# Millet Production Environment and its Importance as a Source of Food and Nutrition

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## Introduction

Among all groups of plant resources, cereal is undoubtedly the most important food crop. In context of present shortage of food, energy and protein, the cereal crops especially the unconventional type with greater draught resistance like millet crop can play an important role in bridging the food and protein-energy gap. At present, a major part of the world population lives on low food intake of about 2,000 kcal per person per day in the developing countries[1]. This situation is more deplorable in rural areas of this part where food deficiency and insufficient caloric intake is the major cause of malnutrition and labour unproductivity. In future, this situation may be more critical, because the world population most likely will be doubled within a few decades, demanding a large increase in food production to feed properly the entire population[2]. This demand can partly be met through increasing the rate and yield of food production and by bringing more land under cultivation and production system. Thus, there is increasing need for production of staple and cereal like foods along with other food production. In fact, the entire world population depends on agriculture for its food and moreover, 70% of the population in tropical countries depends for its income on agricultural resources[2]. Also the gap between production and demands of cereals in tropics is increasing more and more; in thirties, the tropical countries had a surplus of 12 million tons of cereals per year; in 1976 they had deficit of 63 million tons[2]. This deficit may be increased in the coming days if appropriate measure is not taken in different aspects of staple food production.

However, in this paper an attempt has been made to elucidate some aspects of productivity and importance of millet type of cereal grain crops as s source of food and nutrition.

## Production and Environmental Consideration

The general consideration for crop yield and crop selection is determined mainly by the characteristics like soil sitructure and root development; average daily temperature (should be at least 10°C); the intensity and duration of sunlight; the carbondioxide concentration of the air; availability of nutrients and water in the soil; crop species; plant characteristics; occurrence of weeds, pests and diseases; and cultivation practices[2].

In tropics, the favourable sunlight and temperature make it possible to grow a large varieties of crops throughout the year. It is known that about 90-95% of plant dry matter is formed from $CO_2$ and its concentration does not differ significantly from place to place[3]. And also sunlight provides energy required to convert $CO_2$ from air (and for a small part from the soil) with water and nutrients from soil into dry matter of the plant by photosynthetic process and provide food elements like carbohydrates, fats, proteins, vitamins and minerals. The maximum photosynthesis of millet occur at temperature of 35° to 40°C, most suitable in the tropics[4]. With regards to the efficiency of dry matter formation and

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photosynthetic efficiency, plants can roughly be divided into two categories, called efficient and nonefficient, or $C_4$ and $C_3$ species where the efficient species have much less photorespiration[5], a much lower water require-ment, and a higher optimum temperature[6]. According to these requirements corn, sorghum and several millets (Planicum millacenm, Eleusine coracana, and Setaria italica) belong to the efficient group[7]. In this context to locate the position of millet in compare to other cereal crops as a resource material of agricultural food product, the production yields and yields increase by region of millet along with several other cereals are shown in Table 1[8].

Table I. *Production of millet and other creals in 1981 (1,000 t)*

| Region /Production | Rice | Wheat | Corn | Millet |
|---|---|---|---|---|
| World | 413,785 | 458,195 | 451,704 | 29,653 |
| Europe | 4,208 | 179,942 | 62,827 | 1,532 |
| South America | 13,258 | 11,743 | 38,406 | 238 |
| Asia | 376,232 | 137,371 | 86,570 | 17,585 |
| Africa | 8,562 | 8,584 | 32,860 | 10,282 |

From Table I it is understandable that in region where irrigation facilities are not available or insufficient and weather is dry the millet type cereal is an important crop. Millet because of its lower water requirement, can grow on lands where rainfall is low. For providing 1 kg of dry matter, millet requires 250-300 kg water, where rice needs about 700 kg and corn needs about 350 kg[6].

## Food and Nutritional Importance

Food sources are primarily from 1. plant origins e.g. a) cereals and other grains; b) tubers, roots and strachy fruits; c) legumes, beans and peas; d) oil seeds and nuts, and e) fruits and vegetables, and from 2. animal origins like: a) meat and meat products, b) eggs.

Although animal sources are considered to be the ideal sources of protein, at present time there is a need for considering other and alternate sources of food due to many nutritional factors like cardiovascular and colon diseases associated with high consumption of food from animal origin attributable to high cholesterol contents in animal food. In this context food from agricultural sources are safer.

In elaborating the food and nutritional aspects of millet, it is necessary to describe briefly the structure of cereal group of foods.

The grain of cereals like corn, barley, oats, rye and millet, although differ from each other, generally composed of the main parts: (a) the embryo or germ from which root and leaf of new plant are formed when sprouts; (b) the scutellum, rich in thiamine and protein; (c) the endosperm, the storage portion of grain which supplies sprouting embryo with food in the period before root and leaf begin to function; and (d) the bran, the aleurone layer, pericarp and grain or seed coat which forms the covering or protecting layers[2].

The embryo, endosperm and bran differs chemically and nutritionally. The bran contain high percentage of crude fiber, ash and fair amount of fat; the embryo has high content of lipids, total nitrogen and ash; whereas the endosperm is composed of cells containing large quantities of starch and

Table 2. *Percentage distribution of some nutrients in different layers in a cereal grain*

| Layers | by weight | Thiamine % | Riboflavin % | Niacin % | Protein % |
|---|---|---|---|---|---|
| Paricarp and seed coat | 8 | 1 | 5 | 4 | 4 |
| Aleurone layer | 7 | 32 | 37 | 82 | 16 |
| Scutellum | 1.5 | 62 | 14 | 1 | 4.5 |
| Germ (embryo) | 1.0 | 2 | 12 | 1 | 3.5 |
| Total | 17.5 | 97 | 68 | 88 | 28 |
| Endosperm | 82.5 | 3 | 32 | 12 | 72 |

Table 3. *Food composition of millet along with other cereal grains*

| Grain | Carbohydrate % | Protein % | Fat % | Moisture % | Crude fibre % | Calories per 100 gm |
|---|---|---|---|---|---|---|
| Rice | 65 | 8 | 2 | 11 | 9 | 310 |
| Wheat | 69 | 13 | 2 | 11 | 3 | 340 |
| Corn | 72 | 10 | 4 | 11 | 2 | 352 |
| Millet | 71 | 10 | 2 | 10 | 6 | 345 |

protein. The percentages of nutrient contents in different parts of cereal grain is summarised in Table 2[10].

Also the typical percentage composition of cereal grains including millet are given in Table 3 (11, 12).

The food composition of millet (Table 3) is almost similar to rice, wheat and corn. Millet contains more energy than rice and wheat; and more protein than rice. Exceptionally, ragi (a finger millet) is a good source of calcium (13)

## Technological Importance

Millet crop after harvest can be processed both by parboiling (soaking, steaming and drying) and in unboiled condition (only drying). The millet is then dried and milled. The whole millet can be eaten following the cooking preparation like that of rice or can be powdered for further processing into different food items. Millet can also be used for preparing bread and semi-solid food mixture with or without legume and other supplementary food, and for producing specialised food products.

It is recognised that foods from animal origin are important for young children. As they usually contain a good proportion of high quality protein, easily digestable and almost completely absorbed by the body and food from animal origin is the only supplier of vitamin B (14,15). So, the cereal and other staple food if supplemented with food from animal sources, will make an excellent weaning and baby foods. Normally baby food of simpliest type has two ingredients like cereal or root mixed with a legume,

known as basic mix. However, the receipes more suitable for weaning food should be of multi-mixed consisting of (a) a staple as the main ingredient, preferably a cereal, (b) a protein supplement from a plant or animal food, (c) vitamin and mineral supplement, and (d) an energy supplement. In Table 4 a guideline for planning the weaning food basic mixes is given using edible raw portion of millet, other cereal and foods supplemented by different food items (16). To each of the basic maxes (Table 4) oil and sugar is to be added. The amount of protein food is used to supplement the staple to give the best possible protein value (i.e. amino acid score) suitable for a meal of child of two years of age. In all basic mixes the position of millet lies in.between rice and wheat.

The responses of a crop with different processing treatment is a great concern for producers, consumers, traders and industrialists that influences cultivation of crop. The variation of nutritive values related to different processing treatment of millet and other cereals and potato are given in Table 5 (17, 18) as a comparative assessment of crop quality. The malted flour of millet contains highest concentration of energy and other nutrients (Table 5).

Table 4. *Calculated amounts of ingredients for basic mixes*

| Staples (g) / Supplements (g) | Rice | | Wheat | | Millet | | Maize | | Potato | |
|---|---|---|---|---|---|---|---|---|---|---|
| Legume | 65 | 25 | 80 | 10 | 75 | 10 | 55 | 35 | 320 | 20 |
| Soybean | 55 | 20 | 60 | 10 | 55 | 15 | 50 | 25 | 250 | 20 |
| Chick or lean meat | 65 | 25 | 65 | 20 | 65 | 25 | 65 | 35 | 300 | 25 |
| Fresh fish | 70 | 30 | 70 | 30 | 70 | 25 | 70 | 20 | 310 | 25 |
| Egg | 65 | 30 | 65 | 25 | 60 | 30 | 65 | 25 | 300 | 25 |
| Dried skimmed milk | 65 | 15 | 65 | 10 | 60 | 15 | 60 | 15 | 280 | 15 |
| Dried whole milk | 45 | 25 | 55 | 15 | 45 | 20 | 40 | 25 | 220 | 20 |

Table 5. *Comparative nutrtive values (per 100 g samples) of raw and processed millet along with potato and othet cereals*

| | Sample | Energy (kcal) | Protein (mg) | Iron (mg) |
|---|---|---|---|---|
| Rice | : Raw | 310 | 7.5 | 1.7 |
| | Boiled/Steamed | 123 | 2.2 | 0.2 |
| Wheat | : Flour | 337 | 12.3 | 1.5 |
| | Bread | 233 | 7.8 | 1.1 |
| | Chapati | 202 | 7.3 | 2.1 |
| Millet | : Unmalted flour | 25 | 0.4 | 0.3 |
| | : Malted flour | 83 | 1.3 | 1.0 |
| Potato | : Raw | 87 | 2.1 | 0.5 |
| | Boiled | 80 | 1.4 | 0.3 |
| | Roasted | 157 | 2.8 | 0.7 |
| | Crisp | 533 | 6.3 | 2.1 |

## Conclusion

The research (R&D),extension, processing and technological effort for cereal food production was the milestone in successful culmination of green revolution. A systematic approach for exploiting the unconventional cereal like millet will help in meeting the protein-energy and food gap and thereby improving the nutritional status of pople. The diversification of eating habits and practices; and adoption of innovation processing technologies and managements in food and menu preparation using millet as a staple food source will be an additional advantage to our effort for food production, and in solving the food dificiency situation to a great extent.

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