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Oriental wheat noodles versus fortified millet noodles: A review paper

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Abstract
The increasing consciousness of the consumers towards health and nutrition has led to a greater demand of nutrition rich processed foods. In addition to this the rise in global temperatures and climate change has brought forward various food safety issues. Millets being rich in nutrients along with the ability to grow in dry and low rainfall area within a short period of time have the potential to meet the requirements of the consumers as well as aid in solving the food safety crisis in the long run. Barnyard millet is one of the millet which was traditionally consumed instead of rice in many areas. Despite of being a nutritious food grain, there has been a rapid decline in its production since the green revolution. Noodles are processed food enjoying tremendous popularity all around the globe. The fortification of barnyard millet in noodle flours or the processing of noodles entirely using millet flour will further increase the nutritional content and the demand of the already popular food. This will also boost the cultivation of the underutilized barnyard millet. The biggest hurdle to achieving this may be the absence of gluten in the barnyard millet flour. Other than this, in terms of nutrition composition, the millet compares to other cereals and has significantly higher mineral content. The color and texture of the millet added noodles will also vary from the commonly available wheat noodlesmay be considered equivalent when being used as an adjuvant in mucoadhesive drug delivery systems.

Keywords: Barnyard millet, fortification, nutrition

Introduction

Noodles have been a staple food in many parts of the world and are of ancient origin. Nearly 4000 years old according to the discovery of a pot of thin noodles in China which were found to be similar to the *la-Mian* which are the traditional Chinese noodles made by hand pulling and stretching of the dough (Lu *et al*. (2005) [6]. Technological advancements, eating habits, growing health consciousness, regional diversity of raw materials and taste preferences have lead to major evolutions in the noodle formulations and made them one of the most popular foods in the world. They can be made from wheat, rice, potato starch, pulses, millets etc. and are available in variety of shapes and formulations. Processing properties, color and appearance of the noodles are the main criteria that are used to judge the quality of raw noodles. Noodle products are mainly made from refined wheat flour, water and salt by the process of sheeting and cutting essentially by machines. Noodles must have appropriate flavor and texture along with good shelf life and bright color. For noodles to withstand the process of sheeting the flour should have adequate gluten strength. The wheat flours with good amount of gluten and high starch swelling property and good pasting properties of starch are ideal for making noodles (Fu (2008) [2].

Millets are small grain cereals with barnyard millet being one of the smallest along with finger millet, foxtail millet, little millet, kodo millet and porso millet. Small millets are distributed in most of the Asian and African countries and parts of Europe and are the staple food of the millions inhabiting the arid and semiarid tropics of the world. According to a report of Indian Council of Agricultural Research, the cultivation area of small millets in India has seen a gradual decline from 5.6 million hectares in 1954-55 to 3.6 million hectares during 1983-84 which were the result of non adoption of improved methods of cultivation and poor quality of soil (Rao (1989) [10]. These millets have an indefinite storage life as they are devoid of grain storage pests. In the rapidly changing world where issues like food and water scarcity, growing population, climate changes, increase in food prices and growing health issues threaten the global agricultural and food security generally for the poor people, millets are seen as potential food crops for future as they are more affluent in protein, mineral and vitamins than rice and wheat.

Being cheaper in price they are the so called the "poor man's crops" and are important drought-resistant crops and Potential Health benefits (Saleh *et al*. (2013) [11].

Millets come under C4 crops that convert atmospheric carbon dioxide into oxygen. They also have high efficiency of water use and thus can be a helpful crop in current global climatic conditions and declining groundwater level. They are naturally diverse and scientific interventions have further developed new hybrid varieties. These hybrid varieties have increased production per hectare and are resistant to diseases and pests. Millets can thus give a solution to obesity, malnutrition and chronic health issues. (Kumar *et al*. (2018) [4]

Barnyard millet is known to have several potential health benefits. As per USDA/HNIS (1995) and FAO (1995), a 100g edible portion of barnyard millet contains 55.0g of carbohydrate, 11.0g protein, 13.6g crude fiber, and 4.5g mineral that is comparable to other cereals and millets. Its crude fiber and mineral contents are distinctly higher than those of wheat (2.0g fiber, 1.6g minerals) and rice (1.0g fiber, 1.3g minerals). Its mineral content includes a fine amount of iron (18.6mg) and Calcium (22mg) (Hulse *et al*. (1980) [3].

Millets- a potential food grain for the present and future

Millets are super foods that are consumed in India since ancient times. In India, the oldest yajurveda texts have a mention of barnyard millet (aanava). This indicates that the consumption of the millet dates back to Indian Bronze Age (4500BC). According to international crops research institute for the semi arid tropics millets form an integral part of Indian food cultures and were a major grain in India until 50 years ago. Following urbanization and industrialization, millets have been discarded in favor of rice and wheat and are regarded as 'coarse grains' too primitive to be used. This in turn has resulted in decline in low production and consumption of millets. Unfortunately this led to lack of nutrients that are critically important in our diets.

India is among world leaders in terms of production and export of millets. Still, the total millet production has dropped to 20% as they are extensively being replaced by rice and wheat flours. In today's time, with changing lifestyles and growing health issues, millets provide an easy and affordable solution to major food and health issues of the country.

According to Indian institute of millet research, millets have a calming effect in our moods and reduce the risk of migranes and heart attack owing to high amount of tryptophan and magnesium present in them. They also have high protein content, antioxidant content, are non allergic, gluten free, help lower cholesterol and prevent cardiovascular diseases.

Factors influencing noodle quality

Flour characteristics greatly influence the quality of noodles (Oh *et al*. (1985) [8, 9]. They influence the appearance, textural properties, cooking quality and eating quality of noodles which include surface characteristics, water gain, oil uptake, cooking loss, hardness, opaqueness, color, strength, chewiness, gumminess, elasticity, firmness and tolerance to overcooking. (Oh *et al*. (1985) [8, 9]. The amount of starch, ash and protein content in the flour and their quality affect the characteristics of the noodles prepared by it. The difference in these contents is the reason for variations in textural and eating quality of noodles prepared from different types of flours

Starch

The sensory attributes of noodles are positively related to the starch content of the flour (Xue *et al*. (2010) [15]. Studies conclude that the starch content and quality had major influence on the viscoelasticicity of the cooked noodles (Toyokawa *et al*. (1989) [12, 13]. Pasting and gelling properties of starch affect the surface characteristics of noodles. They influence chewiness, hardness, gumminess and springiness in cooked noodles. Higher amylose content decreases oil uptake in the noodles and reduces cooking losses. Amylase based crystallites interlink the three dimensional network of starch and thus maintain its structure.

Protein

Protein acts as a structural component of noodles and also provides textural stability while cooking. The amount and quality of protein affects the color, appearance, oil uptake, cooking time and eating quality of noodles. A decrease in flour protein decreases toughness and increases brightness of the dough for noodles (Moss (1971) [7]. A study by Baik *et al*. (1955) [1] showed that the protein content had more influence on discoloration than ash content and enzymes like polyphenol oxidase.

Ash

The ash content in flour affects the color characteristics and brightness of the noodles. The noodles have a good color grade and bright creamy appearance if the ash content of the flour is in the range of 0.36 to 0.94 (Wang. C *et al*. (2004) [14].

Table 1: Nutrient composition per 100g edible portion; 12% moisture

Food	Proximate Coposition					
	Protein (g)	Fat (g)	Ash(g)	Crude fiber(g)	Carbohydrate(g)	Energy (Kcal)
Wheat	11.6	2.0	1.6	2.0	71.0	348
Barnyard millet	11.0	3.9	4.5	13.6	55.0	300

Source: (Saleh *et al*. (2013) [11] Millet Grains: Nutritional Quality, Processing, and Potential Health Benefits

The data presented shows the proximate nutritional composition of both wheat and barnyard millet flour. The data clearly states that the protein content of the millet is comparable with the wheat. The ash content, fat content and crude fiber of the millet are comparably higher than wheat. Also the amount of carbohydrates is significantly lower.

Table 2: Nutrients in wheat and barnyard millet (per 100g edible portion; 12% moisture)

Food	Nutrient Composition				
	Thiamine (mg)	Riboflavin (mg)	Niacin (mg)	Calcium (mg)	Iron (mg)
Wheat	0.41	0.10	5.1	30	3.5
Barnyard millet	0.33	0.10	4.2	22	18.6

Source: (Saleh *et al*. (2013) [11] Millet Grains: Nutritional Quality, Processing, and Potential Health Benefits

Moreover, the flour of barnyard millet has comparable values of vitamins and minerals when compared to wheat flour. It is significantly higher in iron content.

From the data mentioned in above tables, it can be stated that the noodles made from barnyard millet will tend to be negatively affected due to significantly higher amount of ash content present in them. But higher ash content also positively affects the mineral content of the noodles. The protein content of both wheat and barnyard millet flours are comparable and thus the texture stability during cooking, oil uptake and cooking time will not be much affected. Due to absence of wheat gluten protein in the millet, there will be a need of a binding agent in order to bind the flour together to form dough. This will make the cooking and eating quality of the noodles greatly dependent on the quality and amount of binding agent used. The wheat flour can also be fortified with millet flour in order to increase its nutritive value as well as maintain the textural properties of the wheat noodles.

Conclusion

Barnyard millet proves to be a potential food crop that can help solve many health and food safety issues in India today and in future. Commercial production of barnyard millet noodles and it's fortification in widely popular white wheat noodles will provide an economic boost to its declining production. It will also gift the current lifestyle a healthy functional food that is ready- to- eat. With diseases like diabetes, hypertension, and depression getting more common among the people, this provides a healthy alternative to the costly medicines that also have side effects on our body. Moreover the boost in its production will be a big step towards solving the food crisis in dry and low rainfall regions of the country as these millets grow well even with minimum supply of water and with no special tending needed. They also grow very fast and can be grown and harvested about eight times in a year.

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