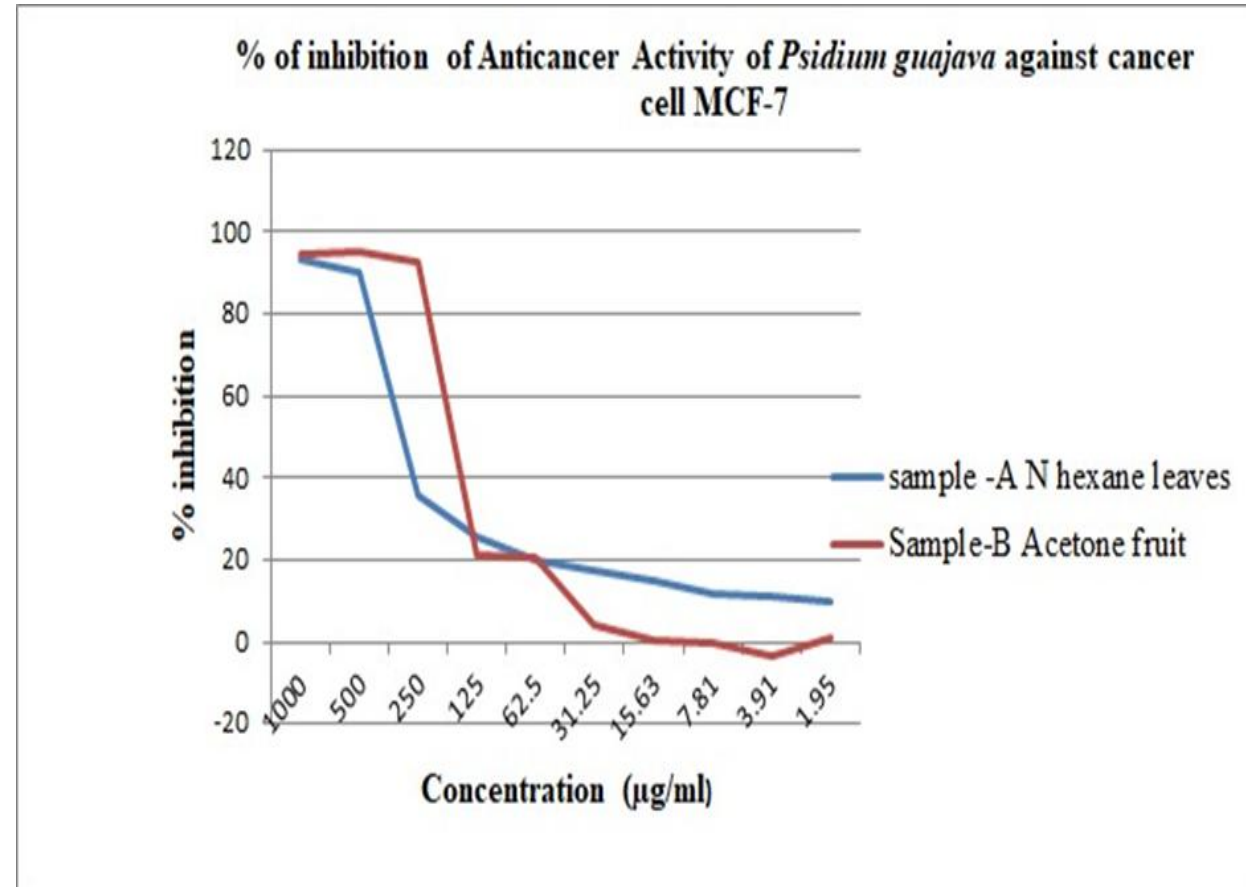


Fig. no. Concentration VS% of inhibition

CONCLUSION

- The phytochemical screening of *Psidium guajava* reveals a rich presence of secondary metabolites such as flavonoids, phenols, steroids, glycosides, and triterpenoids in the fermented guava fruit pulp extract particularly in ethanol and aqueous solvents showing the highest diversity.
- Antidiabetic activity was also highest in pulp extracts, surpassing the standard, and antibacterial activity was most potent in ethanol leaf extracts, especially against *Staphylococcus aureus*, while aqueous extracts showed minimal effects.
- Anticancer screening revealed concentration-dependent cytotoxicity showing stronger activity ($IC_{50} = 225.8 \mu\text{g/mL}$) indicating potential for further therapeutic development.
- The results conclude that fermentation of the guava fruit pulp by using the probiotic strains of *L. plantarum* and *L. rhamnosus* could efficiently enhance the bioactive compounds biotherapeutic potential.

Biotransformation Of Beetroot And Its Bioactive Compounds For The Formulation Of Nutritional Gummies



- ❖ Beetroot (*Beta vulgaris L.*) is recognised for its health benefits, providing bioactive compounds like betalains and flavonoids, which exhibit anti-inflammatory, antibacterial, and antioxidant effects.

OBJECTIVE

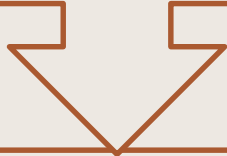
1. To analyse the biotransformation product by assessing their phytochemical properties.
2. To formulate naturally probiotic food enriched with bioactive compounds in the form of gummies.
3. To evaluate the nutritional, sensory properties and stability of the biotransformed product.

METHODOLOGY

Prepare beetroot juice under aseptic conditions, test for phytochemicals and LC-MS test for detecting bioactive compounds



Filter and inoculate the juice with *Lactobacillus plantarum* and monitor parameters to the endpoint of fermentation which was after 72 hrs when the pH 4 was attained and the sugar concentration decreased.

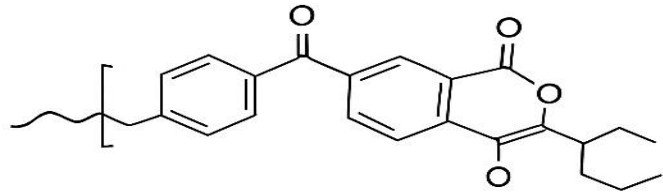


Formulate gummies from biotransformed beetroot juice, evaluate their sensory qualities with human volunteers using a 5-point Hedonic scale, and perform microbial analysis of the product.

TABLE NO. FORMULATION OF GUMMIES	
Ingredients	Biological source
Bioactive compound	Beetroot juice
Gluten free stabilizer	Xanthan gum powder
Preservative	Citric acid
Natural sweetener	Honey
Co-Q10	Nuts, pistachios, sesame
DHA (Docosahexaenoic acid)	Flax seed, walnuts

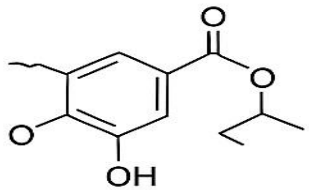
Effect on Bioactive Compounds of Beetroot after Biotransformation with *L. plantarum*

Compound/Class	Control (Raw Beetroot)	After Biotransformation with LAB	Notes
Betacyanins	147.90 ± 5.2 mg/L	349.25 mg/L	Substantial increase due to higher extractability, especially in processed forms
Betaxanthins	64.68 ± 1.0 mg/L	298.38 mg/L	Strong increase, betaxanthins more stable in processed products
Total Polyphenols	225.7 mg/L (as gallic acid)	314.7 mg/L (as gallic acid)	Enhanced with LAB due to liberation of bound phenolics
Antioxidant Activity	20.19% inhibition (DPPH)	25.24% inhibition (DPPH)	Correlates with betalain and polyphenol rise
Betain/Isomer & Aglycons	Major pigment, moderate enzymatic hydrolysis	Higher conversion to aglycons via LAB β-glucosidase activity	Conversion depends on LAB strain, shows strong hydrolytic activity

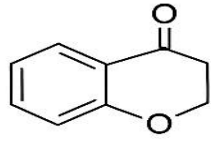


Bound Polyphenol Esters / Glycosides
(in Beetroot Cell Wall Matrix)

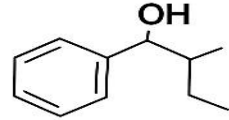
↓
Esterases,
Glycosidases
from *L. plantarum*



Rutin

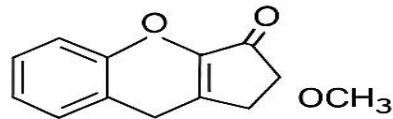


Kaempferol



(+)-Catechin

↓
Further microbial
metabolism — dhydroxylation /
methylation / reduction

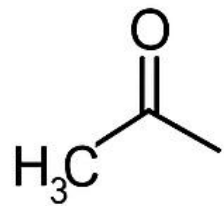


Novel Phenolic Derivatives
(Unique phenolics not present in raw beetroot)

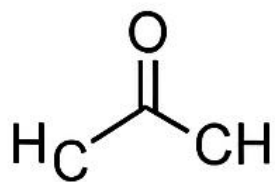
Enhanced Antioxidant Activity

- *L. plantarum* liberates bound polyphenols (like flavonoids) from beetroot cell walls via esterases and glycosidases, notably elevating levels of rutin, kaempferol, and (+)-catechin. This process not only enhances antioxidant properties but also produces unique phenolic derivatives not present in raw beetroot.
- In contrast to this, other VOCs (2,4-dimethylpentene, 4-Ethyl-e-methoxyphenol, 4-methylpyridine, 2,3-butanediol, 4-methyl-2-heptanone, 2,4,6-trimethylpyridine, 3-heptyne-2,6-dione 5-methyl-5-[1-methylethyl]-, 4-methyl-3-penten-2-one, 2-pentanone, 3-acetonylcyclohexanone, 2,3-dimethylphenol, 2-methylbutanoic acid, 1-[2,4-dimethyl-furan-3-yl]ethenone, 2,4-dimethylfuran) **present in control samples were not detected in fermented juice samples.**

The fermentation of beetroot juice of *L. plantarum* led to the formation of 10 new constituents which were not detected in other fermented juice samples.



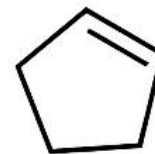
1-Butanone



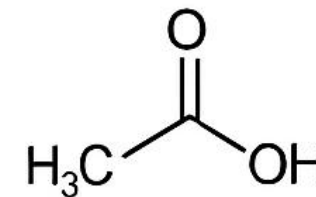
3-Methyl-1-butanol



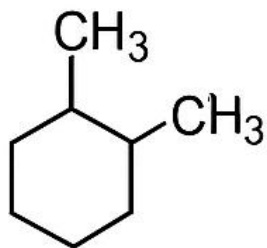
Butanoic acid,
butyl ester



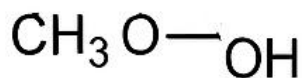
2-Pentylfuran



1-Heptanol



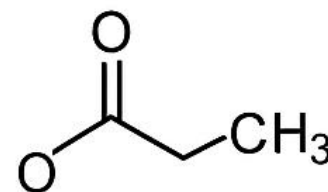
2,6-Dimethyl-
heptan-4-ol



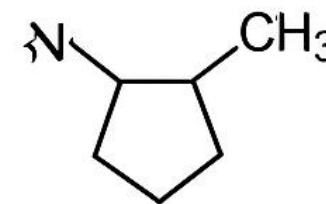
Decanal



4-Acetylcyclo-
heptanone



3-Nonen-2-one



Methyl nonyl ethyl

Results

- **Quality Tests of Gummies**

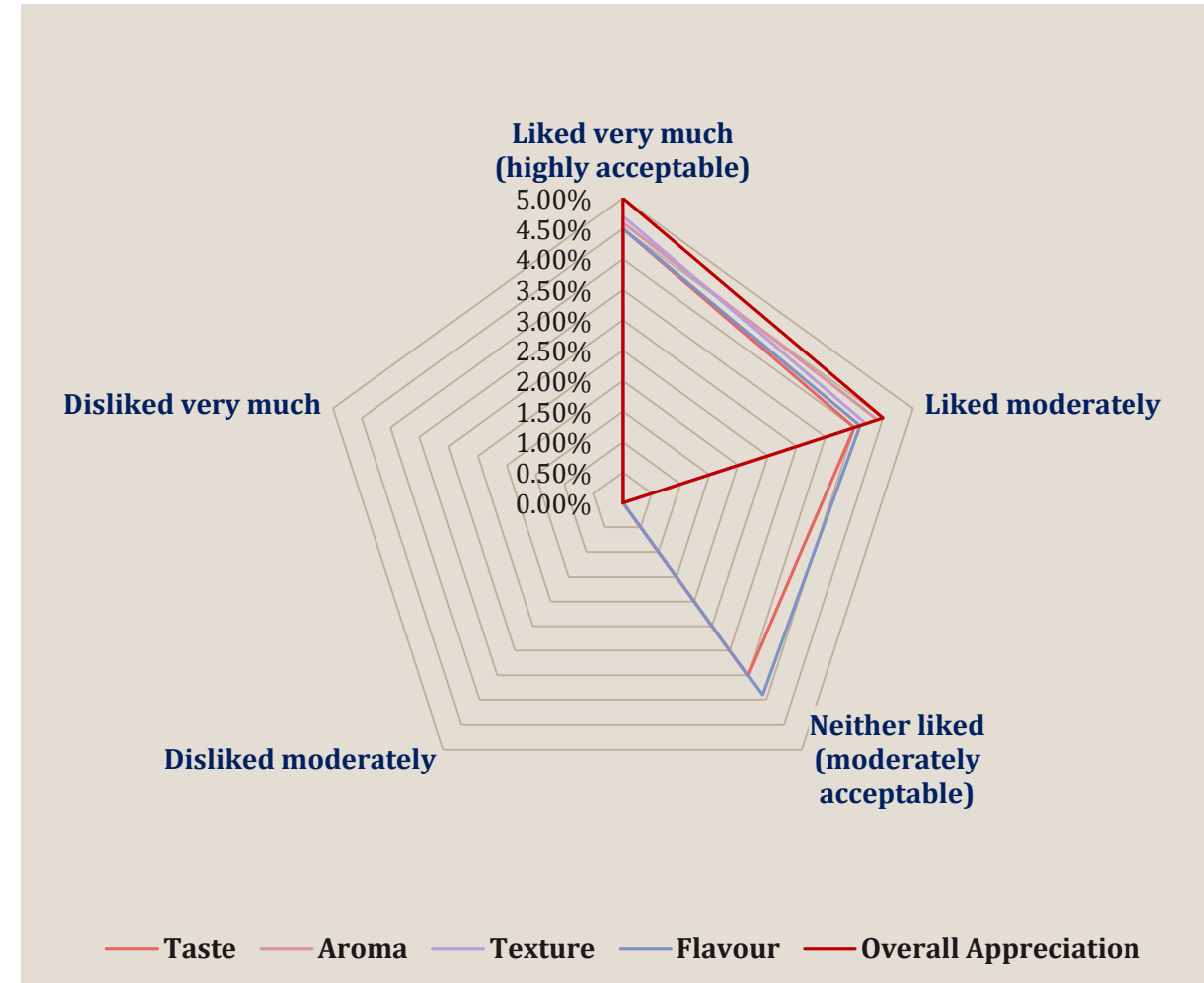
- ❖ **Microbial Analysis by Total Plate Count:**

Table no. Microbial Analysis Of Gummies		
Bacterial	Total count on NA after 48 h incubation at 30 °C	No growth
Yeast and mold	Acidified potato dextrose agar after incubation at 28 °C for 5 days	No growth



Fig. no. Biotransformed Beetroot juice Gummies

- ❖ **Sensory evaluation 5 point hedonic scale graphical representation**



CONCLUSION

- ❖ Beetroot contains a variety of phytochemical compounds that enhance its biotherapeutic applications.
- ❖ LAB-treated beetroot exhibits improved functional food properties—higher bioactive pigment concentration, phenolic content, and antioxidant impact—making it more advantageous than untreated beetroot.
- ❖ This product could greatly help the preventive healthcare market by reducing lifestyle-related disorders through dietary intervention.
- ❖ Future research will focus on enhancing the stability and bioavailability of beetroot bioactive through advanced processing and formulation technologies to boost their efficacy in functional foods



Indian System of Medicine

The following different categories

Aristha and Asavsa

Rasa Rasayan

Lauha Bati

Churna

Avaleha

Ghrita

Parpati

Taila

Goggulu

INDIAN SYSTEMS OF MEDICINE

➔ Preparation and standardization of Ayurvedic formulations

Aristas and Asawas, Ghutika, Churna, Lehya and Bhasma

4. Churna → Churna is ultrafine solid dosage form of drugs.

Churna



Fermented mixture is then clarified staining through a muslin cloth

Fermented liquor

Arista
main.

Powder drug

Asa

Distill
Suras/wi





Recent Research in Science and Technology 2010, 2(10): 59-62
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MICROBIOLOGY

SCREENING ANTIBACTERIAL ACTIVITY OF SOME BHASMA (METAL-BASED HERBAL MEDICINES) AGAINST ENTERIC PATHOGENS

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Department of Microbiology, S.G.B. Amravati University, Amravati- 444602, India

Abstract

Bhasma has been used along with appropriate herbs for treatment of critical ailments as medicinal preparation in Ayurveda. Very little or no published information is available on the antibacterial activity of Bhasmas. Considering the use of Ayurvedic metal based herbal preparations to treat various disorders, we studied the antibacterial potential of some Ayurvedic preparations such as Mandura bhasma, Tamra bhasma, Lauha bhasma and Kashis bhasma against enteric bacterial pathogens such as *Escherichia coli*, *Staphylococcus aureus*, *Enterobacter aerogenes*, *Pseudomonas aeruginosa*, *Bacillus subtilis*, *Klebsiella pneumoniae*, *Salmonella typhi*, *Staphylococcus epidermidis*, *Salmonella typhimurium* and *Proteus vulgaris* using a disc diffusion method. The results revealed that Tamra bhasma possesses strong antibacterial activity while Lauha bhasma and Mandura bhasma showed significant antibacterial activity. Study suggest that the use these bhasma may useful to control the enteric bacterial infection.

Keywords: Antibacterial activity, Bhasma, Enteric bacterial pathogens

Introduction

In India, many ayurvedic herbo-mineral preparations (Bhasmas) traditionally are used for the treatment of chronic ailments. Metals have been used in disease treatment since time immemorial. Gold in medicine was mentioned by Roman physician Pliny and Greek philosopher Dioscrides. Hippocrates, the father of modern medicine, explained the beneficial healing and anti-disease properties of silver. In olden days, people used silver bottles for storing water, wine and milk and to prevent spoiling (Nadkarni, 2005). In

diabetic ulcer, warts, vitiligo and leprosy are well studied (Joseph, 2008). Most of the medicines are mixture of compounds and because of its synergistic action; toxicity is being diminished, thereby increasing bioavailability through the cells of the body. Various commercially available medicines such as Lauha bhasma, Mandura bhasma, Tamra bhasma etc these medicines are particularly used for treating infectious diseases. So far, little is known about the antibacterial properties of these medicines and the scientific basis of its application in treating infectious bacterial diseases. Hence the attempt was made to determine the antibacterial properties of some available (Bhasma)

[Journal List](#) > [J Adv Pharm Technol Res](#) > [v.2\(1\); Jan-Mar 2011](#) > PMC3217688

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PMCID: PMC3217688

PMID: [221712](https://pubmed.ncbi.nlm.nih.gov/221712/)

Antibacterial activity of some Indian Ayurvedic preparations against enteric bacteria pathogens

[D. H. Tambekar](#) and [S. B. Dahikar](#)

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An Indian Journal

Full Paper

NPAIJ, 4(1), 2008 [95-98]

The antibacterial potential of clinically used herbal decoctions available in India

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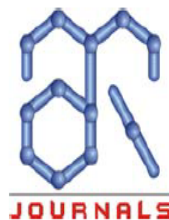
Received: 15th January, 2008; Accepted: 20th January, 2008

ABSTRACT

Due to side effects of synthetic products, herbal products are gaining popularity in the world market. Herbal remedies have been used for the prevention and treatment of disease and for healing purposes since before the beginning of human civilization. The purpose of this experiment was to determine the antibacterial effect of herbal decoctions available in Market against enteric bacterial pathogens. Some herbal decoctions were procured from the local market such as Gokharu kadha (Sandu Brothers), Triphala kadha (Sandu Brothers), Mahamanjishthadi kadha (Baidyanath), Mahasudarshan kadha (Baidyanath). The aqueous solutions of these decoctions were prepared and then tested for their antibacterial activity against enteric pathogens such as *Escherichia coli*, *Staphylococcus aureus*

KEYWORDS

Antibacterial activity;
Herbal decoctions;
Enteric bacterial pathogens.



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Research article



ISSN: 0975-0185

Evaluation of antibacterial potential of Trikatu churna and its ingredients: An *in vitro* study

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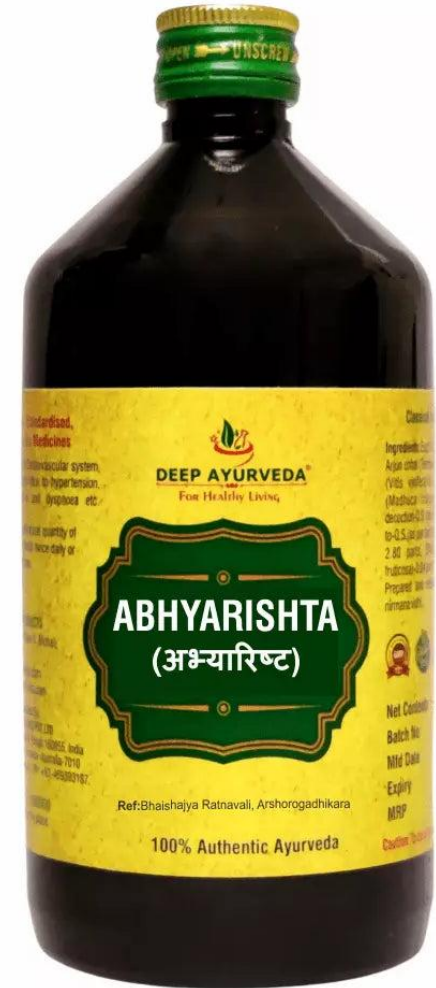
2. Department of Microbiology, Sant Gadge Baba Amravati University, Amravati - 444602, (INDIA)

Abstract

Herbal medicines are being used increasingly as dietary supplements to fight or prevent common disease. The dried fruits of *Piper nigrum* L. (Piperaceae), *Piper longum* L. (Piperaceae) and rhizome of *Zingiber officinale* Roscoe. (Zingiberaceae) were powdered and mixed together in equiproportions to get a polyherbal formulation, Trikatu churna. The aqueous, ethanol, methanol and acetone extracts of these plant's fruits and Trikatu churna were prepared and antibacterial activities were tested by disc diffusion method against enteric bacterial pathogens such as *Escherichia coli*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Proteus vulgaris*, *Staphylococcus epidermidis*, *Salmonella typhi*, *Salmonella typhimurium* and *Enterobacter aerogenes*. The extracts of *Piper longum*, *Piper nigrum* and *Zingiber officinale* were found antibacterial to all bacterial pathogen tested. Trikatu churna exhibited potent antibacterial activity; this might be due to the multifunctional effect of all the three plant ingredients of Trikatu churna. Antibacterial activity of Trikatu churna and its ingredients was carried out in attempt to support the use of Trikatu churna for the treatment of enteric

Aristha and Asava

Asavas and Aristhas are made by soaking the herbs either in powder form or in the form of decoction (kasaya) in a solution of sugar or jaggery, as the case may be, for a specific period of time, during which it undergoes a process of fermentation generation alcohol and facilitates the extraction of the active ingredients contained in the herbs.



Considerations and Challenges

- The molecular mechanisms and their interactions with intestinal microorganisms remain poorly understood
- *In vitro* and *in vivo* experiments have shown that the phytochemicals could reduce the appearance of dysbiosis, the damage to the intestinal barrier, and bacterial translocation and can protect against gastrointestinal problems through various biochemical reactions and physiological processes



future directions

- ✓ Developing **plant-based probiotic carriers** is essential in promoting healthier alternatives to dairy-based substrates.
- ✓ The range of **plant phytochemicals** and the critical quality indicators of foods aids in producing high-quality functional foods.
- ✓ The challenges in maintaining the high viability of probiotics in these types of **functional foods/dietary supplements** as well as the physicochemical parameters, must be carefully controlled to guarantee functional properties

CONCLUSION

The substrates represent potential carriers for **probiotics**, **prebiotics**, and **bioactive compounds**, being a biotechnological alternative in developing bioprocesses in the **current nutritional** and **pharmaceutical areas for optimal health**

FURTHER RESEARCH

Further research should be complemented by a comprehensive study of the parameters of the fermentation process, the confirmation through in vitro and in vivo studies of the proposed health claims for fermented plant substrates, including selected native microorganisms, and the bioprospecting of new strains with probiotic potential isolated from plant matrices and the generation of postbiotics

Our team



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THANK YOU!

Any questions?

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