Nutrient-dense alternate crops for crop diversification and combating malnutrition

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FIGURE 1. Different foods crops

KEYWORDS: Malnutrition, Nutrient dense crops, Millets, Nutritional deficiency, Disorders

SUMMARY

Malnutrition problem is one of the biggest threats that India has been combating since its independence. Further, as farmers worldwide experience more frequent drought and erratic rainfall linked to climate change, the race to find and improve drought-resistant crops grows ever more important. Alternate crops must be incorporated into our normal diet, dispelling the idea that they are only grown by the poorest of the poor. Nutrient dense crops like millets, quinoa, chia, grain amaranth etc. are being increasingly recognized for their potential to play important roles as alternative food grains. Stress-resistant crops are needed to ensure yield stability under stress conditions and to minimize the environmental impacts of crop production. The introduction of new cultivated species and improved varieties of crops is a technology aimed at enhancing plant productivity, quality, health and nutritional value and/or building crop resilience to diseases, pest organisms and environmental stresses. It reduces the risk of total crop failure and also provides alternative means of generating income, as different crops will respond to climate scenarios in different ways.

INTRODUCTION

Malnutrition problem is one of the biggest threats that India has been combating since its independence. Although India has enjoyed strong economic growth over the last 20 years, India is home to 46.6 million stunned children, more than one third of the world's malnourished children. Estimates from the Comprehensive National Nutrition Survey report (2016–18) shows that in India, about 35% of the children under the age of five year were stunted, 33% of the children were underweight and 17% children were wasted.

With a change in daily habits, deficient nutrient diets and over dependence on few cereal foods (Rice or Wheat), chronic lifestyle diseases are reaching a soaring high. Refining operations further reduce the nutritional value of cereals by removal of the germ and aleuronic layers, which are rich in micro nutrients.

The needed change

In the recent years, there has been an increasing demand for functional foods that possess numerous health benefits as well as provide basic nutrients due to intensified consumer awareness and emerging trend towards a healthy lifestyle leading to a major shift in the consumption patterns of food. Further, as farmers worldwide experience more frequent drought and erratic rainfall linked to climate change, the race to find and improve drought-resistant crops grows ever more important. So, naturally stress resistant plants that can survive under harsh stressful environmental conditions are on the radar. These crops are also known as super food crops due to its nutrient dense characteristics and are helpful to minimize the pressure of food insecurity.

Alternate crops must be incorporated into our normal diet, dispelling the idea that they are only grown by the poorest of the poor. Nutrient dense crops like millets, quinoa, chia, grain amaranth etc. are being increasingly recognized for their potential to play important roles as alternative food grains. Stress-resistant crops are needed to ensure yield stability under stress conditions and to minimize the environmental impacts of crop production. The introduction of new cultivated species and improved varieties of crops is a technology aimed at enhancing plant productivity, quality, health and nutritional value and/or building crop resilience to diseases, pest organisms and environmental stresses. It reduces the risk of total crop failure and also provides alternative means of generating income, as different crops will respond to climate scenarios in different ways.

Millets

Millets are a group of highly variable small-seeded grasses and are popularly known as nutri-cereals or nutraceuticals as they are a repository of protein, fibre, vitamins and minerals (Table 1). The majority of the millets are native to India.

Millets are classified as major millets or small millets based on their grain size. Sorghum (*Sorghum bicolor*) and pearl millet (*Pennisetum glaucum*) are two of the most common millets. Finger millet (*Eleusine coracana*), Kodo millet (*Paspalum scorbiculatum*), proso millet (*Panicum miliaceum*), foxtail millet (*Setaria italica*), little millet (*Panicum sumatrense*), and barnyard millet (*Echinochloa colona*) comes under small millets.

Compared to major cereals, millets are more drought-resistant crops, pests and diseases resistant, have a short growing season, and well suited to drought situations. They perform very well in marginal soils and are superior in nutritional properties with high micronutrient contents and low

Academic editor- Dr. Sandeep Singh, PhD, Kanpur, (208021) Uttar Pradesh, India.

glycemic indices. Millets have unique nutritional characteristics, including complex carbohydrates, dietary fiber, minerals (Ca, Fe, P, and Zn), vitamins, proteins, and phenolic compounds and phytochemicals, which aid in the prevention of malnutrition and lifestyle diseases.

salad dressing from the seed or it is eaten raw. Other than bread, the food industry has widely used chia seeds or its oil for different applications such as breakfast cereals, bars, cookie snacks, fruit juices, cake, and yoghurt. Chia requires low maintenance, prefers moderately fertile, well-drained soils, but can cope with-

vitamins, and antioxidants necessary for human health. They act as a shield against nutritional deficiency disorders and provide nutritional security. Because of their more degree of phenotypic plasticity, nutritional profile, high adaptability to various environmental conditions and ability to improve food security, they can be

TABLE 1. A comparison of nutrient composition of different food crops (per 100g edible portion)

Crop	Protein (g)	Fat (g)	Crude fiber (g)	CHO (g)	Energy (kcal)	Ca (mg)	Fe (mg)	Thiamin (mg)	Riboflavin (mg)	Niacin (mg)
Rice (brown)	7.9	2.7	1.0	76.0	362	33	1.8	0.41	0.04	4.3
Wheat	11.6	2.0	2.0	71.0	348	30	3.5	0.41	0.1	5.1
Maize	9.2	4.6	2.8	73.0	358	26	2.7	0.38	0.2	3.6
Pearl millet	11.8	4.8	2.3	67.0	363	42	11	0.38	0.21	2.8
Sorghum	10.4	3.1	2.0	70.7	329	25	5.4	0.38	0.15	4.3
Common millet	12.5	3.5	5.2	63.8	364	8	2.9	0.41	0.28	4.5
Foxtail millet	11.2	4	6.7	63.2	351	31	2.8	0.59	0.11	3.2
Barnyard millet	11.0	3.9	13.6	55.0	300	22	18.6	0.33	0.1	4.2
Kodo millet	9.8	3.6	5.2	66.6	353	35	107	0.15	0.09	2
Little millet	9.7	5.2	7.6	60.9	329	17	9.3	0.3	0.09	3.2
Finger millet	7.7	1.5	3.6	72.6	336	350	3.9	0.42	0.19	1.1
Quinoa	16.5	6.3	9.5	69.0	399	148.7	13.2	0.2-0.4	0.2-0.3	0.5-0.7
China	16.5	30.7	21.1	42.1	486	631.0	7.7	0.6	0.2	8.8
Grain Amaranthus	13.6	7.0	2.2	65.3	371	159.0	7.6	0.1	0.2	0.9

Ref: Chavan and Kadam, 1989; Kulczyński et al., 2019; Soriano-García and Aguirre-Díaz, 2019 and USDA, 2018.

Quinoa

Quinoa (*Chenopodium quinoa* Wild.) is a plant species of the Chenopodiaceae family, native to the Andean region and adapted to diverse agro climatic zones. It is a pseudo cereal with high nutritional value as it is rich in proteins, lipids, fiber, vitamins, and minerals as well as exceptional balance of essential amino acids and high amount of health-beneficial phytochemicals with beneficial hypoglycemic effects while being gluten-free. There has been a growing interest in quinoa globally due its unique nutritional value, wide adaptability and tolerance to abiotic stresses namely cold, salinity and drought.

Chia

Chia (*Salvia hispanica* L.) is an annual plant belonging to the Lamiaceae family native to Mexico and Guatemala. Chia seed is composed of high protein, fats, carbohydrates, high dietary fiber, ash, minerals, vitamins, and dry matter and a high amount of antioxidants. Recently, chia seed has gained importance for human health and nutrition as it is a good source of polyunsaturated fatty acids: omega-3 and omega-6 which promotes beneficial health effects. Chia is commonly consumed as salad from chia sprout, in beverages, cereals, and

acidity and moderate drought.

Grain Amaranth

Amaranthus spp. is characterized by high nutritional value and its adaptation to the marginal lands. The three principal species considered for grain production include *Amaranthus hypochondriacus* L., *A. cruentus* L. and *A. caudatus* L. Amaranthus is a good source of gluten-free high-quality protein including an excellent amino acid balance, high-fiber, and high nutritional values. Amaranthus is a hardy, stress tolerant crop and can be cultivated with minimal external inputs. It is a drought resistant crop with short growth cycle and therefore can be used efficiently for crop diversification on marginal lands. Amaranthus are gaining popularity due to their favorable agronomic traits, including C_4 photosynthesis, dual uses for vegetable and grain production, and tolerance to heat, drought, and salinity stress and adaptability to marginal lands.

CONCLUSION

Nutrient rich underutilized crops like millets, quinoa, chia, grain amaranth etc. should also be included in daily diet as it provides fiber, protein, energy, minerals,

grown in marginal lands. Broader cultivation of these minor crops will diversify plant agriculture and the human diet, and will therefore help to improve national food security and human health.

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Citation: Shanalin *et al.* (2022). Nutrient-dense alternate crops for crop diversification and combating malnutrition. *Frontiers in Food & Nutrition Research*, 8(1), 1-2.