# Functional Foods: Beyond Basic Nutrition

International Life Sciences Institute-India

ILSI-India is a branch of International Life Sciences Institute with Head Quarters in Washington D.C. It works on issues relating to food safety, nutrition, toxicology, risk assessment, biotechnology and environment. It works very closely with industry, R&D organizations, government departments, Ministry of Food Processing Industry, Ministry of Health, Department of Biotechnology, Ministry of Science and Technology and other international organizations like Food of Agriculture Organization of United Nation, UNICEF and WHO.

ILSI -India carries out its mission through sponsoring workshops, conferences, seminars and training programs. It also brings out publications and organizes educational programs. ILSI-India activities cover India and South Asian Region.

The "International Life Sciences Institute (ILSI)" is a nonprofit, worldwide foundation based in Washington D.C. established in 1978 to advance the understanding of scientific issues relating to nutrition, food safety, toxicology, risk assessment, and the environment. ILSI branches include Argentina, Brasil, Europe, India, Japan, Korea, Mexico, North Africa and Gulf Region, North America, North Andean, South Africa, South Andean, Southeast Asia Region, the Focal Point in China, and the ILSI Health and Environmental Science Institute. ILSI also accomplishes its work through the ILSI Research Foundation (composed of the ILSI Human Nutrition Institute and the ILSI Risk Science Institute) and the ILSI Center for Health Promotion.

By bringing together scientists from academia, government, industry and the public sector, ILSI seeks a balanced approach to solving problems of common concern for the well being of the general public. ILSI receives financial support from industry, government, and foundations.

ILSI has a non-governmental status with World Health Organization and a special consultative status with Food and Agriculture Organization of the United Nation.

# Preface

Functional foods have been rediscovered. More than twenty-five centuries back the role of foods for more than normal nutrition was recognized which, to an extent, blurred the distinction between foods and medicine. Now, with the advancement of science, it has been possible to understand how foods prevent or reduce risk of disease.

Many foods contain chemicals which can fight disease and improve quality and length of life. These foods, called functional foods, have now attracted a lot of attention because of the aggressive invasion by non-communicable diseases, the high cost of their treatment and the time it takes for their cure.

There are a number of phytochemicals in plants, fruits and vegetables which offer protection against diseases. Lycopene in tomatoes, allicin in galic, or antioxidants in tea and spinach neutralize free radicals and fight against diseases like cardiovascular diseases, cancer, etc. Technology has also made it possible to separate these phytochemials, encapsulate them or add them to other foods into neutaceuticals which can give even enhanced benefits.

In spite of their long history, functional foods have been scientifically investigated only recently first in Japan with FOSHU. Functional foods are now accepted as an excellent means to resist the onslaught of non-communicable diseases and have produced interesting science and spawned expanding industry in most countries.

ILSI and some of its branches recognized the importance of functional foods quite some time back and through extensive debates formulated the basis for regulation of health claims based on science. Last year ILSI-India organized a Conference to update knowledge about functional foods and identify Indian foods that have strong functionality in reducing disease risk.

Apart from fruits and vegetables, India has the added advantage of spices and herbs. These possess functionalities which have been extensively explored in Ayurveda.

This Monograph captures some of the important suggestions made at the Conference and supplemented by the participants later. It is the first step taken by ILSI-India to disseminate information about functional foods and, it is hoped, will inspire the consumers to adopt functional foods and scientists to undertake further research.

**D. H. Pai Panandiker**
**Chairman, ILSI-India**

**15th April 2012**

# Contents

## Functional Foods: Beyond Basic Nutrition

# Functional Foods: Beyond Basic Nutrition

## Introduction

*The ancient Hindu religious literature (Vedas) says that "Annam is Aham" meaning 'you are what you eat'. Similar approaches were espoused by Hippocrates in fourth century BC. "Let food be your medicine", he said, "and medicine be the food". Current science reinforces these statements.*

Science has now enabled us to understand the chemical composition foods, body metabolism, to help us make food choices which can prevent and reduce risk for diseases..

Through much of its history, nutrition has concerned itself with appropriate diet which can be insurance against many diseases. The selection of a balanced diet, which provides adequate intake of nutrients in keeping with basic metabolism and physical activity, remains the cornerstone of sound nutrition. Though many people intend to eat a healthy diet they fail to do so mainly for reasons of busy lifestyle, appetizing tastes of non- healthy foods or long preparation time. This has created a demand for convenience food as well as for foods that provide health benefits. It is now possible to create foods with specific characteristics that are capable of influencing body functions over and above meeting the basic nutrition needs. These foods have come to be known as "functional" foods, although at some level all foods are functional. But the specially designated functional foods would additionally have the potential to promote long-term health, improving both physical and mental health and well-being.

## 1. Nutrition And Health

With economic progress the way we live has undergone basic changes. No doubt, these changes have also improved, in some respects, the quality of life and means to handle disease which have extended life expectation. At the same time there is a shift from rural to urban centres, from vigorous physical activity to sedentary habits, rise in consumption of unbalanced diets leading to problems of overweight or obese and higher incidence of non-communicable diseases such as diabetes, cardiovascular diseases, chronic respiratory diseases and so on.

Science offers tools to maintain healthy life if only we choose our foods appropriately and opt for life styles which ensure energy balance.

Not all people are able to afford and fewer still can design their daily diets in a way that they meet the recommended daily allowances (RDAs) for different vitamins, minerals and trace materials. Many people therefore suffer micronutrient deficiencies which give rise to a variety of health problems. For instance, there has been a steady accumulation of evidence that iron deficiency anemia limits maximal physical performance, sub-maximal endurance, and spontaneous activity in the adult, resulting in diminished productivity with attendant economic losses, iron and iodine deficiency adversely affect the cognitive development in children. Vitamin D deficiency adversely affects bone health in children and adults. Vitamin A is deficiency affects night vision, growth and repair of tissues, and immune system functions. Lack of folate and folic acid hamper for red

blood cell formation, protein metabolism, cell division and growth. Lack of Zinc adversely affects immune system, digestion, stress level, energy metabolism etc.

Micronutrient deficiencies are widespread, the problem being more severe in children in developing countries like India. Micronutrient deficiencies which have resulted in stunting and wasting. Partly the problem is with mothers who are themselves deficient in micronutrients, particularly iron, and consequently transmit the deficiency to the children.

Increasing attention needs to be paid to these deficiencies which can have long term consequences. Appropriate food intake particularly in the formative years of life is extremely important.

Hence it is important to adopt a different nutrition strategy to make up for the deficiencies or build up strengths that will help withstand the onslaught of non-communicable diseases.

## 2. Functional Foods As An Option

In recent years there has, therefore, been interest in functional foods and it has been increasing considerably because of the growing health consciousness among the public, new research outcomes, and the increased incidence of non-communicable diseases due to urbanization.

Functional foods can be divided into two categories:

- First, natural foods, mainly foods and vegetables which are loaded with antioxidants, phytochemicals and physiologically active components that protect humans from illness or enhance their health.
- Second, functional foods which are processed and modified for bioactive ingredients.

Processed functional foods enhance, add, remove or replace one or more of the components in food with special qualities by enzymatic, chemical or technological means or increase the bioavailability of these components.

Broadly, functional foods, whether natural or processed promote better physical and mental health, reduce risk of diseases like cancer, CVD, diabetes, etc, enhance immunity and slow down aging. No wonder people have been taking interest in functional foods to increase health benefit and reduce disease risk. Presently, the market in India for functional foods is estimated at over Rs.600 billion or $12 billion. What is surprising, it is growing at the rate of nearly 33% per year.

## 3. WHO Report

Consumers from all over the world are looking for health foods which can, not only prevent diseases but promote health and well being. New science based investigations are emerging which appear to confirm the traditional use of some of these foods as well as support the long history of their use. Mounting heath care costs and the consumer desire to maintain health and quality of life have led scientists to focus attention on different foods that can reduce the risk of non-communicable diseases.

In May 2004, the World Health Organization (WHO 2004) published a report on a “Global Strategy on Diet, Physical Activity and Health “. The Report states that the burden of non-communicable diseases has rapidly increased and lack of sufficient actions to prevent these diseases presents a major challenge to global public health.

The WHO not only highlights the type of overall dietary change it sees as necessary but also refers to “functional

foods" as foods aiming for specific health purposes, including mental and physical performance. Thus within the global strategy, functional foods could play an important role in the risk – reduction of non-communicable diseases and by providing benefits beyond normal nutrition and in optimizing health and general wellbeing.

## 4. Food Functionality: Defining the Concept

The term "functional foods" may have gained prominence only in recent years, but in Asia, foods with functional properties have been regarded as an integral part of some cultures for centuries.

The first systematic exploration of the positive aspects of food functionality was undertaken in Japan. Research programs funded by the Japanese government during the 1980s focused on the ability of some foods to influence physiological functions. This led, in 1991, to the definition in Japanese law of a category of "foods for special dietary use", which were allowed to carry claims for specific health effects on their labeling. The claims had to be substantiated in order to receive the approval of the Japanese Ministry of Health and Welfare, and the foods could then be designated as "Foods for Specified Health Use" (FOSHU).

In the latter half of the 1990s the European Commission funded an activity to establish a science – based approach to exploring the concept of functional foods. This Concerted Action, "Functional Food Science in Europe" (FUFOSE). Involved a large number of European experts in nutrition and related sciences and produced a consensus report that has become widely used as a basis for discussion and further evolution of thinking on the topic. FUFOSE developed a working definition of a functional food as one that 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 an improved state of health and well-being and/or reduction of risk of disease". In the context of this working definition, a "target function "is a biological activity ongoing in the body that is a target for intervention with a view to the maintenance or improvement of health and well-being and / for reduction of risk of disease.

From a practical point of view, a functional food can be:

- A natural, unmodified food
- A food in which one of the components has been enhanced through special growing conditions, breeding or biotechnological means
- A food to which a component has been added to provide benefits
- A food from which a component has been removed by technological or biotechnological means so that the food provides benefits not otherwise available
- A food in which a component has been replaced by an alternative component with favorable properties
- A food in which a component has been modified by enzymatic, chemical or technological means to provide a benefit
- A food in which the bioavailability of a component has been modified
- A combination of any of the above.

Processed foods with functional qualities have attracted a lot more attention. That is because with the new researches it has been possible to identify the bioactive ingredients in foods that make foods functional. Some foods like fruits, vegetables, fish and whole grain products may have some of the substances such as fibre, omega-3 fatty acids, lycopene and lutein etc. which go beyond normal nutrition and provide additional health benefits. Foods fortified with omega-3 fatty acid, spreads that contain plant sterols, foods enriched with folate, enhance

health effects of foods. Plant sterols, for instance, can reduce LDL by 6-15 %. So also oats. Fortified milk improves bone mineral status and lowers risk of osteoporosis. Foods fortified with minerals and beverage like Iron, Vitamin A and or Iodine offer many health benefits without requiring any change in the eating habits.

Processing may greatly affect the active ingredient which provides the health benefit. There are many different processes with different effects on quality of foods as well as on the active ingredient present in the food. At times modern technology provides a process which is low temperature process to provide the same high quality product but would not harm the active ingredient. On the other hand, some changes in the formulation and/or processing can provide increased effectiveness of functional foods. Some of the ingenious ways have been used to incorporate these substances into food products.

## 5. Key Aspects of Functional Foods

India has a rich history of having a variety of traditional and ethnic foods with functional attributes. From an Indian context, functional foods include everything from herbal extracts to functional ingredients and from nutritionally improved common foods to even exotic ingredients added to it.

All functional foods should however conform to the general requirement that it must be safe. In any discussion of food functionality, in either a regulatory or a scientific context, there is no consideration of a trade-off between health benefit and health risk. Whether a food is considered to be functional or not, it must always be safe.

### *Functional Foods Are Not Medicines*

Functional foods are not medicines. Although they are intended to modify the physiological functions within the body in a positive way, their mode of action is to restore, reinforce or maintain normal body processes in ways consistent with normal physiology. Medicines on the other hand function by intervening in disturbed physiological processes or by amplifying physiological processes beyond normal ranges in order to achieve an effect. As a general rule functional foods are intended to be consumed as part of normal diet and take the form of food or beverages.

### *Benefits of Functional Foods*

The bio components in functional foods act and benefit in a variety of ways. To illustrate, functional foods help in:

- Early development and growth
- Regulation of energy balance and body weight
- Cardiovascular function
- Defence against oxidative stress
- Intestinal functions - the gut micro flora
- Mental state and performance
- Physical performance and fitness
- Bone Health modification
- Improving micronutrient status
- Regulating hormones
- Modifying glycemic response
- Slowing the ageing process

The predominant benefit from functional foods is in respect of prevention and control of non-communicable diseases by neutralizing free radicals, reducing weight and building up immunity.

### *What Makes Foods Functional?*

- Many fruits, vegetables, spices, etc., contain elements which, apart from normal nutrition requirements, help counter diseases and are therefore

considered functional foods. The identification of ***biochemical ingredients*** that make foods functional has enabled separation of these biochemical from food. Lycopene in tomatoes, allicin in garlic, a variety of ***antioxidants*** that neutralize free radicals came to be separated from foods to manufacture nutraceutical. That has blurred the difference between foods and medicines.

Plant polyphenols, phytoestrogens, phytosterols and other phytophenols including organic acids and depsides together comprises the major active secondary metabolite compounds which are chiefly responsible for free radical scavenging , anti-proliferative, antitumor, anti-inflammatory , antibacterial, antifungal, antiviral, antineoplastic, hepatoprotective, immunomodulating and pro-apoptotic activities and prevention and amelioration of diseases like cancer, atherosclerosis and other chronic diseases. Much of the health-promoting effects of these compounds can be associated with ***antioxidant activity*** and may relate to interactions with key enzymes, signalling cascades involving cytokines and transcription factors or antioxidant system.

Antioxidants protect the cells from the mischief of free radicals. The latter are molecules which are produced during digestion of food or from smoking or from other environmental exposures. The free radicals damage organs in the body and can cause heart disease, cancer, etc. The antioxidant measure of different foods and the damage and disease caused by free radicals are indicated below.

**Fig. 1: Antioxid nt Measures**

| Item | Antioxidant Capacity (μ mol Trolox/g DM) |
|---|---|
| Black Tea | 927 |
| Green Tea | 814 ± 30 |
| Spinach | 129 ± 6 |
| Beet | 81 ± 25 |
| Leaf Letuce | 49 ± 7 |
| Cauliflower | 46 ± 11 |
| Garlic | 46 ± |
| Onion | 40 ± 2 |
| Cabbage | 32 ± 2 |
| Carrot | 26 ± 8 |
| Corn | 22 ± 4 |
| Potato | 15 ± 5 |
| Cucumber | 15 ± 2 |
| Sweet Potato | 14 ± 2 |

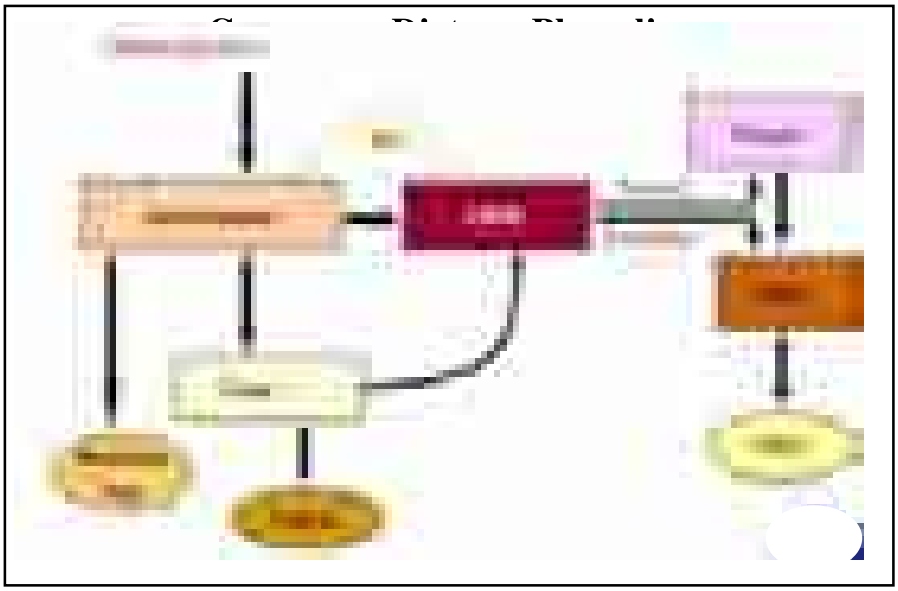
J. Agric. Food Chem. 1996, 44, 3426-3431

**From Presentation on Plant Polyphenols, Phytosterols, and Other Antioxidants at ILSI-India Conference on Processed Foods and Beverages for Health: Beyond Basic Nutrition By, Dr. H P Singh, Sr. Scientist, Institute of Himalayan Bioresource Technology**

**Fig. 2: Free Radical Damage And Health**


**From Presentation on Plant Polyphenols, Phytosterols, and Other Antioxidants at ILSI-India Conference on Processed Foods and Beverages for Health: Beyond Basic Nutrition By , Dr. H P Singh, Sr. Scientist, Institute of Himalayan Bioresource Technolgy**

**Fig. 3: Consumed Dietary Phenolics Metabolism in Humans**



**From Presentation on Plant Polyphenols, Phytosterols, and Other Antioxidants at ILSI-India Conference on Processed Foods and Beverages for Health: Beyond Basic Nutrition By , Dr. H P Singh, Sr. Scientist, Institute of Himalayan Bioresource Technology**

There is overwhelming evidence from epidemiological, in vitro, in vivo and clinical data trials that indicate that functional foods from plant and animal sources can reduce the risk of non communicable diseases like diabetes, cardiovascular diseases and cancer.

- There has been considerable research on edible oils and fats to identify their impact on health parameters. Some oils which are health promoting and contain components like , for instance omega 3 and omega 6 fatty acids which help improve HDL and promote cardiovascular health. The choice of oils and fats in daily diet is critical and when judiciously made can ensure better health and longer life.

***Probiotics And Prebiotics***

- A special mention needs to be made of pro-biotics and pre-biotics with established functionality.The GI tract harbors a diverse, complex and dynamic community of microbial flora called the intestinal micro biota which has evolved in symbiosis with its host exerting several trophic, metabolic and protective effects. The continuous interaction between the gastro intestinal epithelial cell monolayer and intestinal micro biota forms a functional relationship that profoundly contributes to the host intestinal development, nutrition, immunity and intestinal epithelial homeostasis. Manipulation of the intestinal micro biota is emerging as a potential alternative therapy for prevention and treatment of IBD, IBS, cancer, etc.
- Prebiotics targets indigenous beneficial bacteria already established in the gut. They are non-digestible food ingredients that stimulate the growth and / or activity of one or a limited number of bacteria that improve host health. They are distinct from most dietary fibres like pectin, celluloses, xylan, which are not selectively metabolized in the gut. Some prebiotics, like inulin, occur naturally in several foods such as leek, asparagus, chicory, garlic, artichoke, onion, wheat, banana and oats, as well as soybean. However, these foods contain only trace levels of prebiotics. Hence the active ingredients from such sources are removed and added to more frequently consumed products in order to attain levels whereby a prebiotic effect may occur, e.g. cereals, confectionery, biscuits, infant feeds, yoghurts, table spreads, bread, sauces, drinks, etc.
- Foods fortified with multiple micronutrients offer many health benefits. Almost any food or beverage like wheat flour, salt, sugar, bakery items, breakfast cereals, milk and dairy products and fruit juices can be fortified.

***Communicating Benefits To The Consumer***

The new knowledge developed through scientific investigations should be shared to benefit the society. Nutrition science has made considerable difference to what people eat and has undoubtedly helped them to improve their health and lengthen their life. Although functional foods have long history, the recent knowledge about functional foods needs to be communicated to the people with the principal objective of reducing the incidence of non-communicable diseases.

Fruits and vegetables are natural functional foods and every functional food has a message to the consumer. Tomato, broccoli, mushrooms, reduce cancer risk; garlic, oats, reduce risk of cardiovascular diseases; blackberries, cocoa, tea, nuts are excellent antioxidants and slow down aging; strawberries strengthen the immune system, and so on. It is important to communicate the benefits of functional foods to all stakeholders.

The simplest way of communicating benefits of functional foods to consumers is through food labeling and claims

which should be reliable and simple to understand. Claims could be health claims and claims about reduction of disease risk. Codex Alimentarius has subdivided health claims into two: nutrient function claims and other function claims.

Essentially health claims describe the physiological role of a nutrient in growth, development and normal functions of the body, or they refer to specific beneficial effects of foods or food components beyond their generally accepted nutritional effects, other than the reduction of disease risk. For example, a claim might say that calcium aids in the development of strong bones and teeth and then draw attention to the calcium content of the food for which the claim is made. Or, it might say that consumption of a particular food helps to maintain a high state of mental alertness or physical performance.

Claims referring to reduction of disease risk are claims that consumption of a food or one of its components reduces a risk factor in the development of a human disease. For a claim to be truthful, it must accurately reflect its underlying basis. Substantiation of the claim should be based on a systematic review of the evidence relevant to the claim and an assessment of whether the wording of the claim is fully consistent with scientific evidence.

Several guidelines have been developed. For example, those in the USA, Canada, Australia / New Zealand and the UK provide detailed guidance on the nature of scientific evidence to be provided and suggest how it should be evaluated. In Europe, "Process for the Assessment of Scientific Support for Claims on Foods" (PASSCLAIM) provides the generic tool to assess the scientific support for health- related claims for foods and food components.

***The Role Of Technology***

Food to food fortification, sprouting, malting and fermentation are processes that enhance the functional properties of food.

Technology in food processing is an established part of the food chain. It serves to convert raw materials into edible, safe and nutritious food with the taste and texture, shelf life and convenience to suit everyday needs. Technology also provides the means to extract components with functionality from foods and raw materials and to optimize their form and chemical structure to make them suitable for inclusion in new food products. The extraction of phytosterols from plant sources and their esterification, either as sterols or in hydrogenated form as stanols, to enable them to be incorporated into products for use in reducing serum LDL-cholesterol provides an example of this. As more food components with the desired functionality are identified, technology has the potential to maximize their accessibility and availability so that they become available on an everyday basis in a form that suits consumers' needs and preferences.

Technology can help to achieve this goal in three ways:

- By creating new functional food components in traditional materials, in new raw materials or by synthesizing.
- By maximizing the presence of functional food components already existing in foods and raw materials by improving their preservation, modifying their function by increasing their bioavailability.
- By providing the means to monitor the amount and effectiveness of functional components in foods and materials to ensure that they are retained to the maximum degree at all stages in the food chain.

## 6. Functional Foods With Health Benefits

It is not enough merely to know about functional foods generally but to identify the functional qualities of each functional food so that the consumer is able to select the food that will be of benefit to him. ILSI-India therefore consulted a number of experts for their suggestions about functional foods, their functionality in relation to particular disease and the benefit that can be derived.

Appendix I gives a list of functional foods with their health benefits. The list is not complete and ILSI-India will update it at different intervals to take account of the new researches that are made.

Appendix II outlines the benefit of different bioactive components and the foods in which they are predominantly found. Foods fortified with minerals and vitamins are also considered as functional foods, however, these appendices provide information on the functional components and bioactive ingredients in natural fruits, vegetables, spices and herbs.

In the Appendices names are mentioned of experts who made presentation at the Conference that ILSI-India had organized in Delhi in 2012 and which have been drawn on extensively in the Monograph, as also of the names of experts who gave suggestions about functional foods and their benefits.

## Bibliography And Further Readings


1. Aggett PJ, ANTOINE J-M, Asp N-G, Bellisle F, Contor L, Cumming JH, Howlett J, Muller DJG, Persin C, Pijls LTJ, Rechkemmer G, Tuijtelaars S, Verhagen H, (2005) PASSCLAIM: Process for the assessment of scientific support for claims made on foods. Consensus on criteria. European Journal of Nutrition 44 (suppl 1): I/5-I/30.
2. Andersson H, Asp N-G, Bruce A, Roos S, Wadstrom T, Wold AE, (2001).Health effects of probiotics and prebiotics: a literature review on human studies. Scandinavian Journal of Nutrition 45:58-75.
3. Asp N-G Cumming JH, Mensik RP, Prentice A, Richardson DP, Saris WHM, (eds) (2003). PASSCLAIM: Process for the assessment of scientific Support for claims on foods. Phase one: preparing the way. European Journal of Nutrition 42 (Suppl 1): I/3-I/119.
4. Asp N-G , Cumming JH, Howlett Rafter J, Riccardi G, Westenhoefer J, (eds) (2004). PASSCLAIM: Process for the assessment of scientific support for claims on foods. Phase two: moving forward. European Journal of Nutrition 43 (Suppl 22): II/3-II/183.
5. Chaplin S, (2005). Type @ diabetes prevention and management. ILSI Europe Concise Monograph Series. ILSI Press, Washington, DC.
6. Corthesy-Theulaz I, den Dunnen JT, Ferre P, Geurts JMW, Muller M , van Belzen N, can Ommen B, (2005).Nutrigenomics: the impact of biomics technology on nutrition research. Annals of Nutrition and Metabolism 49:335-365.
7. Diplock AT, Aggett PJ, Ashwell M, Bornet F, Fern EB, Roberfroid MB,(1999).Scientific concepts of functional foods in Europe: consensus document. British Journal of Nutrition 81(Suppl): S1-S27.

8. FAO/WHO (2001) Report of a Joint FAO/WHO Expert Consultation on the evaluation of Health and nutrition properties of probiotics in food including powder milk with live lactic acid bacteria, Cordoba, Argentina 1-4 October 2001. FAO, Rome.

9. Food Standards Australia New Zealand (FSANZ) (2004). Initial assessment report: proposal P293: Nutrition , health and related claims , August 2004.

***Available at: http//*** *WWW.foodstandards.gov.au*

10. Gibson GR, Roberfroid MB< (1995).Dietary modulation of the human colonic microbiota: introdfrucing the concept of prebiotics. Journal of Nutrition 125:1401-1412.

11. Harland JI, (2005). Nutrition and genetics: mapping individual health. ILSI Europe Concise Monograph Series. ILSI Press, Washington, DC.

12. Health Canada (2002). Interim guidance document-preparing a submission for foods with health claims: incorporating standards of evidence for evaluating foods with health claims. Bureau of Nutritional Sciences, Food Directorate, Health Products and Food Branch, Health Canada, Ottawa.

***Available at:*** *http://WWW.hc-sc.gc.ca*

13. Joint Health Claims Initiative (2002). Guidelines for preparing dossiers to substantiate health claims, February 2002. Joint Health Claims Initiative, UK.

***Available at:*** *http//WWW.jhci.org,uk*

14. Rchardson DP, Affertsholt T, Asp N-G Bruce A, Grossklaus R, Howlett J, Pannemans D, Ross R, Verhagen H, Viechtbauer V, (2003). PASSCLAIM-Synthesis and review of existing processes. European Journal of Nutrition 42 (Suppl 1): I/96-I/111.

15. Clydesdale FM. A proposal for the establishment of scientific criteria for health claims for functional foods. Nutr Rev. 1997 Dec;55(12):413-22. Review.

16. Arvanitoyannis IS, Van Houwelingen-Koukaliaroglou M. Functional foods: a survey of health claims, pros and cons, and current legislation. Crit Rev Food Sci Nutr. 2005;45(5):385-404. Review.

17. Coates PM , Milner JM, Bioactive components in food and supplements for health promotion in In:Bowmann BA , Russel RM,eds.Present knowledge in nutrition. Washington DC: International Life science Institute:959-967, 2006

18. Fogliano V, Vitaglione P. Functional foods: planning and development. Mol Nutr Food Res. 2005 Mar;49(3):256-62. Review.

19. International life science institute, Europe, Dietary fibre. ILSI Europe concise monograph series.2006.

20. R.D. Sharma, An evaluation of hypocholesterolaemic factor of fenugreek seeds (T. foenum graecum) in rats. Nutr Rep Int. 1986;33:669–677

21. Sharma RD, Raghuram TC. Hypoglycaemic effect of fenugreek seeds in non-insulin dependent diabetic subjects. Nutr Res 1990;10:731–739

22. Sharma RD. Effect of fenugreek seeds and leaves on blood glucose and serum insulin responses in human subjects. Nutr Res 1986;6:1353-64

23. Raghuram TC, Sharma RD, Sivakumar B, et al. Effect of fenugreek seeds on intravenous glucose disposition in non-insulin dependent diabetic patients. Phytotherapy Research 1994;8(2):83-86

24. Broca C, Manteghetti M, Gross R, Baissac Y, Jacob M, Petit P, Sauvaire Y, Ribes G. 4-Hydroxyisoleucine: effects of synthetic and natural analogues on insulin secretion. Eur J Pharmacol. 2000 Mar 3;390(3):339-45

25. Srinath Reddy K, Katan MB. Diet, nutrition and the prevention of hypertension and cardiovascular diseases. Public Health Nutr. 2004 Feb;7(1A):167-86. Review

26. Kris-Etherton P, Daniels SR, Eckel RH et al. Summary of the scientific conference on dietary fatty acids and cardiovascular health: conference summary from the nutrition committee of the American Heart Association. Circulation. 2001 Feb 20;103(7):1034-9.

27. Dietary supplementation with n-3 polyunsaturated fatty acids and vitamin E after myocardial infarction: results of the GISSI-Prevenzione trial. Lancet. 1999 Aug 7, 354(9177):447-55

28. Kendall CW, Jenkins DJ. A dietary portfolio: maximal reduction of low-density lipoprotein cholesterol with diet. Curr Atheroscler Rep. 2004 Nov;6(6):492-8. Review

29. de Lorgeril M, Salen P, Martin JL, Monjaud I, Delaye J, Mamelle N. Mediterranean diet, traditional risk factors, and the rate of cardiovascular complications after myocardial infarction: final report of the Lyon Diet Heart Study. Circulation. 1999 Feb 16;99(6):779-85

30. Hasler CM, Bloch AS, Thomson CA et al. American Dietetic Association. Position of the American Dietetic Association: total diet approach to communicating food and nutrition information. J Am Diet Assoc 2002;102:100-8

31. Castro IA, Barroso LP, Sinnecker P. Functional foods for coronary heart disease risk reduction: a meta-analysis using a multivariate approach. Am J Clin Nutr. 2005 Jul;82(1):32-40. Review.

32. Doll R, Peto R. The causes of cancer: quantitative estimates of avoidable risks of cancer in the United States today. J Natl Cancer Inst. 1981 Jun;66(6):1191-308. Review

33. Milner JA. Diet and cancer: facts and controversies. Nutr Cancer. 2006;56(2):216-24. Review.

34. Krishnaswamy K. Turmeric-The salt of the orient is the spice of life. New Delhi, India, Allied Publishers Pvt. Ltd., 2006.

35. Aggarwal BB, Kumar A, Bharti AC. Anticancer potential of curcumin: preclinical and clinical studies. Anticancer Res. 2003 Jan-Feb;23(1A):363-98. Review

36. Cheng AL, Hsu CH, Lin JK et al. Phase I clinical trial of curcumin, a chemopreventive agent, in patients with high-risk or pre-malignant lesions. Anticancer Res. 2001 Jul-Aug;21(4B):2895-900.

37. Hastak K, Lubri N, Jakhi SD et al. Effect of turmeric oil and turmeric oleoresin on cytogenetic damage in patients suffering from oral submucous fibrosis. Cancer Lett. 1997 Jun 24;116(2):265-9.

38. Sharma RA, McLelland HR, Hill KA et al. Pharmacodynamic and pharmacokinetic study of oral Curcuma extract in patients with colorectal cancer. Clin Cancer Res. 2001 Jul;7(7):1894-900.

39. N. Dhillon, R. A. Wolff, J. L. Abbruzzese, D. S. Hong, L. H. Camacho, L. Li, F. S. Braiteh and R. Kurzrock. Phase II clinical trial of curcumin in patients with advanced pancreatic cancer. Journal of Clinical Oncology, 2006 ASCO Annual Meeting Proceedings (Post-Meeting Edition). Vol 24, No 18S (June 20 Supplement), 2006: 14151

40. Vadhan-Raj S, , Weber DM, Michael Wang BS et al. Curcumin Downregulates NF-kB and Related Genes in Patients with Multiple Myeloma: Results of a Phase I/II Study. 1177 Blood (ASH Annual Meeting Abstracts) 2007 110: Abstract 1177

41. World Cancer Research Fund/American Institute for Cancer Research. Food, Nutrition, Physical activity and the Prevention of cancer: a Global perspective. Washinton,DC:AICR, 2007

42. Anura V Kurpad and Rebecca Raj. Anura. The Effect Of Ivy Gourd (Coccinia Cordifolia) Extract On Diabetic Patients.Bulletin of Nutrition Foundation Of India (NFI). 2002 Jan;1:1-5.

43. Ohama H, Ikeda H, Moriyama H. Health foods and foods with health claims in Japan. Toxicology. 2006 Apr 3;221(1):95-111. Epub 2006 Feb 20.

44. A European Commission Concerted Action Programme and ILSI Europe. Passclaim. http://europe.ilsi.org/passclaim.

45. Food Safety and Standards Act, 2006, Government of India

46. ILSI Europe Functional Foods Monograph by John Howlett, ttp://www.ilsi.org/Europe/Pages/ConciseMonographSeries.aspx

47 Report of the Regional Expert Consultation of the Asia Pacific Network for Food and Nutrition for Functional Foods and Their Implications in the Daily Diet: FAO RAP Publication 2004/33

48 Journal of Agriculture and Food Chemistry

49 Agriculture Research Magazine

50 European Food Research Technology (2006) 224: 109-115

51 PDR for Herbal Medicines, www.scribd.com

52 The FASEB Journal

53 Mayo Clinic: High Cholesterol

54 Clinical Biochemistry and Nutrition Journal

55 Papers presented at ILSI-India Conference on “Processed Foods and Beverages for Health : Beyond Basic Nutrition”, April 28-29, 2011

56 “Chemico-Biological Interactions”; Beneficial effects of Murraya koenigii leaves on antioxidant defense system and ultra structural changes of pancreatic â-cells in experimental diabetes in rats; Palanisamy Arulselvan, Sorimuthu Pillai Subramanian; January 2007

57 “Journal of Pharmaceutical Sciences and Research”; Pharmacological studies of anticancer, anti inflammatory activities of Murraya koenigii (Linn) Spreng in experimental animals; P.Muthumani, et al.; 2009

58 “Archives of Pharmaceutical Sciences and Research”; Effect of Murraya Koenigii leaves Extracts on Gastrointestinal motility: Involving Calcium Channel Innervation in Mice; S.V. Tembhurne, D.M. Sakarkar; October 2009

59 Report of ILSI-India Conference on Micronutrient Fortification of Foods: Science, Application & Management: www.ilsi-india.org

## Table 1: Examples of Select Functional Foods and Claimed Benefits Fruits and Vegetables

| S.No | Common Name | Scientific Name(If any) | Functional Component | Proposed Claimed Benefits |
|---|---|---|---|---|
| 1. | Pomegranate | Punica Linn | *Ellagic Acid, Quercetin, Gallic Acid Ellagitannins (Punicalagins) and Many Anthocyanins* | Beneficial in Dyspepsia, Gastro -Intestinal Disorders, Reduced Appetite, Diarrhoea. Nausea/Vomiting Epistaxis, Diabetes Antiatherogenic, Antioxidant, Anti - Hypertensive, Hypoglycaemic and Anti-Inflammatory Effects. |
| 2. | Banana,(Ripe) | Mangifera Linn | *Gallic Acid, Quercetin* | Invigorating & Refreshing, Laxative, Diuretic |
| 3. | Mango,(Ripe) | Mangifera Linn | *Gallic Acid, Quercetin* | Invigorating & Refreshing, Laxative, Diuretic |
| 4. | Jamun | Eugenia Jambolana or Syzygium Cumini L | *Phenols, Alkaloids* | Very Potent Hypoglycemic Action, Beneficial in Diarrhea & Dysentery, Piles |
| 5. | Tomato | Solanum Lycopersicum | *Lycopene* | Anti-Cancer |
| 6. | Amla ( Indian Gooseberry) | Emblica Officinalis | | Digestive, Stomachic, Carminative, Fever, Anaemia, Jaundice, Vomiting |
| 7. | Shatavari | Asparagus | *Asparagus Racemosus* | Rejuvinator, Intellect Promoting, Appetiser, Ophthalmic, Anti-Diarrhoeal, Intrinsic Haemorrhage, Night-Blindness |
| 8. | Isabgol | Psyllium Husk | *Plantago Ovata* | Effective for Constipation, Piles, Dysentery, Abdominal Pain |
| 9. | Neem | *Azadirachta Indica* | *Melia Azadirachta Linn* | Fungal, Bacterial and Other Skin Infections, Eczema. Diabetes Mellitus- as an Ancillary Agent. Dental Hygiene |
| 10. | Piyaj (Onion) | *Allium Cepa* | *Organosulphur: Allyl Sulfar,Diallyl Sulfide and Flavonoids* | Reduces Blood Sugar Levels in Experimental Diabetes. Inhibits Platelet Aggregation and Controls Higher Lipid Content in the Blood (Hyperlipidaemia) |
| 11. | Grain Products, Fruits and Vegetables | *Different varieties* will have different n scientific names | *Dietary Fiber, Fiber (Particularly Soluble Fiber)* | Cancer Risk Reduction; Risk Reduction Coronary Heart Disease |

| | | | | |
|---|---|---|---|---|
| 12. | Soybean | *Glycine Max* | *Phytosterols, Isoflavones, Saponins, Phenolic Acids, Phytic Acid* | Ant Carcinogens, Lowers Blood Cholesterol, Prevents Heart Diseases, Bone Health Healthy Brain Immune Function Meno Pausal Health |
| 13. | Broccoli and Other Cruciferous Vegetables | Brassica Oleracea, Different varieties of Cruciferous Vegetables will have different n scientific names | Glucosinolates are Converted to Indoles, Isothiacyanates | Cancer Risk Reduction |
| 14. | Papaya | Carica Papaya | Lycopene | Cancer, Heart Disease and Diabetes Risk Reduction |
| 15. | Watermelon | Citrullus Lanatus | Lycopene | Cancer, Heart Disease and Diabetes Risk Reduction |
| 16. | Mushroom | Fungi | Eritadenine | Lowers Blood Cholesterol |
| 17. | Marine Fish | Different species of Marine Fish will have different n scientific names | Omega 3 Fatty Acids (DHA, EPA) | Coronary Heart Disease Risk Reduction |
| 18. | Tea (Green and Black) | Camelia Sinensis | Flavonoids, Especially Catechins | Coronary Heart Disease Risk Reduction |
| 19. | Golden Kiwi | Actinidia Arguta | Antioxidant Nutrients & Polyphenols | Immunomodulatory, Inhibition of Platelet Aggregation and Lowered Tag Levels, Improves Gut Health Through Improving Laxation, Aiding Digestion and Promoting a Healthy Gut Microflora. |
| 20. | Goji Berry | Lycium Barbarum Var. Goji | Vitamin C, Beta-Sitosterol and Other Phytosterols, Carotenoids | Helps Strengthen Immunity |
| 21. | Plums- Fresh & Dried Plum (Prunes) | Prunus Domestica | Fiber, Sorbitol, Neochlorogenic and Chlorogenic Acids | Improves/Maintain Digestive Health & Heart Health and Supports Bone Health |
| 22. | Mangosteen | Garcinia Mangostana | Xanthones | Antioxidant, Antitumoral, Antiallergic, Anti-Inflammatory, Antibacterial, Antifungal and Antiviral Properties |
| 23. | Cranberry | Vaccinium Macrocarpum | Proanthocyanidins (Pacs) | Alleviates Symptoms of UTI |

| | | | | |
|---|---|---|---|---|
| 24. | Amla | Phyllanthus Emblica Officinalis | Hydrolysable Tannins Vitamin A, Vitamin C | Antioxidant Action, Immunomodulatory, Anti-Cancer Properties, Hepato-Protective Action, Anti-Ulcerative Action, Significant Adaptogenic and Anti-Stress Action, Prevent Inflamma tion, Age-Related Renal Disease, and Diabetes |
| 25. | Coconut Water | Cocos Nucifera L.) | Potassium & Other Electrolytes Salt , Cytokines | Isotonic, Diuretic, High Blood Pressure & Stroke Risk Reduction,Anti-Ageing, Anti-Carcinogenic, and Anti-Thrombotic Effects, Growth Promoting Properties, Body Application Prevents Prickly Heat and Summer Boils and Subsides the Rashes Caused by Small Pox, Chicken Pox, Measles, Etc, Checks Urinary Infections, Cures Malnourishment, |
| 26. | Noni (Indian mulberry) | Morinda Citrifolia, | Alkaloids | Anti diabetic |
| 27. | Eggs With W-3 Fatty Acids | | W-3 Fatty Acids | Heart Health |
| 28. | Yoghurt | | Bifido Bacteria | Improve Gut Health and Reduce Risk to Colon Cancer |
| 29. | Probiotic Dahi , Ice Cream or Other Probiotic Products | | Probiotic Microbes | Gut Health<br>Healthy Digestive System<br>Strengthen The Body`S Defense Against Infections and Diseases<br>Improves Immunity, Improves Digestion, Prevent Gut Infection, and Manages Traveler's Diarrhea. |
| 30. | Sweet Potato | *Ipomoea Batatas* | *Vitamin A, Dietary Fibre* | Strengthens Immune System_,_Maintains Healthy Digestive Tract, Helps with cholesterol Management, Diabetes and Insulin Resistance |
| 31. | Sorghum | *Sorghum Bicolor* | *Phenolics* | Helps with Diabetes, Insulin Resistance, Cholesterol Management |
| 32 | Bael | Aegle Marmelos | *Dieatary Fibre, Vitamin A* | Appetitiser, Help in Constipation Problem |
| 33. | Whey Drink | Sourced from Milk | *Whey Proteins* | Heart Health |
| 34. | Grape | Vitis | *Resveratrol* | Antifungal and Defensive Properties |

| | | | | |
|---|---|---|---|---|
| 35. | Orange | *Citrus Sinensis.* | *Flavonoids* | Provides Immunity and Protect Against Heart Disease |
| 36. | Honey | Mellis | *Inulin, Fructooligosaccharides (FOS), Polydextrose* | Supports Maintenance of Digestive Health; Supports Calcium Absorption |
| 37. | Oats | Avena Sativa | *Beta-Glucans, Saponins, Terpenoids, Phytic Acid* | Lower Risk for High Cholesterol, Heart Disease, Diabetes, and Cancer |

**Spices And Herbs**

| S. No | Common Name | Scientific Name (If Any) | Functional Component | Proposed Claimed Benefits |
|---|---|---|---|---|
| 1. | Black Cumin | Nigella Linn | *Alkaloids, Unsaturated Fatty Acids* | Stimulant, Diuretic, Diaphoretic, Galactagogue |
| 2. | Nutmeg | Myristica Bochmer | *Epicatechin, Cyanidin* | Treats Dysentry, Stomach Ache, Rheumatism.Sciatica |
| 3. | Basil Leaves | Hyptis Jacq | *Glutamic Acid, Valine, Proline, Threonine* | Stimulant, Carminative, Antiseptic, Galactagogue, Beneficial in Colic, Stomach Ache |
| 4. | Mint Leaves | Mentha, Linn | *Quercetin & Vitamin K* | Antiseptic, Anti-Bacterial, Carminative, Beneficial in Stomach Ache, Indigestion |
| 5. | Turmeric | Curcuma Longa | *Curcumin* | Anti Inflammatory Effect, Benefits in Rheumatoid Arthritis, Cancer Prevention, Effective Treatment for Inflammatory Bowel Disease |
| 6. | Fenugreek Seeds | Trigonella Foenum-Graecum L Family | *Diosgenin, A Steroid Saponin, Phytochemical Compounds Such as Choline, Trigonelline Diosgenin, Yamogenin, Gitogenin, Tigogenin and Neotigogens.* | Helps Lower Blood LDL-Cholesterol Levels, by Inhibiting Bile Salts Re-Absorption in the Colon and Helps to Protect the Colon Mucus Membrane from Cancers.<br>Helps Digestion, and Bowel Movement Relieve Constipation Ailments.<br>Facilitator Action on Insulin Secretion. Lower Rate of Glucose Absorption in the Intestines<br>Phytochemical Compounds Such as Choline, Trigonelline Diosgenin, Yamogenin, Gitogenin, Tigogenin and Neotigogens. |

| | | | | |
|---|---|---|---|---|
| 7. | Aswagandha | Winter Cherry | *Withania Somnifera* | Rejuvenating, Anti-Inflammatory, Bronchial Asthma, Alleviates Insomnia, Cardiac Disorder |
| 8. | Brahmi | Indian Pennywort | *Bacopa Monnieri* | Rejuvenator, Promoting Intellect, Depression, Relieves Anxiety & Tension, Enhances Memory Power, Mental Debility, Epilepsy And Insanity, Arthritis, Effective for Nervous Disorders |
| 9. | Yastimadhu | Licorice, Mulethi | *Glycyrrhiza Glabra* | Ophthalmic, Health Promoter, Complexion Promoter, Retention of Urine, Heart Diseases, Anaemia. Sore Throat with Hoarseness of Voice and Cough. Acid Peptic Disease. Chronic Liver Diseases General Tonic |
| 10. | Neem | Azadirachta Indica | *Nimbin, Nimbinin and Nimbidin and Azadirachtin* | Blood Purifier, Anti-Fungal, Anti- Bacterial and Anti-Viral. Anti-Diabetic. Curing Indigestion |
| 11. | Tulsi (Basil) | Ocimum Tenuiflorum | *Antioxidants Epigalloctechin-3 Gallate (EGCG)* | Antiseptic, Remedies for Respiratory Disorders , Colds, Headaches, Stomach Disorders, Inflammation, Malaria, Reducing Blood Glucose Levels, Cataracts, Lowers Blood Cholesterol Level Kidney Stones Stress Eye Disorders, Healing, Immune Supporting and Stress Relieving Properties,. |
| 12. | Ghritkumari (Indian Aloe Vera) | Aloe Barbadensis | *Vitamins, Minerals, Plant Sterols, Salcylic Acid, Amino Acids, Enzymes, Sugar, Lignins Polysaccaraide* | Used For Liver & Spleen Disorder, Promotes & Regulates Menstrual Period, Digestive Health Skin Health |
| 13. | Kesar (Saffron) | Crocus Sativus | *Carotenoids Safranal and Crocin* | Hypertension, Heart Health, Reduces Gentamicin-Induced Nephrotoxicity, Lung Cancer, AMD, Memory, PMS, Effective for Pimples, for Fair Complexion |
| 14. | Lavang (Clove) | Syzygium Aromaticum | *Cinnamaldehyde and Eugenol* | Stimulant and Effective in Relieving Flatulence, Cholera, Coughs, Asthma and Headaches. Promote Enzymatic Flow and Boost Digestive Functioning. Antiseptic, Anti-inflammatory |

| | | | | |
|---|---|---|---|---|
| 15. | Elaichi (Cardamom) | Elettaria Cardamomum Maton | *Vitamins, Minerals and Essential oils* | Nausea, Indigestion Abdominal Pain Bronchitis and Upper Respiratory Infections. Antiseptic, Antispasmodic, Carminative, Digestive, Diuretic, Expectorant, Control Heart Rate and Blood Pressure, Red Blood Cell Formation |
| 16. | Tejpata (Bay Leaf) | Cinnamonum Tamala | *Polyphenols Cineol, Eugenol, Chavicol, Acetyl Eugenol, Methyl Eugenol, A- And B-Pinene, Phellandrene, Linalool, Geraniol And Terpineol, Vitamins And Minerals* | Flatulent Dyspepsia. Halitosis. Cough Diabetes Mellitus, Antiseptic, Anti-Oxidant, Digestive, |
| 17. | Ajawain | Trachyspermum Ommi | *Thymol, Methylpheno, Isothymol* | Gastro-Intestinal Disorders Diarrhoea, Dysentry, Atonic Dyspepsia, Colic & Indigestion. Relieving Asthma. Beneficial in Rheumatic & Neurological Pain |
| 18. | Siya Jeera (Caraway Seeds) | Carum Carvi | *Dietary Fiber Principle Volatile Compounds are Carvone, Limonene, Carveol,Pinen, Cumuninic Aldehyde, Furfurol,and Thujone, Vitamins, Minerals and Antioxidants* | Stomach Disorders, Prevent Constipation Flatulence, Hookworms Scabis Bad Breath, Lower Serum LDL Cholesterol Levels |
| 19. | Lahsun (Garlic) | Allium Sativum | *Allicin, Diallyl Sulfide* | Reduces Glucose Metabolism Diabetics, Slows the Development of Arteriosclerosis and Lowers the Risk of Further Heart Attacks in Myocardial Infarct Patients, Lowers Blood Cholesterol, Inhibit Cancer Process |
| 20. | Dalchini | Cinnamomum Zeylanicum | *Cinnamaldehyde,* | Increase Salivation Improve Digestive Functions. Antibacterial Action.Anti-Inflammatory, Antioxidant, Anti-Tumor and Anti-Diabetic Benefits, Decreased Weight Gain, Anti Insulin Resistance and Reduces Cholesterol Levels |
| 21. | Imli (Tamarind) | Tamarindus Indica | *Fruit Acids: Tartaric Acid, Non-Starch Polysaccharides* | Laxative, Bilious Vomiting, Alcohol Intoxication, Fever, Pharyngitis, Stomatitis, Constipation and Hemorrhoid |

| | | | | |
|---|---|---|---|---|
| 22. | Ginger | Zingiber Officinale Roscoe | *Gingerol* | Anti Flatulence, Anti-Oxidant, Anti-Cancer, Anti-Inflammatory |

## Others

| S. No | Common Name | Scientific Name (If Any) | Functional Component | Proposed Claimed Benefits |
|---|---|---|---|---|
| 1. | Linseed / Flax Seed | Linum Usitatissimum | *A-Linolenic Acid, Omega – 3Fatty Acid* | Effective in Coronary Heart Diseases and Stroke, Hypertension and Inflammatory and Autoimmune Disorders. Arthritis, Asthma |
| 2. | Olive Oil | Olea Europea. | *Hydroxytyrosol S* | Protect Against Cancer |
| 3. | Cocoa | Theobroma Cacao | *Flavanols , Catechins, Epicatechins, Epigallocatechin* | Maintenance of Heart Health |

**Source:** Contributions from Dr. Biplab K Nandi, Sr. Food & Nutrition Officer (Retd.), FAO Asia Pacific Regional Office, Ms. Deepti Sharma, Manager- Nutrition Claims & Communication, Dabur India Ltd., Dr. H P Singh, Sr. Scientist, Institute of Himalayan Bioresource Technology Prof. J S Pai, Execuitve Director, Protein Foods & Nutrition Development Assn. of India, Dr. Parmeet Kaur, Chief Dietician, All India Institute of Medical Sciences, Dr. R D Rai, Head, Divn.of Biochemistry, Indian Agricultural Research Institute, Dr. Santanu Basu, Asst. Professor, University Institute of Chemcial Engineering & Technology, Punjab University, Dr. S K Saxena, Director Export Inspection Council of India.

## Table 2: Examples of Bioactive Ingredients in Select Fruits, Vegetables, Herbs and Spices and Claimed Benefits

| S. No. | Name | Source(S) | | Claimed Benefits |
|---|---|---|---|---|
| | | Common Name | Scientific Name, If Any | |
| 1. | Physillium Husk | Isabgol | *Plantago Ovata* | Beneficial for Both Constipation and Diarrhoea, Assist in Maintaining a Normal and Healthy Bowel Function, and Irritable Bowel Syndrome |
| 2. | Volatile Oils: Cineol, Alpha-Terpinyl Acetate, Linalyl Acetate Fatty Oils and Starch | Elaichi, Cardamom | *Elettaria* | Inhibits Platelet Aggregation, Lowers Blood Pressure, Common Cold ,Cough/Bronchitis, Fevers and Colds, Inflammation of the Mouth and Pharynx, Liver and Gallbladder Complaints, Loss of Appetite, Tendency to Infection, Digestive Complaints, Vomiting and Diarrhea, Morning Sickness and Loss of Appetite as well as Roemheld Syndrome, Urinary Tract Disorders |
| 3. | Methylhydroxy Chalcone Polymer (MHCP) | Elaichi, Cardamom | *Elettaria Cardamomum* | Increases Glucose Metabolism |
| 4. | Cuminaldehyde, Gamma-Terpenes, Beta-Pinenes, P-Cymene, 1,3-P-Menthandial | Jeera, Cumin Seeds | *Cuminum Cyminum* | Hypoglycemic Effect, Dyspepsia, Diarrhea and Jaundice |
| 5. | Polyphenolic Compounds (Gallic Acid, Protocatechuic Acid, Caffeic Acid, Ferulic Acid, Quercetin and Kaempferol) | Bitter Cumin | *Cuminum Nigrum L* | Anti Oxidant and Anti Bacterial Activities |
| 6. | Phenolic and Flavonols, Isomahanine, Murrayanol, Carbazole Alkaloids (Mahamimbine, Murrayanol and Mahanine) | Kadipatta Curry Leaf | *Morraya Koenigii* | Anti Microbial, Anti Inflammatory, Anti Diabetic, Hypoglycemic, May Reduce Total Cholesterol, LDL.VLDL, Raise HDL |

| | | | | |
|---|---|---|---|---|
| 7. | Fruit Acids: Tartaric Acid (3-10%); Including Among Others, Malic Acid, Citric Acid, Lactic Acid, Invert Sugar (25-30%), Pectin | Imli , Tamarind | *Tamarindus Indica* | Decreases Body Weight, Laxative, Bilious Vomiting, Alcohol Intoxication, Fever, Pharyngitis Stomatitis, Constipation and Hemorrhoid |
| 8. | Lectin, Triterpenes, Proteins, And Steroids | Karela, Bitter Gourd Bitter Melon | *Mamordica Linn* | Hypoglycemic Effect, Relieves Gout, Rheumatism, Spleen and Liver Diseases |
| 9. | Fenugreek Extract: Saponins | Methi, Fenugreek | *Trigonella Foenum-Graecum* | Hypoglycemic Effect |
| 10. | Arjuna Extract: acids (arjunic acid, terminic acid), glycosides (arjunetin arjunosides), strong antioxidants (flavones, tannins, oligomeric proanthocyani-dins), and minerals. | Arjuna, Arjun Herb, Arjun Root | *erminalia Arjuna* | Anti-Hypertensive & Good for Heart Health |
| 11. | Garcinia Extract: Hydroxycitric Acid | Malabar Tamarind Citrin, Gambooge, Brindal Berry, Gorikapuli, | *Garcinia Cambogia* | Weight Loss |
| 12. | Catechins and Gallic Acid | Green Tea and Black Tea | *Camellia Sinensis* | Antioxidant & Fat Burner, Reduces CHD, Inhibition of Eicosanoid Synthesis |
| 13. | Guggul Extract: Z-Guggulsterone & E- Guggulsterone | Guggul | *Commiphora Mukul* | Weight Loss, Hypolipidemic, Improves Thyroid Function,i |
| 14. | Brahmi Extract: alkaloids (brahmine and herpestine), saponins | Brahmi | *Bacopa Monnieri* | Cognition/Memory Enhancer |

| | | | | |
|---|---|---|---|---|
| | (d-mannitol and hersaponin, acid A, and monnierin), flavonoids (luteolin and apigenin) | | | |
| 15. | Ashwagandha Extract: Withaferin A And Several Other Steroidal Lactones | Ashwagandha, Winter Cherry | Withania Somnifera | Anti Stress |
| 16. | Phytonutrients like Convolvine, Convolidine, Convoline, Convolvidine, Confoline, Subhirsine, β-Sitosterol, Phyllabine, and Scopoline | Shank Pushpi | *Convolvulus Pluricaulis* | Cognition/Memory Enhancer Hyper thyroidism, Anti-Ulcer Effects, Reduces Stress and Anxiety and Hypertension, Reduces Risk of Neurodegenerative Diseases Like Dementia And Alzheimer's Disease. |
| 17. | Phyto-Estrogens | Shatavari | *Asparagus Racemosus* | Health and Wellness, Nervousness, Anorexia, Insomnia, Hyperactive Children |
| 18. | Bhumi Amla Extract: Lignansniranthin, Nirtetralin, and phyltetralin chemi-cal compounds. | Bhumi Amla Niruri | Phyllanthus Niruri | Heptaprotective |
| 19. | Salai Guggul Extract: Boswellic Acids | Kundur, Sala | Boswellia Serrata | Joint Health |
| 20. | Gurmur Extract Gymnemic Acid | Gurmur | *Gymnema Sylvestre* | Hypoglycemic Effect |
| 21. | Anantmul Extract Coumarins, triterpenes, flavonoids, pregnane glycosides and steroids | Anantmul, Indian Sarsaparilla | *Hemidesmus Indicus* | inflammation, diarrhoea, respiratory disorders, skin diseases, syphilis, fever, bronchitis, asthma, eye diseases, urinary disorders, loss of appetite Skin Health |

| | | | | |
|---|---|---|---|---|
| 22. | Kaunch Seed Extract: Mucuna pruriens | Kapikacchu, Markati, Atmagupta | *Mucuna Pruriens* | Male Reproductive Health |
| 23. | Isoflavones | Soybeans | *Glycine Max* | Maintenance of Bone Health, Healthy Brain and immune Functions for Women, Maintenance of menopausal health |
| 24. | Resveratrol | Red Grapes | *Vitis Vinifera* | Maintenance of Heart Health , Healthy Immune System |
| 25. | Cineol | Eucalyptus Oil | *Eucalyptus globules* | Soothes Indigestion, Relieves Gas, Freshens Breath, anti-inflammatory, antispasmodic, antiseptic and pain-relieving properties, Improves Lung Functions and Heart Health |
| 26. | Eugenol | Oil of Cloves | *Eugenia Caryophyllata* | Reduces Cholesterol |
| 27. | Myristicin | Essential Oil of Nutmeg and to a Lesser Extent In Other Spices Such As Parsley and Dill | *Myristica Fragrans* | Treats Diarrhea and Colic, Anti-Inflammatory |
| 28. | Capsaicin | Chili Peppers | *Capsicum Annuum* | Relieves Cold and Fever, Soothes Upset Stomach, Anti-Inflammatory |
| 29. | Zingerone | Ginger | *Zingiber Officinale Roscoe; Occasionally Zingiber Capitatum* | Prevention and Management of Nausea. Relieves Osteoarthritic Pain, Stomach Ache, Diarrhea, Asthma, Nausea, Respiratory Disorders and Anti Cacenogenic |
| 30. | Organosulfur Compound: Diallye Sulfides, Allyl Solfides | Garlic | Allium Sativum | Antibacterial and Anti- Fungal Properties, Used in Dyslipidemia and Hypertension. Treatment of Atherosclerosis, Benign Prostatic Hyperplasia, Diabetes, Gastrointestinal (Gi) Disorders, and Stomach and Colon Cancer |
| 31. | Curcumin Antioxidant of Both O2 And N2 Species. | Turmeric | *Curcuma Longa* | Antiseptic, Anti-Inflammatory, Antifungal, Antibacterial, Antiviral, Hepato Protective Antiulcer, Antiarthritc and Many Such Disease Conditions. Increases the Bile Flow and Lowers Cholesterol |
| 32. | Anthraquinones | Aloe | *Aloe Vera* | Osteoarthritis, Bowel Diseases Including Ulcer ative Colitis, Fever, Itching and Inflammation, Stomach Ulcers, Diabetes, Asthma, and Relieves Some Side Effects of Radiation Treatment |

| | | | | |
|---|---|---|---|---|
| 33. | Lutein & Zeaxanthin | Green Leafy Vegetables Such Spinach | *Spinacia Oleracea* | Filters Blue Light and Supports Eye Health , May Protect Against Cancer |
| 34. | Chlorophyll | Wheat Grass | *Triticum Aestivum L* | Antibiotic , Anti-Inflammatory and Nourishes Growing Blood Cells |
| 35. | Nimbidin, Azadirachtin | Neem, Margosa Tree | *Azadirachta Indica* | The Anti-Bacterial, Anti-Fungal, Prevents Skin Disorders and Keeps the Skin Healthy, Hypoglycemic Effect |
| 36. | Phytosterols: Sitosterol, Stigmasterol, Campsterol | Nuts | *Different varieties have different scientific names* | Prostrate Cancer, Reduce Serum Cholesterol |

Source: Contributions from Ms. Deepti Sharma, Manager- Nutrition Claims & Communication, Dabur India Ltd., Dr. H P Singh, Sr. Scientist, Institute of Himalayan Bioresource Technology, Dr. Parmeet Kaur, Chief Dietician, All India Institute of Medical Sciences, Dr. R D Rai, Head, Divn.of Biochemistry, Indian Agricultural Research Institute, Dr. Santanu Basu, Asst. Professor, University Institute of Chemcial Engineering & Technology, Punjab University, Dr. S K Saxena, Director Export Inspection Council of India.

[Disclaimer -ILSI/ILSI-India are not responsible for veracity of any statement or findings]


**International Life Sciences Institute-India**

Y-40 B, Ist Floor, Hauz Khas, New Delhi – 110 016
Phone: 91-11-26523477, 26968752, 26853056, 41654760
Fax: 26968752, 26853056 Email: info@ilsi-india.org