



Food Biodiversity combats Antigens

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Food is any substance [1] consumed to provide nutritional support for an organism. Food is usually of plant or animal origin and contains essential nutrients, such as carbohydrates, fats, proteins, vitamins or minerals. This is the substance ingested by an organism and assimilated by the organism's cells to provide energy, maintain life or stimulate growth. The following general aspects with regards to food are energy density, macronutrient content and quality, minerals and vitamins, bioactive substances, antinutritional factors and food processing. The nutritional values of the main food groups—cereals, legumes, pulses, roots, vegetables, fruits and animal foods are so important for a healthy human being. Most food has its origin in plants. Some food is obtained directly from plants; but even animals that are used as food sources are raised by feeding them food derived from plants. Cereal grain is a staple food that provides more food energy worldwide than any other type of crop [2]. Corn (maize), wheat, and rice – in all of their varieties – account for 87% of all grain production worldwide [3][4].

Seeds of plants are a good source of food for animals, including humans, because they contain the nutrients necessary for the plant's initial growth, including many healthful fats, such as omega fats. Edible seeds include cereals (corn, wheat, rice, etc), legumes (beans, peas, lentils, etc), and nuts. Oilseeds are often pressed to produce rich oils - sunflower, flaxseed, rapeseed (including canola oil), sesame, etc. [5]. Fruits are the ripened ovaries of plants, including the seeds within. Some botanical fruits, such as tomatoes, pumpkins, and eggplants, are eaten as vegetables. Vegetables are a second type of plant matter that is commonly eaten as food. Animals are used as food either directly or indirectly by the products they produce. Meat is an example of a direct product taken from an animal, which comes from muscle systems or from organs (offal) also include milk produced by mammary glands. In addition, birds and other animals lay eggs, which are often eaten. Vegans do not consume any foods that are or contain ingredients from an animal source.

Malnutrition

It is lack of proper nutrition, caused by not having enough to eat or being unable to use the food that one does eat. Globally, almost 200 million children under 5 suffer from stunting, wasting or both and at least 340 million from the hidden hunger of vitamin and mineral deficiencies. At the same time, 40 million children under 5 are overweight and the toll from overweight and obesity keeps rising, even in lower-income countries. The typical diet in populations with a high prevalence of malnutrition consists predominantly of a starch-rich staple, such as a cereal (maize, rice) or tuber (cassava), with limited amounts of fruits, vegetables, legumes, and pulses, and little or no animal-source food. Such a diet is bulky, has

a low density of energy and nutrients and a low bioavailability of minerals and will result in impaired growth, development, and host defense to infections. For instance, green leafy vegetables may provide a high content of micronutrients and be a valuable food, although they have low fat and low energy contents. In cereal dominated diets, the plant foods should be processed to reduce the contents of antinutrients and fibers. A main issue is to identify a cost-effective balance between the amount of foods—which have a high content of minerals important for growth (e.g., phosphate and zinc) and of protein of high quality (PDCAAS), with virtually no antinutrients, but which also have a high cost—and the amount of plant-based foods.

Different Foods

Cereals are mainly grasses cultivated for their edible grains or fruit seeds. Cereals are the cheapest way to provide energy. In low-income countries, these foods provide 70% or more of the energy intake [6]. The most important staple foods in terms of global production are maize, wheat, and rice. Cereal grains supply energy mainly as starch, also an important source of protein. They contain from 6 to 14 g of protein/100 g dry weight, and from 7% to 14% of the energy comes from protein. The amino acid composition of cereals is in most cases not optimal, typically being deficient in lysine. There is some calcium and iron, but the absorption of these minerals is not high. They are important sources of B vitamins but contain no vitamin C and no provitamin A, except for whole yellow maize. The amount of fat in cereals is generally low, with a predominance of n-6 PUFAs. Legumes have a high nutritional quality. The protein content is high, typically from 20 to 35 g/100 g, or a protein energy percentage of 20 to 30. The quality of the protein is not high because of a low content of methionine. The lysine content is high compared with cereals, and therefore legumes complement the low lysine content of cereals, resulting in a high PDCAAS in foods containing both cereals and legumes. The fat content is low, about 1% to 3%, with the exception of whole peanuts and soybean, which contain about 43 and 18 g of fat/100 g, respectively. Most fruits are good sources of vitamin C and should be consumed raw with plant-based meals to enhance iron absorption. Yellow- and orange-fleshed fruits are good sources of provitamin A. No food or nutrition supplement can provide as many micronutrients, bioactive compounds, antioxidants together as the diversified food items.

Healthy Diet

Functional foods may be "designed to have physiological benefits and/or reduce the risk of chronic disease beyond basic nutritional functions and may be similar in appearance to conventional food and consumed as a part of a regular diet" [7] The term was first used in Japan in the 1980s where there is a government approval process for functional foods called Foods for Specified Health Use (FOSHU) [8]. Health food is food marketed to provide human health effects beyond a normal healthy diet required for human nutrition. Foods marketed as health foods may be part of one or more categories, such as natural foods, organic foods, whole foods, vegetarian foods or dietary supplements. A healthy diet provides the body with essential nutrition: fluid, macronutrients, micronutrients, and adequate calories [9] [10]. The requirements for a healthy diet can be met from a variety of plant based and animal-based foods, although a non-animal source of vitamin B12 is needed for those following a vegan diet [11].

Poor intake of various vitamins and minerals can lead to diseases that can have far-reaching effects on health. For instance, 30% of the world's population either has, or is at risk for developing, iodine deficiency. It is estimated that at least 3 million children are blind due to vitamin A deficiency. Vitamin C deficiency results in scurvy. Calcium, Vitamin D and phosphorus are inter-related; the consumption of each may affect the absorption of the

others. Kwashiorkor and marasmus are childhood disorders caused by lack of dietary protein. Obesity, a serious problem in the western world, leads to higher chances of developing heart disease, diabetes, cancer and many other diseases. Macronutrients are fat, protein, and carbohydrates. Micronutrients are the minerals and vitamins. Additionally, food contains water and dietary fiber.

Food Biodiversity

It is defined as "the diversity of plants, animals and other organisms used for food, covering the genetic resources within species, between species and provided by ecosystems." Production of food biodiversity looks at the thousands of food products, such as fruits, nuts, vegetables, meat and condiments sourced from agriculture and from the wild (e.g. forests, uncultivated fields, water bodies). Major staple commodity crops, which have increased substantially in the share of the total food energy (calories), protein, fat, and food weight that they provide to the world's human population, including wheat, rice, sugar, maize, soybean, palm oil and sunflower. Other crops have declined sharply over the same period, including rye, yam, sweet potato, cassava, coconut, sorghum and millets. Nutritionally, diversity in food is associated with higher E, micronutrient adequacy of diets. On average, per additional species consumed, mean adequacy of vitamin A, vitamin C, folate, calcium, iron, and zinc increased by 3%. From a conservation point of view, diets based on a wide variety of species place less pressure on single species. It is suggested that the protein requirement of children with moderate malnutrition should be at least 24 of g protein/1,000 kcal (equivalent to about 9.6 protein energy percent [E%]) and preferably 26 g/1,000 kcal (10.4 E%) and that the protein digestibility-corrected amino acid score (PDCAAS) should be at least 70%. About 5 g of fat has been found to be needed per meal to provide good bioavailability of vitamin A. The absorption seems to be improved somewhat by fat rich in oleic acid (C18:1), but other oils are probably almost as good [6]. Therefore, we assume the essential fatty acid issue to be the most relevant with. Foods with a high n-3 PUFA content, such as soybean oil, rapeseed oil, and fish, should be promoted. The most important dietary mono- and disaccharides are glucose, fructose, lactose, and sucrose (sugar). These sugars are good sources of energy and will typically increase the energy density of a diet. The staple food with the largest amount of starch is maize, but wheat, rice, and potatoes also have high contents of starch [12]. Starch is stored as amylose and amylopectin in granules in plant tubers and seeds. The most fiber-rich plant foods are unrefined cereals and legumes, including soybeans, beans, lentils and peas. Soluble fibers, e.g., pectins, gums and mucilages, are found in all plant foods, especially fruits and vegetables, but in varying amounts.

Model Plate

This plate typically illustrates proportion of foods from different food groups to be sourced for a 2000 Kcal Indian diet. The plate, designed by the ICMR-National Institute of Nutrition, recommends sourcing of macronutrients and micronutrients from minimum of 8 food groups per day with vegetables, fruits, green leafy vegetables forming essentially half the plate of the recommended foods per day. The other major portion is occupied by cereals and millets, followed by pulses and milk/curd. The amount of pulses and milk in the menu provides good quality protein and supply of all essential amino acids. Milk and milk products represented in a glass as a part of the model plate help to achieve the required protein, calcium, and are the sole source of Vitamin B12 in a vegetarian diet. A balanced diet should provide around 50-60% of total calories from carbohydrates, preferably from complex carbohydrates, about 20-30% from total fats/oils and a minimum of 10-15% from proteins. 'My Plate for the Day' provides typically 13.5% calories or energy (E) from protein, 29 %E from fat and 56%E from carbohydrates required to meet the 2000 calories need in a day.

The plate has been designed on the basis of Recommended Dietary Allowances (RDA) guidelines for Indians, and actual dietary consumption patterns of Indians with the goal to guide people to achieve a balanced diet sourcing E from different food groups. The per cent of calories and protein that are derived from different food groups is given in the table below. In case of non-vegetarian diet, the pulses can be substituted with proportionate amount of fish, flesh foods or eggs. The cost of the 'My plate for the day' has been estimated based on commonly consumed foods. The cost of each food group has been estimated taking into consideration the different types of foods consumed in a particular food group from different parts of the country as on December, 2019 (agmarknet.in/priceTrends). For non-vegetarian menu, pulses are replaced with meat/chicken for estimating the price. The cost of non-vegetarian menu works out to approximately Rs.78 and vegetarian menu is Rs.66 per person per day.

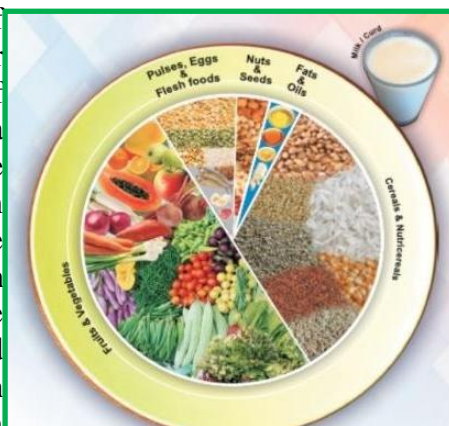


Table: Calories (energy) and protein from different food

Food groups	Foods to be consumed / day (weight of raw foods in grams)	Percent of total calories / day from each food group	Total calories / day (kcal) from each food group	Total protein / day (grams) from each food group
Cereals incl. Nutriceals	270	45	900	20
Pulses*	90	17	340	21
Milk/ Curd	300	10	200	10
Vegetables+ And green leafy vegetable	300	5	100	4
Fruits#	100	3	67	1
Nuts & Seeds	20	8	150	4
Fats & Oils\$	27	12	243	-

* Eggs/fish/meat can substitute pulses

+ Prescribed amount of vegetables may be consumed either in cooked form/ salad

Prefer fresh fruits (avoid juices)

\$Use different varieties of cooking oils, vegetables, fruits, nuts, etc., to obtain a variety of phytonutrients, vitamins, minerals and bioactive compounds

Source: ICMR-NIN

Conclusion

By and large it is essential to consume diversified food which helps in combating many antigens. Though this model plate is not a representation of any therapeutic diet, regular consumption of foods in the mentioned proportion, coupled with regular physical activity has the potential to reduce the risk of non-communicable diseases such as diabetes, hypertension, heart attack, stroke, cancer, arthritis, etc. The total dietary fiber content is reported as 17% to 20% in millets and 14% in sorghum, quinoa, legumes and pulses, lentils, bean, soybean, peanuts, roots like cassava, potato, sweet potato, plantain, vegetables, green leafy vegetables,

moringa, Fruits Most fruits contain readily available energy in the form of simple sugars, mainly fructose.

Today, the majority of the food energy required by the ever-increasing population of the world is supplied by the food industry. Food safety and food security are monitored by agencies like the International Association for Food Protection, World Resources Institute, World Food Programme, Food and Agriculture Organization, and International Food Information Council. They address issues such as sustainability, biological diversity, climate change, nutritional economics, population growth, water supply, and access to food. The right to food is a human right derived from the International Covenant on Economic, Social and Cultural Rights (ICESCR), recognizing the "right to an adequate standard of living, including adequate food", as well as the "fundamental right to be free from hunger".

References

1. "food" . Encyclopedia Britannica. Archived from the original on 2017- 07-27. Retrieved 2017-05-25.
2. Society, National Geographic (2011- 03-01). "food" . National Geographic Society. Archived from the original on 2017-03-22. Retrieved 2017-05-25.
3. "ProdSTAT" . FAOSTAT. Archived from the original on 2012-02-10.
4. Favour, Eboh. "Design and Fabrication of a Mill Pulverizer" . Archived from the original on 2017- 12-26.
5. McGee, Chapter 7.
6. Latham MC, Food and Agriculture Organization. Human nutrition in the developing world. Rome: FAO, 1997
7. "Food for special medical purposes" . European Commission.13 October 2017.
8. Melina, Vesanto; Craig, Winston; Levin, Susan (December 2016). "Position of the Academy of Nutrition and Dietetics: Vegetarian Diets". *Journal of the Academy of Nutrition and Dietetics*. 116 (12): 1970– 80. doi:10.1016/j.jand.2016.09.025 .PMID 27886704 .
9. "Basics about Functional Food" (PDF). US Department of Agriculture, Agricultural Research Service. July 2010.
10. "FOSHU, Ministry of Health, Labor and Welfare, Japan". Government of Japan.
11. Lean, Michael E.J. (2015). "Principles of Human Nutrition". *Medicine*. 43 (2): 61–65. doi:10.1016/j.mpmed.2014.11.009 .
12. World Health Organization, Food and Agricultural Organization of the United Nations (2004). Vitamin and mineral requirements in human nutrition (PDF) (2. ed.). Geneva: World Health Organization. ISBN 978-92-4-154612-6.