NUTRITIONAL QUALITY, POTENTIAL FUNCTIONAL IMPLICATIONS OF MILLETS IN HEALTH AND DISEASE-INDIA

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ABSTRACT

In the 21st century, climate changes, water scarcity, increasing world population, rising food prices, and other socioeconomic impacts are expected to generate a great threat to agriculture and food security worldwide, especially for the poorest people who live in arid and sub arid regions. These impacts present a challenge to scientists and nutritionists to investigate the possibilities of producing, processing, and utilizing other potential food sources to end hunger and poverty. Agriculture is a primary activity in the world. It includes growing crops, fruits, vegetables, flowers and rearing of livestock. In the world, 50 per cent of people are engaged in agricultural activity. Two-thirds of India’s population is still dependent on agriculture. Favorable topography of soil and climate are vital for agricultural activity. The land on which the crops are grown is known as arable land. After almost 70 years of Independence, malnutrition continues to plague India. Even while vast segments of resource-poor people suffer from under nutrition, particularly micronutrient deficiencies (hidden hunger), there is a growing incidence of obesity and chronic diseases like diabetes, cardiovascular diseases, cancer etc.

The Global Nutrition Report 2016 demonstrates India’s slow overall progress in addressing chronic malnutrition, manifest in stunting (low weight for age), wasting (low weight for height), micronutrient deficiencies and overweight. Our track record in reducing the proportion of undernourished children over the past decade has been modest at best, and lags what other countries with comparable socio-economic indicators have achieved. In India human malnutrition is not lack of adequate food, but lack of right kind of food. Because though India ranks number one in production of millets and rank number two in terms of green leafy vegetables production next to china, but the awareness about the consumption and health benefits of millets is very poor in India. Developing countries are suffering with three of the most widespread micronutrient deficiencies are that of iron, zinc and vitamin A. Iron deficiency affects nearly 3.7 billion people and 49% of population is at risk for inadequate zinc in their diet. Vitamin A deficiency is the leading cause of preventable blindness in children leading to blindness in 2.5-5 lakh children each year and increases the risk of diseases and death from severe infections (http://www.who.int/nutrition/topics/vad/en/). Millets are the emerging as a potential alternative feed, fodder and bio-energy besides food crop to reduce mal nutrition problem in developing countries includes India.
Millet are one of the cereals asides the major wheat, rice, and maize. Millets are major food sources for millions of people, especially those who live in hot, dry areas of the world. They are grown mostly in marginal areas under agricultural conditions in which major cereals fail to give substantial yields. Millets need very little water for their production. Compared to irrigated commodity crops currently promoted by policy measures, millets and require just around 25% of the rainfall regime demanded by crops such as sugarcane and banana. Thus, they do not burden the state with demands for irrigation or power. Millets are important foods in many underdeveloped countries because of their ability to grow under adverse weather conditions like limited rainfall. In contrast, millet is the major source of energy and protein for millions of people in Africa. It has been reported that millet has many nutritious and medical functions (Yang et al., 2012).

In 2007, global millet production reached about 32 million tones with the top producing countries being: India (10,610,000), Nigeria (7,700,000), Niger (2,781,928), China (2,101,000), Burkina Faso (1,104,010), Mali (1,074,440), Sudan (792,000), Uganda (732,000), Chad (550,000) and Ethiopia (500,000) (FAO, 2009).

**Position of millets in comparison to staple food grains in human food chain**

There is a decline in consumption of millets and its products, where in it is originated and grown is due to the shift in consumer habits, rapid rate of urbanization, time and energy required to prepare millet based foods, inadequate domestic structure, poor marketing facilities, processing techniques, unstable supplies and relative unavailability of millets and its products, including flour, compared with other foodstuffs. Though mechanical pearling or polishing is well known for wheat, rice and maize, but for millet, this primary step in the commercial processing is essentially unknown. For instance, large imports of wheat and rice and policies to subsidize production of those crops in some countries had considerable negative impact on millets production. Millets could be in great demand in the future if the technologies for specific industrial end users are developed.

Though India is the largest producer of millets in the world, between 1961 and 2012, there has been drastic reduction in the area under cultivation of millets. Unfortunately the National food security mission launched in 2007, during the 11th five year plan, addresses the issue of cereals and pulses, but not millets. There is an emerging need to focus it on millet research and consumption intern of more health benefits compare with rice and other crops.
Table: 1 Fifty years of cultivation of millets vis-à-vis other crops in India *(Area in Million ha)*

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<tbody>
<tr>
<td>Jower</td>
<td>17.36</td>
<td>17.68</td>
<td>16.09</td>
<td>16.10</td>
<td>11.33</td>
<td>8.68</td>
<td>7.53</td>
<td>6.25</td>
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<tr>
<td>Bajra</td>
<td>11.34</td>
<td>11.97</td>
<td>11.57</td>
<td>10.65</td>
<td>9.32</td>
<td>9.58</td>
<td>8.75</td>
<td>8.78</td>
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<tr>
<td>Ragi</td>
<td>2.30</td>
<td>2.70</td>
<td>2.63</td>
<td>2.41</td>
<td>1.77</td>
<td>1.53</td>
<td>1.38</td>
<td>1.18</td>
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<tr>
<td>Small Millets</td>
<td>5.34</td>
<td>4.56</td>
<td>4.67</td>
<td>3.16</td>
<td>1.66</td>
<td>1.06</td>
<td>0.91</td>
<td>0.80</td>
</tr>
<tr>
<td>Total Millets</td>
<td>36.34</td>
<td>36.91</td>
<td>34.96</td>
<td>32.30</td>
<td>24.08</td>
<td>22.08</td>
<td>18.57</td>
<td>18.6</td>
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<tr>
<td>Rice</td>
<td>31.52</td>
<td>35.47</td>
<td>39.48</td>
<td>41.14</td>
<td>42.84</td>
<td>43.66</td>
<td>44.55</td>
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<tr>
<td>Wheat</td>
<td>12.37</td>
<td>12.57</td>
<td>20.45</td>
<td>23.03</td>
<td>25.01</td>
<td>26.48</td>
<td>27.71</td>
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<tr>
<td>Maize</td>
<td>37.00</td>
<td>48.00</td>
<td>60.30</td>
<td>58.00</td>
<td>59.80</td>
<td>75.88</td>
<td>81.74</td>
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<tr>
<td>Total cereals</td>
<td>51.08</td>
<td>55.48</td>
<td>68.76</td>
<td>71.305</td>
<td>74.65</td>
<td>78.36</td>
<td>82.16</td>
<td>99.15</td>
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<td>Share of millets (%)</td>
<td>42</td>
<td>40</td>
<td>34</td>
<td>31</td>
<td>24</td>
<td>21</td>
<td>18</td>
<td>14.6</td>
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### Nutritive Value of Millet Grains

Nutritional quality of food is a key element in maintaining human overall physical well-being because nutritional well-being is a sustainable force for health and development and maximization of human genetic potential. Therefore, for solving the problem of deep-rooted food insecurity and malnutrition, dietary quality should be taken into consideration (Singh and Raghuvanshi 2012). In addition to their cultivating advantages, millets were found to have high nutritive value and comparable to that of major cereals such as wheat and rice. It has also been reported that millet proteins are good sources of essential amino acids except lysine and threonine but are relatively high in methionine. Millets are also rich sources of phytochemicals and micronutrients (Mal and others 2010; Singh and others 2012).

### Health benefits of Millets

Millets contain more dietary fiber compared to rice and wheat. This enhances slow release of energy, thereby increasing physical efficiency. Millets also contain fat in a considerable quantity which is needed for body. They are a source of ‘B’ Vitamin and minerals. Compared to rice and wheat, mineral content in millets is higher. While finger millet contains 30 times more calcium than rice and wheat, other millets possess at least 2 time more calcium than rice and wheat. Little millet and foxtail millet have a higher degree of iron. Millets are also characterized by therapeutic qualities. Millets being non glutsinous so used for people with gluten allergy. The fat content in minor millets not only provides energy but also aids in controlling the cholesterol synthesis in the body. Millet protein contains amino acids in balanced proportions and is rich in methionine, cysteine and lysine. These are especially beneficial to vegetarians who depend on plant food for their protein nourishment. The grain contains a high proportion of carbohydrates and dietary fiber which help in prevention of constipation, lowering cholesterol and slow release of glucose to the blood stream during digestion. Important vitamins namely thiamine, riboflavin and niacin are present in high quantities. It is reported that cardiovascular
diseases, duodenal ulcers and hyperglycemia occur rarely in millet eaters. Awareness created on nutritional importance of small millets leads to the prevention of malnutrition.

**Millet and Diabetes:** Millets have been reported to have beneficial effect on diabetes mellitus. The diabetes preventing effect of millets is primarily attributed to high fiber content. The beneficial effect of soluble dietary fiber may be mediated through slower absorption and digestion of carbohydrates. This leads to reduced demand for insulin.

**Millet and cardiovascular disease:** Obesity, smoking, unhealthy diet, and physical inactivity increase the risk of heart attacks and strokes. Most of the world countries face high and increasing rates of cardiovascular disease. It has been demonstrated that rats fed with a diet of native and treated starch from barnyard millet had the lowest blood glucose, serum cholesterol, and triglycerides compared with rice and other minor millets. Also, the feeding of proso millet protein improved plasma levels of adiponectin, high-density lipoprotein (HDL) cholesterol in genetically obese type-2 diabetic mice under high-fat feeding conditions (Park and others 2008).

**Millet and Other Degenerative Diseases:** Diets high in fiber and antioxidants have been shown to have beneficial effect on serum lipid profile besides blood sugar. Some forms of cancer are also prevented by high fiber diets. Millets being high in fiber, antioxidants and complex carbohydrates are potential candidates for having beneficial effects on diseases like CVD, cancer and ageing in general. Few in vitro and animal studies support this view but well controlled studies in human are needed.

**Millet against cancers and celiac disease:** Millet grains based on literature values are known to be rich in phenolic acids, tannins, and phytate that act as “antinutrients”. However, it has been established that these antinutrients reduce the risk for colon and breast cancer in animals. It has also been reported that populations consuming sorghum and millet have lower incidences of esophageal cancer than those consuming wheat or maize. Furthermore, a recent study has demonstrated that millet phenolics may be effective in the prevention of cancer initiation and progression in vitro (Chandrasekara and Shahidi 2011c).

**Millet and aging:** The chemical reaction between the aldehyde group of reducing sugars and the amino group of proteins, termed as non enzymatic glycosylation, is a major factor responsible for the complications of diabetes and aging (Monnier 1990). Millet grains are rich in antioxidants and phenolics; however, it has been established that phytates, phenols, and tannins can contribute to antioxidant activity important in health, aging, and metabolic syndrome.

**Antimicrobial activity:** Millet grain fractions and extracts were found to have antimicrobial activity. In one study, seed protein extracts of pearl millet, sorghum, Japanese barnyard millet, foxtail millet, samai millet, and proso millet were evaluated in vitro for their ability to inhibit the growth of *Rhizoctonia solani*, *Macrophomina phaseolina*, and *Fusarium oxysporum*. 
Conclusion: Based on the results of studies carried out, millet grains contain many health-promoting components such as dietary fiber, minerals, vitamins, and phytochemicals that include phenolic compounds, and they are comparable to those of major grains and they also have several potential health benefits. However, novel processing and preparation methods are needed to enhance the bioavailability of the micronutrients and to improve the quality of millet diets. Research is also needed to determine the bioavailability, metabolism, and health contribution of millet grains and their different fractions in humans. Making millet food products that deliver convenience, taste, texture, color, and shelf-stability at economical cost for poor people is needed. In addition, for promoting utilization of millet grains in urban areas to open new markets for farmers to improve their income, developing highly improved products from millet is needed. As the largest producer of millets, India can capture world market with appropriate, well-tested foods.

Literature