



Review

Food rainbow to boost immunity in different age groups –review on nature’s perspective

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Abstract

Food is a blessing in simple terms it not only nourishes and gives vitality but also provide reservoir to keep the body functioning in pace. Food act as a diet and medicine depends on how one uses it sensibly and accurately. The food rainbow is rich in variety with respect to appearance, taste, chemical composition, nutritional value and medicinal properties. As immunity is an integral part of body and it can be well maintained if one is having a good portion utilized daily from the food rainbow. In natural medicine the kitchen spices have played a pivotal role in health and making food palatable. Natural sources like vegetables, fruits, meat, nuts, dairy, grains and etc., are enriched with this blessing to heal and boost immunity. Every cell function when it has the proper nutrition, and every single body is different from other then comes the age and gender differentiation. This difference of age and gender demands variety of meals incorporated in daily diet thus food rainbow utilization is the key to maintain proper functioning of body cells and also boosting immunity. Energy packed food rainbow has not only the physiological benefits it vitalizes the emotional and psychological health as well. Co-ordination in all processes is achieved while maintaining healthy lifestyle and nutrition. As we all are well aware about the significance of maintaining a proper diet regimen to obtain sound health and active lifestyle. This article will elaborate about the food rainbow which must be included in daily routine in different age groups and genders. The daily recommendation for certain nutrients is different with growing age and also at the time of advancement in age. From research perspective the recommendations can be followed, and results can be recorded for further enhancement on immunity booster food. This could be done at level of educational institute with students and teachers to extend the analysis and educate people from early age to understand and alter their diet according to their age and gender and get most out of it.

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Introduction: An infection can be prevented by an ideal immune response bases on healthy diet and nutrition. For example, ample amount of protein diet is important to produce antibody. Deficit of micronutrient may increase the risk of Infections. Similarly, less nutrient intake is linked to oxidative stress and inflammation and it ultimately affects the immune system. Gut flora converts the dietary fiber and Vitamin D by fermentation into fatty acids (short-chain) then it has anti-inflammatory effects and enhances immunity. In COVID-19 crises the Immune System should be strengthening to reduce oxidative stress and inflammatory processes by good nutrient intake in diet ^[1]. As the natural medicine pillars are based with methodology to find out root cause of ailments. So it stresses the six essential causes (Asbab-e-Sitta-e-Zaruriya) to be in alignment for every individual to attain state of good health yet preventing infection by stronger immunity. The six essential causes are:

Environment (atmospheric air)

Diet (food & drink)

Movements (activity & rest)

Sentiments (emotions)

Metabolism (retention & elimination)

Rest (sleep & wakefulness) ^[2]

Antioxidants & immune response: Natural antioxidants termed as a substance that prevent cell damage via free radicals to maintain the health in both plants and animals. All living cell needs proper amount of antioxidants to avoid bad effects of free radicals or reactive oxygen species (ROS) to safe cell from damage. Antioxidant nutrients are commonly comprised of vitamin E, vitamin C, selenium, copper, Iron, zinc and β -carotene that helps in better immune function and plays role in fighting viruses, bacteria and parasites. The inflammatory process comprised of activation of phagocytes or bacterial by-product acting on specific receptors that trigger flavor proteins to increase the production of superoxide anion radical (O_2^-), then neutrophils, macrophages are assigned to release superoxide free radicals and H_2O_2 too. Hence the antioxidants are vital to combat free radicals ^[3]. Dietary antioxidants from natural sources (plants, fruits, herbs and spices) are rich in nutrients that help to reduce the oxidative stress. As shown in the Table 1, lists of free radicals that affect the living cell at different levels. Free radical can be produced in result of cellular metabolism, as shown in Figure 1, ultraviolet light exposure, drug intake, inflammations and smoking which leads to DNA damage, protein oxidation and immune cell damage. These changes can result in carcinogenic activity in body, neurodegenerative disorders and cardiovascular diseases and leads towards aging. The nutrients like carotenoids, polyphenols, vitamin C and E can scavenge these free radicals and act as strong antioxidants and minimize effects of free radical ^[4]. As the Figure 2 shows increase oxidative stress (misbalance in antioxidants and free radicals)

leads to oxidative damage that deteriorates the lipids, protein and nucleic acids lead by tissue injury and inflammations and make the cell prone to infections and diseases ^[5]. Age related immune deficiencies are reversed by antioxidant supplementation which acts by increasing interleukins-2, total lymphocytes and T-cell subsets, mutagen response; killer cell activity enhanced antibody response to antigen and on the other hand decline in prostaglandin production and lipid per oxidation ^[6]. Reactive oxygen species (ROS) is the main culprit to damage mRNA, lipid protein oxidation, impaired mitochondrial function leads to more oxidative stress resulting in aging due to membrane alterations at cellular levels, organelle dysfunction and individual is at risk of cancer, obesity, atherosclerosis dementia and etc., as shown in Figure 3 ^[7].

Nutraceuticals concept: Diet- Drug (Ghiza e Dawai) and Drug-Diet (Dawa e Ghizai), Hippocrates quotes that "Let food be thy medicine". Substances that are utilized as diet consist of pharmacological properties and known as Diet-Drug. They have restorative properties and contribute to the overall health of an individual, for instance, wheat, gram, egg, certain vegetables and organic product etc. Drug-Diet used as medicaments however they have dietary ingredients, for example, Amla (*Phyllanthusemblica*), nectar, Pudina (*Menthaarvensis*), Hulba (*Trigonellafoenum-graecum*), Lettuce (*Lactuca sativa*) and etc. So, the Diet-Drug has dietary benefits and Drug-Diet has restorative properties and both in combination act as immunity enhancer and individual's wellbeing. Distinguishing proper diet for every individual is a necessary component. Proper guidelines to food rainbow utilization can help in creating good quality of Body Fluids (humors in natural medicine) and vice versa. However, the Diet Treatment is utilized in natural medicine on the topmost priority as a standard of treatment. Rainbow food has dietary benefits and also having pharmacological activities. For example, lemon juice, peppermint decoction, chamomile tea, grain water (oats), bioactive compound and flavoring agents that can be used to heal and prevent certain ailments. Phytochemically food rainbow is rich in immune modulation and have promising results on diabetes, hypertension, carcinogenic activity and calming effects. Table 2 highlights the phytochemicals of different groups of food rainbow that aid in immunity boosting mechanism.

Role of food on human body:

Development and Growth

Energy assimilation

Cell repair and its maintenance.

Functional components of food rainbow: Table 3 shows that different food and its active constituents have many effects on human body by enhancing the biochemical and physiological state ^[8].

Covid -19 & food rainbow: Plants are best source of ascorbic acid and carotenoids, so it helps in cell

modulation and immunity enhancement. Flavonoids rich spices also play the part. They act as anti-inflammatory and vitality enhancer. This enhances the lymphocyte action which initiates the phagocytosis and help in stopping infection process [9]. Table 4 describes micronutrients present in food. Covid-19 susceptible individuals with weak immunity must incorporate good load of antioxidants from food rainbow to boost the immunity. Group of vitamins including water soluble and fat soluble are naturally designed to support immune system and prevent infections which includes vitamin C, D & E. Fruits like guava, oranges, papaya, kiwi, Indian gooseberry are enriched with ascorbic acid while Peppers, beetroot, cauliflower, eggplant, lemon and spinach are some of the vegetables that are good source of ascorbic acid. Vitamin C is playing a major role in DNA replication and cell expansion. In fact, greens from rainbow food like kale, broccoli and mushrooms strengthen the immune system [10]. Kitchen drugs and spices like black pepper, ginger, garlic, cinnamon, turmeric, basil and cloves. They can be sprinkled on meals and can be utilized in form of herbal tea [11]. It should be our priority to pick those foods from food rainbow that can assist human health from preventing the infections [12].

Immunity boosting food rainbow (age –wise): All age groups have different nutritional needs to functions properly in term of growth and physiological processes. Table 5 shows immunity enhancing food groups that can be utilized for infants and children for nourishment. Table 6 indicates the value of Iron and calcium is a must for teenagers along with fat soluble vitamins and omega 3 fatty acids. Table 7 shows that adult female should include low fat, high iron and high calcium diet in the daily requirement. Adult males should take good amount of protein, antioxidant and omega 3 fatty acids that helps in maintaining reproductive, cardiac and muscular vitality as shown in Table 8. Aged group people are susceptible to catch infections and fall ill easily. So, they need food that helps them to combat infections as shown in Table 9.

Immune boosting nutrients and its recommended daily allowance: Nutrients are chemical components of food that supply nourishment to the body e.g., vitamins, calcium, folic acid etc., as shown in Table 10.

Conclusion: A healthy immune system defends by counter attacking the invading antigens (first line of defense). If invading antigen crosses the barrier then immune response accelerates by producing WBCs, chemicals mediators and proteins which will form antibodies against the infection(second line of defense). Healthy immune system is blessing and to nurture this blessing one must needs to incorporate food rainbow in the plate according to age, gender and specific body requirements. The plate of any individual is the fuel to not only biological process but a reservoir of how you look and what will be the body response after attack of any diseases or infection. Strong backup leads to strong immune response. Choosing healthy options from food rainbow is an option for optimum health and also preventing infections and diseases.

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Table 1. List of free radicals

S. No	Free radicals	Sensitivity / reactivity
1	Hydrogen peroxide	Resultant of multiple reactions and produce potent reactive species
2	Superoxide anion	Formed in cardiovascular system, mitochondria and other cell types
3	Hydroxyl radical	Formed during iron overload and highly reactive
4	Peroxyl radical	Reactive and produce from proteins, lipids, DNA and sugar molecules during oxidative damage
5	Peroxynitrite	Highly reactive and formed from superoxide & NO

Table 2. Phyto-chemicals of different food rainbows

1.	Citrons Fruit	Flavones
2.	Apple, Pear, Citrus Fruits Some Vegetables	Ferulic Acid, Caffeic Acid
3.	Brussels, Cauliflower, Broccoli, Horse Radish, Kale, Cabbage	Sulphorafane
4.	Tea	Catechins
5.	Carrots, Various Fruits	Beta- Carotene
6.	Tea, Apple, Onion, Broccoli	Flavones
7.	Cherries, Red Grapes, Berries	Anthocyanadines
8.	Carrots, Tomatoes, Parsley, Red Palm Oil, Grains, Green Fruit, Soy Products, Pink Grapefruit, Oranges	Carotenoids
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8.	Carrots, Tomatoes, Parsley, Red Palm Oil, Grains, Green Fruit, Soy Products, Pink Grapefruit, Oranges	Carotenoids

Table 3. Food items with is functional components.

S. No	Food Items	Functional Component	Functions
1	Fluid milk, margarines, fatty fish, fish oils, leafy greens, canola, soy,	Omega 3 Fatty acid ,vitamin D, vitamin K	Bone health
2	Cereals, grains	folate	Reduced risk of Diabetes
3	Soybeans	Soy phytoestrogen	Menopause symptoms
4	Cheese, Meat Product	Conjugated Linoleic Acid	Improve Body Composition
5	Legumes, grain, soy, green leafy vegetables	Folate	Neural Tube Defect
6	Legumes, grains, meat, fish, dairy product, milk, liver, eggs, peanut,	Thiamin, Riboflavin, Niacin	Health of Elderly Peoples
7	Red grapes, berries, cherries, fish oil, linseed, rapeseed, walnut	DHA,EPA, Omega 3 Fatty Acids	Improve Mental Functions

Table 4. Food rainbow enriched with micronutrient.

Specific Micronutrient	Vit B	Vit C	Ca	Sel	Fe	Mg
Fruits	Orange juice Bananas prunes	Citruses Orange Strawberry Grapefruit	Orange juice Goose berry	Banana	Dried apricot Resins	Banana Pineapple
Vegetables	Green leafy vegetables Mushroom Asparagus Cauliflower Sweet potatoes	Potato Tomato Broccoli Red pepper turnip	Kale Broccoli Turnip	Broccoli Green beans	Spinach	Spinach lettuce

Table 5. Immunity boosting food rainbow for infants and children.

Recommended Food	Advantages
Potatoes	<ul style="list-style-type: none"> Rich source of vitamin A and carotene Good for eyes
Brown rice	<ul style="list-style-type: none"> Rich source of magnesium Good for central nervous system
Plain yogurt	<ul style="list-style-type: none"> Rich in vitamin D and helps in calcium absorption in bone Good for GIT flora acting as a probiotic
Blue berries	<ul style="list-style-type: none"> Rich source of vitamin C and antioxidants Helps to combat cold
Avocado	<ul style="list-style-type: none"> Rich source of vitamin B-6, vitamin E and omega 3 Good to fight viral infections

Table 6. Immunity boosting food rainbow for teen-age.

Recommended Food	Advantages
Walnut & frozen yogurt	<ul style="list-style-type: none"> Rich source of iron, omega 3 and calcium A good option to control the craving of sweets
Whole wheat (pasta, chapatti)	<ul style="list-style-type: none"> Wheat is rich in vitamin E and iron. Aids in fertility
Sesame seeds and chickpeas (Hummus)	<ul style="list-style-type: none"> Rich in magnesium and calcium Addition of vegetables in it can be a good option for vitamins and carotenoids.
Granola and Skimmed milk	<ul style="list-style-type: none"> Skimmed milk is a good source of calcium and no saturated fats. granola is rich in iron –it has more iron than cereals

Fresh tomato	<ul style="list-style-type: none"> Rich source of vitamin E and C
Almond and peanut butter	<ul style="list-style-type: none"> Rich source of omega 3 Good for brain

Table 7. Immunity boosting food rainbow for females.

Recommended Food	Advantages
Red and green Apples	<ul style="list-style-type: none"> It contains an antioxidant called as quercetin and polyphenols. It is rich in iron and vitamin C. It can help fighting common cold. Iron deficiency
Pulses (lentils)	<ul style="list-style-type: none"> Lentils are a good source of protein other than meat. it is a readily available option to fulfill needs of iron in females (cooked lentil 1 cup)
Mushrooms	<ul style="list-style-type: none"> it contains a compound aromatase. aromatase helps fighting breast cancer also rich in zinc and folate
Dark chocolate	<ul style="list-style-type: none"> rich in antioxidants that helps in reducing cortisol levels. good to be taken in stress
Cheese	<ul style="list-style-type: none"> Parmesan contains twice more calcium than all other cheese with low fat (saturated) content. cottage cheese can also serve this purpose. so good for bone health

Table 8. Immunity boosting food rainbow for males.

Recommended Food	Advantages
Watermelon	<ul style="list-style-type: none"> it overcomes dehydration. it has ability to enhance the regenerative protein. this repairs mitochondria and build muscles
Tomatoes	<ul style="list-style-type: none"> It is rich in lycopene. It fights prostate cancer and also GIT carcinomas. Boosts immunity
Almonds	<ul style="list-style-type: none"> Rich in fats, proteins and antioxidant
Fatty fish	<ul style="list-style-type: none"> Fish that are rich in Omega 3 fatty acid like tuna, salmon and sardines They enhance immunity and plays part in arterial health by removing plaque from them
Turkey/chicken	<ul style="list-style-type: none"> It is rich in zinc and vitamin B Turkey breast lowers down the chances of prostate cancer. It also enhances sperm count

Table 9. Immunity boosting food rainbow for seniors/ aged

Recommended Food	Advantages
Pomegranate	<ul style="list-style-type: none"> Rich in iron and antioxidants It helps controlling blood pressure, combats menopausal hot flushes, prevents viral infections and reduces arthritic pain.
Broccoli	<ul style="list-style-type: none"> Good source of vitamin K, A & C, high in fiber and antioxidant Aids in overall health
Green tea	<ul style="list-style-type: none"> It has tannins and antioxidants. It lowers down risk of cancers and reduces inflammations
Cinnamon	<ul style="list-style-type: none"> It lowers blood sugar levels and low-density lipids (LDL). It is having anti-inflammatory property and helps prevent dementia and Alzheimer's diseases

Table 10. Recommended daily allowance (RDA) for immune boosting micronutrient.

Nutrients	Adult Men	Adult Women	9 -12 yrs. Kids	4 -8 yrs. Kids	1-3 yrs. kids
Vitamin A	900µg	700µg	600 µg	1,333 IU	1,000 IU
Niacin	16mg	14mg	12 mg	8 mg	6 mg
Vitamin C	90mg	75mg	45 mg	25 mg	15 mg
Vitamin D	15-20 µg	15-20 µg	600 IU	600 IU	600 IU
Vitamin E	22.4 IU	22.4 IU	16.4 IU	10.4 IU	9 IU
Folic acid	400 µg	400µg	300 µg	200 µg	150 µg
Iron	8 mg	8-18 mg	8 mg	10 mg	7 mg
Calcium	1000mg	1000-1200 mg	1,300 mg	1000 mg	700 mg
Magnesium	400-420mg	310 - 320 mg	240 mg	130 mg	80 mg
Zinc	11mg	8mg	8 mg	5 mg	3mg
Copper	900µg	900µg	700 µg	440 µg	340 µg

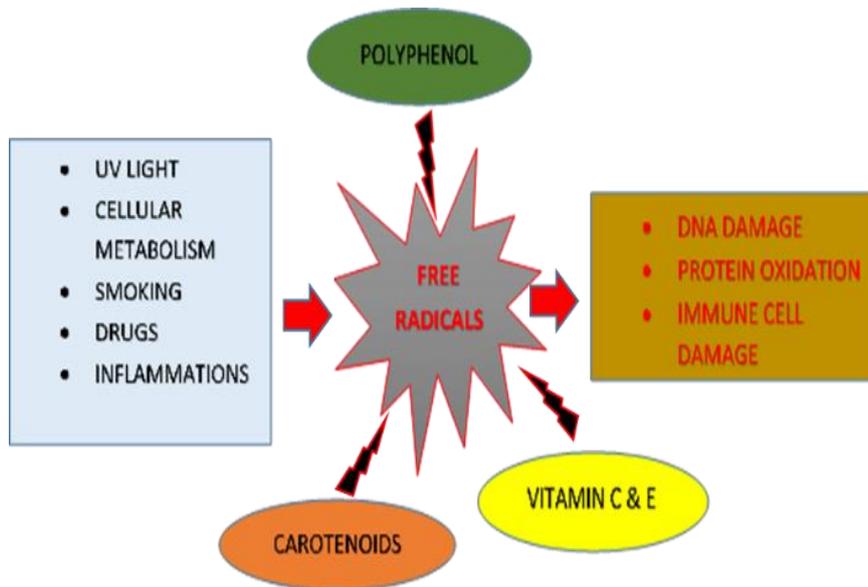


Fig 1. Free Radical causing cell damage and antioxidants scavenging free radicals.

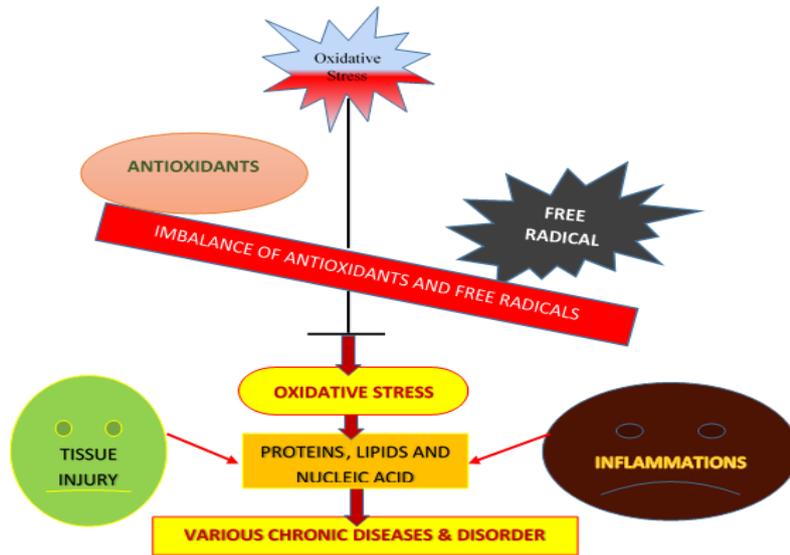


Fig 2. Oxidative stress

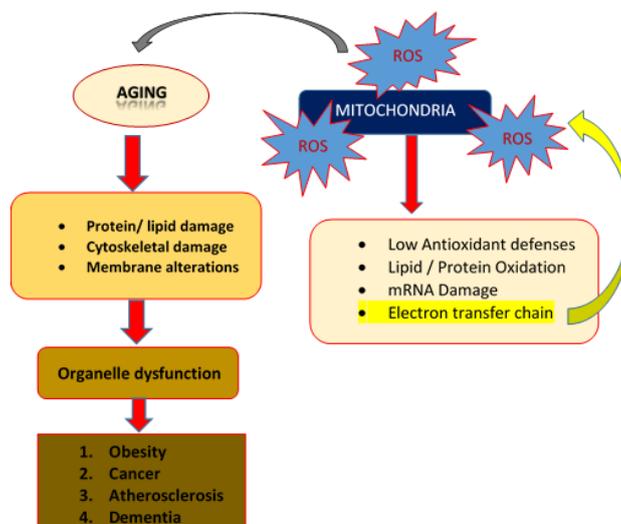


Fig 3. Reactive oxygen species and its damage