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Functional Foods— A Pathway to a Healthy Lifestyle



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ABSTRACT

The increasing stress levels and ignorance of health due to lack of time have led to poor health conditions causing many diseases at a very early age. So for achieving good health and for living a good quality of life, it is necessary to intake the basic nutritional requirements of our body. However, present competitive era makes it impossible for many, to follow a healthy lifestyle. Therefore, this is where FUNCTIONAL FOODS have marked a new epoch. As stated by Hippocrates, "Let thy food be thy medicine and thy medicine be thy food". Therefore, the present review article focuses on what are functional foods, their types and classification, the present scenario of functional foods and most importantly the novel functional foods, which are expected in the near future.



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INTRODUCTION

In today's era, increasing stress levels and ignorance of health, has led to poor health conditions causing many diseases at a very early age. Most people list stress as the number one reason for unhealthy food choices and weight gain. Many times people use food to cope with stress leading to the formation of a vicious cycle ^[1].

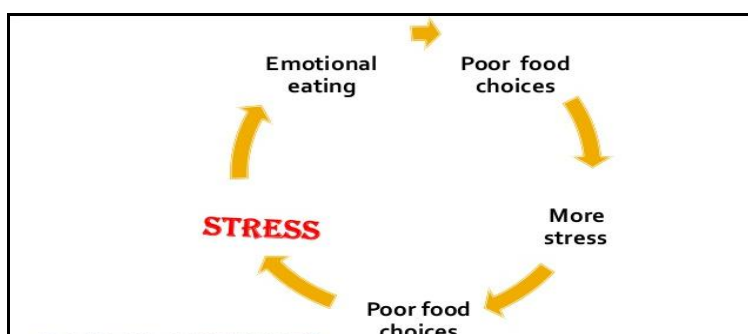


Fig 1:- The Vicious Cycle

http://www.sportscentermorehead.com/_blog/Fitness_Blog/post/stress-food/

Thus, food becomes one of the very important keys to good health. So for achieving congruous health and for living a competent quality life, it is necessary to intake the basic nutritional requirements of our body. However, the present competitive period makes it impossible for many to follow a healthy lifestyle. Therefore, this is where functional foods play a vital role and have marked a new epoch. As stated by Hippocrates, “Let thy food be thy medicine and thy medicine be thy food” (400 BC). This was stated to emphasize the importance of nutrition to prevent or cure disease. ^[2]

What are functional foods?

Functional food is a food, which gives an additional function (often one related to health promotion or disease prevention) by adding new ingredients or more of existing ingredients.

Three different definitions of functional foods as stated by important organizations are as follows,

1. In 1994, the National Academy of Sciences' Food and Nutrition Board defined functional foods as “A modified food that claims to improve health or well-being by providing benefit beyond that of the traditional nutrients it contains”. ^[3]

2. The International Life Sciences Institute defines them as “foods that, by virtue of the presence of physiologically-active components, provide a health benefit beyond basic nutrition”.^[4]

3. In a 1999 position paper, the American Dietetic Association defined functional foods as “foods those are whole, fortified, enriched or enhanced foods that provide health benefits beyond the provision of essential nutrients (e.g., vitamins and minerals), when they are consumed at efficacious levels as part of a varied diet on a regular basis”.^[5]

PRESENT SCENARIO

The present scenario of the functional foods market can be explained by the two pie graphs below:-

The pie graph below (fig no. 2) shows the market share of functional foods by different countries. As depicted in the graph the major share in the functional food market is held by the U.S. and the least in Eastern Europe/ Russia and the Middle East/ Africa. 4% share is held by rest of Asia, is where India lies in rest of Asia.

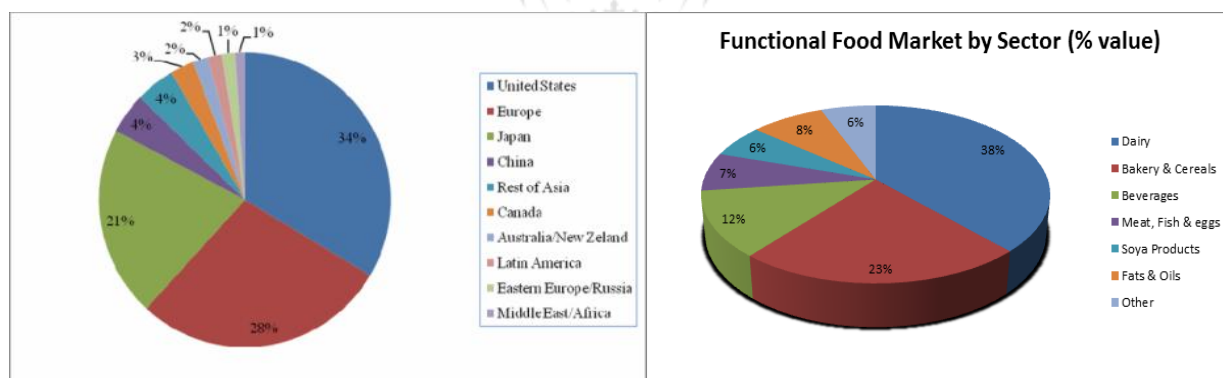


Fig. No. 2:- Market Share of Functional Foods Fig. No. 3:- Functional Food Market by Sector (% Value)

This pie graph (Fig no.3) above depicts the functional food market by sector i.e. the utility of different functional foods available in the market. The maximum share is of Dairy products and the least is of Soya products and others. In others all the probiotics, prebiotics and other protein supplements etc. can be considered. Dairy products are widely consumed functional foods until date. People prefer them to other probiotic products because they are inexpensive, readily available, come from natural resource and have no side effects.

Types of Functional foods: ^[6]

Functional foods can be categorized majorly as follows,

1. Conventional Foods- Conventional foods are most basic of the functional foods because they have not been modified by enrichment or fortification; they are still in their natural state.

(i) Whole foods – Whole foods are plant foods that are unprocessed and unrefined, or processed and refined as little as possible, before being consumed. Few examples as follows,

a) Oats- The fiber content that is the key ingredient helps to reduce the cholesterol.

b) Fruits and vegetables- The vitamins and nutrients that are the key ingredients help to reduce the risk of certain cancer and heart disease.

2. Modified Foods- This category includes foods, which are fortified, enriched or enhanced with nutrients or other beneficial ingredients.

(i) Fortified foods - Fortified foods are those that have nutrients added to them that do not naturally occur in the food. Few examples are as follows,

a) Milk and fruit juices with vitamin D and calcium - The key ingredient having potential to reduce the risk of osteoporosis and hypertension is calcium.

b) Grains with Folic acid – The key ingredient having the potential to reduce the risk of heart disease and neural tube birth defects.

(ii) Enhanced foods– Enhanced foods are foods in which nutrients that were lost during food processing have been added back. **Example-** Beverages and salad dressings with antioxidants, phytosterol-enriched flavored milk and nutrition bars.

3. Medical Foods- Food which is formulated to be consumed or administered internally under the supervision of a physician and which is intended for the specific dietary management of a disease or condition for which distinctive nutritional requirements, based on recognized scientific principles, are established by medical evaluation. **Example-** Axona® (Used for treating Alzheimer), Souvenaid® (Used in Dementia).^[7]

4. Foods for special dietary use- These are similar to medical foods, but they are available commercially and do not require the supervision of a healthcare provider. These foods fill

special dietary needs that are due to specific health conditions, such as celiac disease, lactose intolerance, or obesity. **Example-** Gluten-free foods, lactose-free dairy products, foods designed to aid weight loss and infant food.

Table no. 1- Examples of Functional Components ^[8]

<https://www.foodinsight.org/Content/3842/Final%20Functional%20Foods%20Background.pdf>

Class/Components	Source	Potential Benefit
(A) VITAMINS		
1. Vitamin A (Retinoic Acid)	Organ meats, milk, eggs, carrots, sweet potato, spinach, tomato	Supports maintenance of eye enhances immunity, improves bone health and contributes to cell integrity
2. Vitamin B ₁ (Thiamine)	Lentils, peas, brown or enriched white rice, pistachios, and certain fortified breakfast cereals	Supports the maintenance of mental function and helps regulate metabolism
3. Vitamin B ₂ (Riboflavin)	Lean meats, eggs, green leafy vegetables, dairy products, and certain fortified breakfast cereals	Supports cell growth and helps regulate metabolism
4. Vitamin B ₃ (Niacin)	Dairy products, poultry, fish, nuts, eggs, and certain fortified breakfast cereals	Supports cell growth and helps regulate metabolism
5. Vitamin B ₅ (Pantothenic Acid)	Sweet potato, organ meats, lobster, soybeans, lentils, and certain fortified breakfast cereals	Helps regulate metabolism and hormone synthesis
6. Vitamin B ₆ (Pyridoxine)	Beans, nuts, legumes, fish, meat, whole grains, and certain fortified breakfast cereals	Supports maintenance of immune health and helps regulate metabolism
7. Vitamin B ₇ (Biotin)	Liver, salmon, dairy, eggs, oysters, and certain fortified breakfast cereals	helps regulate metabolism and hormone synthesis

8. Vitamin B ₉ (Folic Acid)	Beans, legumes, citrus fruits, green leafy vegetables and fortified bread, cereals, pasta, rice	May reduce a woman's risk of having a child with a brain or spinal cord defect and supports maintenance of immune health
9. Vitamin B ₁₂ (Cobalamin)	Eggs, meat, poultry, milk, and certain fortified breakfast cereals	Supports maintenance of mental function; helps regulate metabolism and supports blood cell formation
10. Vitamin C (Ascorbic Acid)	Citrus fruit, guava, sweet red/green pepper, kiwi, strawberries, fortified foods and beverages	Neutralizes free radical which may damage cells and supports maintenance of bone and immune health
11. Vitamin D (Cholecalciferol)	Sunlight, fish, fortified foods such as yogurts or cereals, and beverages, including milk and juices	May reduce the risk of osteoporosis, helps regulate calcium and phosphorus, supports immune health and helps support cell growth
12. Vitamin E (Tocopherol)	Sunflower seeds, almonds, hazelnuts, turnip greens, fortified foods and beverages	Neutralizes free radical, which may damage cells and supports maintenance of immune and heart health
(B) MINERALS		
1. Calcium	Sardines, spinach, yogurt, low-fat dairy products, fortified foods, nuts, and beverages.	Reduce the risk of osteoporosis
2. Magnesium	Spinach, pumpkin seeds, whole grain bread and cereals, halibut fish, almonds, brazil nuts, beans	Supports the maintenance of normal muscle and nerve function, immune health and bone health
3. Potassium	Potatoes, low-fat dairy products, whole grain bread & cereals, citrus juices, beans, coconut water, and banana.	May reduce the risk of high blood pressure and stroke if given in combination with a low sodium diet
4. Selenium	Fish, red meat, whole grains, garlic, liver, eggs	Neutralizes free radicals which may damage cells, supports the maintenance of immune and prostate health
(C) HERBALS		
1. Beta-Carotene	Carrots, pumpkin, sweet potatoes, cantaloupe, spinach, tomatoes	Neutralizes free radicals which may damage cells, bolsters cellular antioxidant defenses and precursor of vitamin a in the body

2. Lutein and Zeaxanthin	Kale, collards, spinach, corn, eggs, citrus fruits, asparagus, carrots, broccoli	Supports maintenance of eye health and reduce the risk of stroke.
3. Lycopene	Tomatoes and processed tomato products, watermelon, red/pink grapefruit	Supports maintenance of prostate health
4. Anthocyanins	Berries, cherries, red grapes	Cellular antioxidant defences and supports the maintenance of healthy brain function
5. Flavonoids (Flavanols & Flavanones)	Tea, cocoa, chocolate, apples, grapes, Citrus fruits	Supports maintenance of heart health, Neutralizes free radicals which may damage cells and bolster cellular antioxidant defences
6. Procyanidins and Proanthocyanidins	Cranberries, cocoa, apples, strawberries, grapes, red wine, peanuts, cinnamon, tea, chocolate	Supports maintenance of urinary tract health and heart health

(D) PROTEIN SUPPLEMENTS





1. Soy protein	Soybeans and soy-based foods like milk, yogurt, cheese and tofu	May reduce the risk of congestive heart disease and a rich source of phytoestrogen
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(E) MACRO AND MICRONUTRIENTS FORTIFIED

1. Dietary Fibre	(i) Insoluble fiber	Wheat bran, corn bran, fruit skins	Supports maintenance of digestive health and may reduce the risk of some types of cancer
	(ii) Beta-glucan	Oat bran, oatmeal, oat flour, barley, rye	May reduce the risk of coronary heart disease
	(iii) Soluble Fibre	Psyllium seed husk, peas, beans, apples, citrus fruits	May reduce the risk of coronary heart disease and some types of cancer
	(iv) Whole grains	Cereal grains, whole wheat bread, oatmeal, brown rice	May reduce the risk of coronary heart disease and some types of cancers and supports maintenance of healthy blood glucose level
2. Fatty Acids	(i) Monounsaturated fatty acids (MUFAs)	Nuts, olive oil, canola oil	May reduce the risk of coronary heart disease

	(ii) Polyunsaturated fatty acids (PUFAs) – Omega-3 fatty acids-ALA	Walnuts, flaxseeds, flaxseed oil	Supports the maintenance of heart and eye health and supports the maintenance of mental function
	(iii) PUFAs – Omega-3 fatty acids – DHA/EPA	Salmon, tuna, marine and codfish liver and other fish oils.	May reduce the risk of coronary heart disease, supports the maintenance of eye health and mental function
	(iv) Conjugated linoleic acid (CLA)	Beef and lamb; some cheese	Supports the maintenance of desirable body composition and immune health
(F) PROBIOTICS			
1. Yeast, Lactobacilli, Bifidobacteria and other specific strains of beneficial bacteria		Certain yogurts and other cultured dairy and non-dairy applications	Supports maintenance of digestive and immune health and benefits are strain specific
(G) PREBIOTICS			
1. Inulin, Fructooligosaccharide (FOS), polydextrose		Whole grains, onions, some fruits, garlic, honey, leeks, banana, fortified foods, and beverages	Supports maintenance of digestive health, supports calcium absorption, use for weight loss, constipation and diabetes

Table no. 2- Marketed Products:

<p>DanActive®^[9] https://www.amazon.com/Danactive-Probiotic-Yogurt-Strawberry-Blueberry/dp/B003M5OV5A</p>	
	<ol style="list-style-type: none"> 1. Category- Probiotic Yogurt 2. Company- Dannon® 3. Probiotic- <i>Lactobacillus casei</i>Immunitas® 4. Use- Supports immune system
<p>NutriBar^[10] https://www.kindsnacks.com/double-dark-chocolate-nut</p>	
	<ol style="list-style-type: none"> 1. Category- Energy Bar 2. Company- Kind Protein 3. The key ingredient- MUFAS (mono-unsaturated fats), omega-3s, magnesium, calcium, soy protein 4. Use- build and maintain muscle mass, synthesizes red blood cells, repair wounds or damaged tissues
<p>Myotein®^[11] https://www.amazon.com/XPI-Myotein-Protein-Powder-Chocolate/dp/B0047Y6I24</p>	
	<ol style="list-style-type: none"> 1. Category- Protein Powders 2. Company- DNR® 3. Ingredients- Whey Protein Isolate, Whey Protein Concentrate, and casein. 4. Use- Growth, and development in pregnant women, improve bone health and treats deficiency of vitamin D.
<p>Chyawanprash®^[12] https://www.satnam.eu/dabur-chyawanprash-500-g-p-3439.en.html</p>	
	<ol style="list-style-type: none"> 1. Category- Herbal (Medical food) 2. Company- Dabur ® 3. Ingredients- Indian Gooseberry (Amla), sesame oil, berries, and various herbs and spices. 4. Use-Stimulates the body's immunity response helps in purification of blood & elimination of harmful toxins from the body. Supports healthy functioning of the heart and keeps the respiratory passages clean & clear.

FUTURE PROSPECTS

1) Probiotics, Prebiotics and Synbiotics^[13]

(i) **Probiotics:**-Probiotics are foods or supplements that contain live microorganisms intended to maintain or improve the "good" bacteria (normal microflora) in the body. To reduce their

susceptibility and achieve controlled release at the target site, various microencapsulation strategies have been introduced to enhance the stability of probiotics. [14]

(ii) Prebiotics:-Prebiotics are foods (typically high-fiber foods) that act as food for human microflora. Prebiotics are used with the intention of improving the balance of these microorganisms.

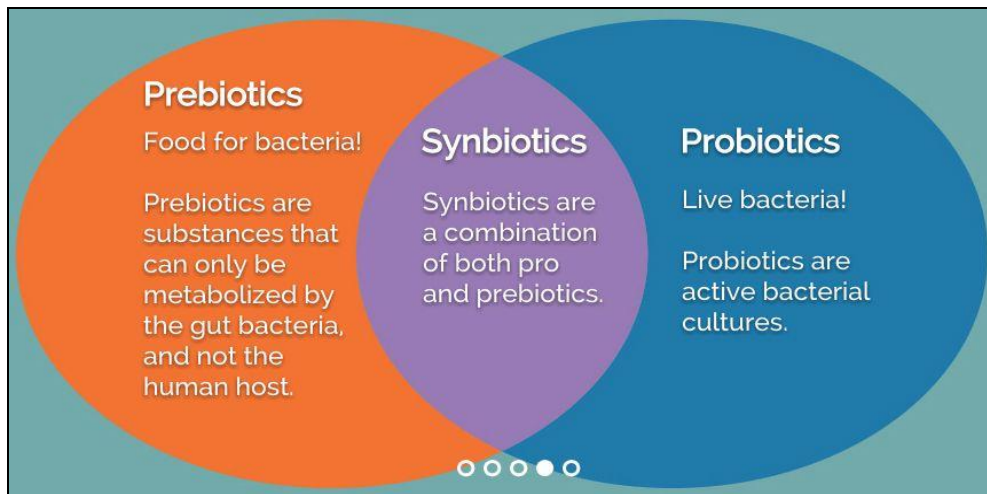


Fig No. 4 - Probiotic, Prebiotic and Synbiotic [15]

<https://www.pinterest.com/pin/488781365792786252/>

(iii) Synbiotic:-The term synbiotic is used when a product contains both probiotics and prebiotics. Because the word alludes to synergism, this term should be reserved for products in which the prebiotic compound selectively favors the probiotic compound. Example:- oligofructose and probiotic bifidobacteria.

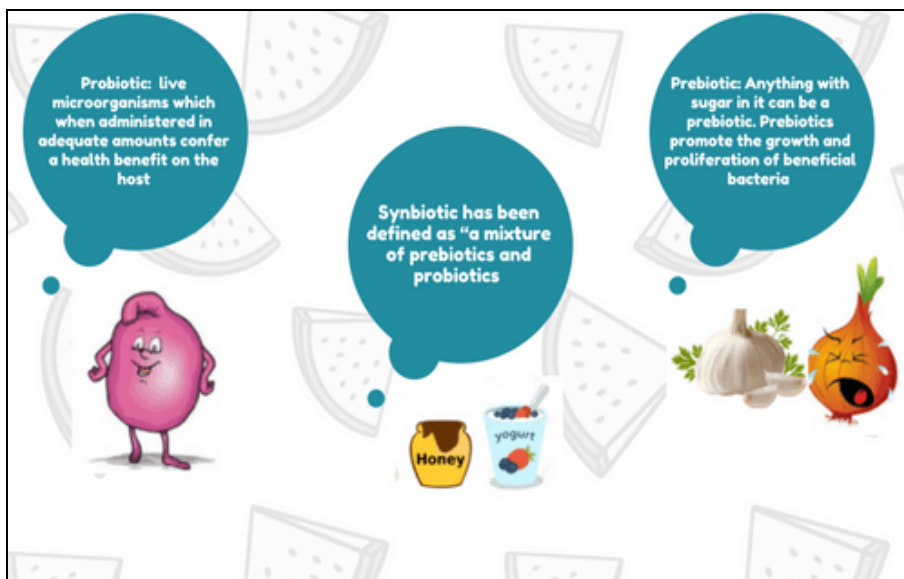


Fig No. 5- Example of synbiotic seen in day to day life

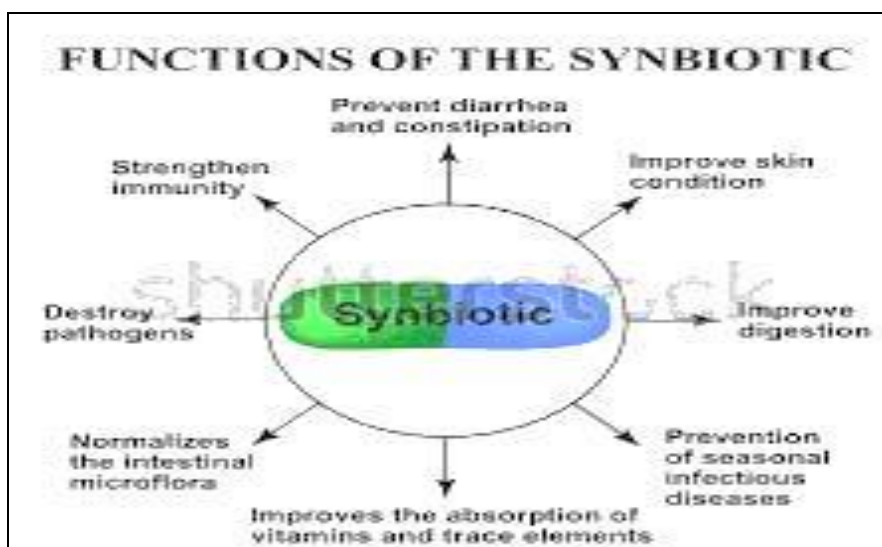



Fig No. 6 – Functions of Synbiotic

Table no. 3- Marketed product of Synbiotic

<p>Marketed product: Synbiotic plus® ^[16] http://www.vitarealm.com/synbiotics-plus</p>	
	<ol style="list-style-type: none"> Category- Synbiotics Company- Vitarealm® Ingredients- <i>Lactobacillus Acidophilus</i>, <i>Bifidobacterium Longum</i>, <i>Lactobacillus Casei</i>, <i>Lactobacillus Plantarum</i>, <i>Bifidobacterium Lactis</i>, <i>Lactobacillus Paracasei</i>, <i>Lactobacillus Rhamnosus</i>, Galactooligosaccharides (GOS) Use- Keeps immune system healthy.

2) SuperBeets-^[17]

Humann Launches SuperBeets Line Based on Best-Selling Product. The unique family of products supports a healthy cardiovascular system, with additional benefits that help promote a healthy immune system, help maintain healthy skin, and improve energy and focus. The new line extension is anchored by the brand's best-selling original SuperBeets formula, a highly concentrated, scientifically formulated functional food that capitalizes on beets to generate Nitric Oxide in the body. Nitric Oxide helps blood vessels dilate, which increases circulation and oxygen delivery throughout the body. The result is additional natural energy and support for healthy blood pressure. , SuperBeets Immune is the latest to join the SuperBeets family of products. This unique formula combines the clinically-studied ingredient Wellmune[®] along with non-GMO beetroot powder and Vitamin C to promote immune health, maintain a strong immune system, and support a healthy cardiovascular system. SuperBeets ^[18] Immune key ingredient, Wellmune[®], has been shown to promote immune health without overstimulating the system, making it safe to take daily. Leveraging the formula's innovative ingredients, SuperBeets Immune strengthens the body's natural defenses and helps you stay healthy during times of stress.



Fig No. 7– beet elites



Fig No.8 – super beets

<https://www.humann.com/>

Wax-free Brown Rice (WFBR)-^[19]

One of the widely consumed staple food for a large part of the world's population, particularly Asia; RICE remains the third-highest worldwide produced agricultural commodity, after maize and sugarcane.

However, there are many different types of rice but in terms of health benefits, not all are produced equal. In addition, we are into a constant investigation about which is healthier - Brown Rice or White Rice. The known about Brown Rice has become a sought after cereal, especially because of the numerous health benefits it provides. The health benefits of Brown

rice are partially due to the way it is prepared and it is regarded superior to its more commonly consumed cousin, white rice, mainly because of a minor prowess in their processing. Brown rice is a whole-grain with the unpalatable outer husk extracted; while, white rice is the same cereal with the husk, sub-aleurone and pericar bran layer, and cereal germ removed. The WFBR and its low protein reduced wax-free brown rice are becoming apparent as a highly healthier nutritious grain option. Characterized by the low protein, low phosphate, and trace of potassium, the WFBR is depicted to be highly helpful in preventing health problems such as kidney damage, osteoporosis, and exposure to other fatal diseases.

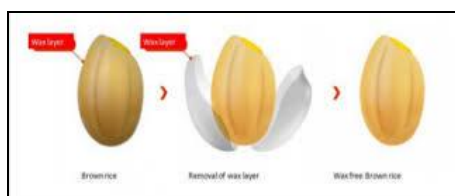


Fig No.9 – Wax layer of brown rice and wax removal Fig No. 10– Brown rice (Left), Wax-free brown rice (right) [20]

<http://www.cbs8.com/story/39338620/medical-rice-a-new-invention-in-brown-rice-both-wax-free-and-protein-reduced-by-dr-shaw-watanabe>

Served for analysis, the vitamin lipid metabolism in low protein WFBR is perceived to be dramatically improved by retaining high amino acids activity and all energy contents, while limiting the excess intake of fat-soluble vitamins that pose a greater risk for toxicity when consumed in shed loads.

During the proprietary manufacturing process of Wax-free Brown Rice (WFBR), only the water-resistant, indigestible wax layer that surrounds the rice kernels are removed while keeping the nutrient-rich bran layer intact for the purpose to improve its alimentary value and at the same time making it more appetizing.

Scanning the metabolic syndrome WFBR in comparison to its cousin cereal rice in a systematic cross-over fashion, the increase in insulin resistance, and glucose and LDL-cholesterol levels after white rice consumption period found to be significantly lowered after ingestion of WFBR.

CONCLUSION

Therefore, to conclude functional foods are foods, which provide a health benefit beyond basic nutrition with added physiologically active compounds. The trend of using functional foods and probiotics for better immunity and other physiological reasons, all over the world including India is a big headway in food technology. But the use of probiotics and functional foods should be done under right guidance at right time and to right age groups of population otherwise, a boon may become a curse.

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