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Development of Sorghum Noodles Fortification with Moringa (Moringa Oleifera) Leaf Powder

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ABSTRACT

The study of noodles from sorghum flour, rice flour, and, Moringa oleifera leaf powder development was carried out at the Department of Food Technology, Parul Institute of Applied Sciences, Parul University, Vadodara Gujarat, India. The cereal grain sorghum has a number of agronomic benefits, contains substances that are good for your health, and is gluten-free. One of the most beneficial tropical trees is Moringa Oleifera, which offers vital nutrients and antioxidants to treat vitamin and mineral deficiencies, support a healthy cardiovascular system, help to promote normal blood sugar levels, neutralize free radicals, improve eyesight, mental clarity, and bone strength, and may be helpful in cases of malnutrition, general weakness, lactating mothers, menopause, depression, and osteoporosis. Moringa is a multi-beneficial plant with high nutritional value, making it an excellent protein supplement for malnutrition and animal feed. Although Moringa oleifera leaves are high in nutrients, the addition of saponins may increase the bitter taste and unpleasant smell.

This study set out to create noodles using moringa leaf powder, sorghum flour, and rice flour and to assess their sensory acceptance, antinutritional content and proximate composition. The findings revealed in moisture (7.62), total ash (5.48), protein (6.80), fat (1.86), carbohydrate (78.24), energy (358.9), calcium (242.4) (Ca), and potassium (353.5) content, the total number of E. coli 0157, and coli form. In order to guarantee global food security and meet nutritional needs, the concentration of moringa plant powder must be limited. Moringa Oleifera leaves powder affected, macronutrient, and minerals content in wet noodle products. It is recommended that concentrations of 5%, 10%, and 15% should not exceed 5% because it affects the organoleptic of the product.

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KEYWORDS: *noodles, sorghum (jowar), Moringa oleifera (drumstick tree) leaf powder*

1. INTRODUCTION

Noodles are a widely consumed food item in many parts of the world. In many Asian nations, noodles have been considered as a staple food. In general, the benefit of instant noodles is that they are simple to prepare, delicious, and convenient to serve. It also has a lower cost and a longer shelf life (Ebtihal et al., 2019). Noodles can be made from a variety of flour such as rice, wheat, maize, finger millet (ragi), sorghum (jowar), and semolina using an extruder by adding water and flavorings such as egg and spice. Noodle consumption has been increasing, but the low fat and protein content limits its nutritional value. To improve the overall nutritional profile of noodles we, use sorghum flour, rice flour, and Moringa oleifera leaf powder.

The sorghum crop is a vital food-security cereal crop in many places of Africa, Asia, and the semi-arid tropics around the world (FAO/WHO, 2007). In terms of production, Sorghum is the African continent's second most important cereal. This is because Africa's average sorghum production is around 20 million tonnes mt per year (FAO, 2019; Taylor, 2003; Collar, 2019). As a gluten-free grain, sorghum lacks viscoelastic properties. Protein (kafirin) derived from sorghum is more challenging to hydrate than wheat gluten protein. Sorghum increased starch content led to a high gelatinization temperature for starch and a low water-holding capacity Gluten protein is often required in fine-dried noodles to strengthen the noodle's resistance to breaking during the drying process (Arendt and Zannini, 2013). Sorghum's nutritional value is distinguished by its protein level, which ranges from 7 to 16% with an average of 11% (Taylor and Anyango, 2011). Cysteine was found in sorghum protein (Kafirin). When sorghum is cooked - wet, kafirin cross-linking via disulfide bonding occurs. As a result, sorghum grain protein is difficult to digest (Duodu et al., 2003).

Moringa oleifera, also known as the drumstick tree, is a Moringaceae family member and is also known as the "Miracle Tree." (Mahato et al, 2022). Being a native of north-western India, it has received widespread recognition in ethnomedicine as well as the Ayurvedic and Unani medical systems. (Milla et al, 2021). According to Saifu (2015), the moringa tree leaf is used as a famine food to ensure food security. The moringa tree leaf, according to the NRC, contains essential nutrients such as protein, amino acids, carbohydrates, vitamins, minerals, and organic acid .(Oduro et al. and Madukwe (2013) According to reports, the moringa tree leaf also has antibacterial and anti-inflammatory properties. Product development using moringa leaf powder has not yet been properly customized and commercialized in developing countries such as Ethiopia, specifically Hawassa, despite the fact that moringa provides multiple benefits such as alleviating malnutrition and food insecurity, which are common problems in developing countries.

Moringa has a wide range of nutritional advantages that are determined by factors like genetic make-up, environmental factors, and manufacturing techniques. For an animal to establish immunity (for the synthesis of antibodies and cells), proteins, minerals (zinc, copper, and iron), and vitamins (A and E) are also required. In order to combat infections, these nutrients also assist organs and tissues in communicating with one another. Moringa oleifera is recognized as a versatile plant because of its range of applications. Excellent sources of calcium, iron, and vitamins A, B, and C can be found in its leaves.

The leaves of the Moringa plant are said to be particularly nutrient-dense since they have quantities of vitamin A, vitamin C, iron, calcium, and potassium that are comparable to those found in carrot, orange, spinach, and banana. Based on a comparison of its amino acid profiles with the FAO/WHO/UNO reference protein for children, it is likewise a good source of protein. High antioxidant activity levels found in moringa leaves have been linked to cancer chemoprevention, protein oxidation-reduction, and lipid peroxidation inhibition.

The main purpose of this study is to assess the acceptability of noodles made with 70% sorghum flour, 10% rice flour, and 5% moringa (Moringa oleifera) leaf powder as well as other ingredients. The assessment was carried out among various samples of noodles (T0, T1, and T2) containing different amounts of Moringa oleifera leaf powder (5%, 10%, and 15%). To complete this noodles development experiment, chemical test, organoleptic test, mineral test, and microbiological test are.

2. Materials and Methods:

2.1. Materials:

Sorghum flour, rice flour, and salt were purchased from the local market in Vadodara, Gujarat, India. Garlic and Ginger were purchased from the local market in Vadodara, Gujarat, India. After that garlic powder and ginger powder prepare in the Parul Institute of Applied Science Laboratory. however Moringa oleifera leaf powder was purchased from Amazon. Sorghum flour, rice flour, and moringa leaf powder were sieved into fine flour of uniform particles. The sorghum flour, rice flour, and moringa powder were later packed in a polyethylene bag and finally stored at room temperature. The sorghum flour, rice flour, and moringa leaf powder were then mixed according to the formulation.

2.2. Methods:

Sorghum Noodle Preparation

Noodles were prepared by using 70% sorghum flour, and 10% rice flour, with different proportions of Moringa oleifera leaf powder (5%, 10%, and 15%). Here, after samples are referred to as T0, T1, and T2 respectively. in the prepared sample T0 ,70% sorghum flour is used. Initially, for T1 and T2 samples rice flour and sorghum flour were mixed. In a large mixing bowl, combine the rice flour, sorghum flour, moringa leaf powder, ginger powder and garlic powder, and salt. Mix it well and slowly add the water, a little at a time, and mix the ingredients with your hands until you get dough that is smooth and elastic. If the dough is too dry, add a little more water. If it is too wet, add a little more flour. Wrap the dough in plastic wrap and let it rest for 15 minutes. Cut the dough into small pieces that will fit into the hand extruder. Place the dough into the hand extruder and turn the handle to push the dough through the extruder. The dough will come out in the shape of noodles. Finally, the extruded product (noodles) was cut into comparable sizes. Than it dried, packed, and stored at room temperature until cooked and served for sensory evaluation.

Sorghum flour (70%) + rice flour (10%)

↓

Mixing all raw materials together

(Ginger powder + garlic powder + Moringa oleifera leaf powder + salt)

↓

Dough making (flour + oil +water)

↓

Dough resting (15 minutes)

↓

Cut the dough into small pieces

↓

Extrusion (hand extruder)

↓

Drying (sun dry-15 hours)

↓

Packaging of noodles

2.3. Flow chart for the processing of noodles

Formulation of sorghum noodles:

Ingredients	T0	T1	T2
Sorghum flour	70g	60g	60g
Rice flour	10g	17g	12g
Moringa leaf powder	5g	10g	15g
Ginger powder	5g	5g	5g
Garlic powder	5g	5g	5g
Salt	3g	3g	3g

2.4. Cooking Noodles:

Noodle samples were cooked for 10-15 minutes in salted boiling water at 85°C in a small stainless steel thick-bottomed saucepan occasionally stirred with a wooden kitchen spoon to prevent sticking, then strained, rinsed, and washed with cooled running water. Before testing noodles, it was strained from the cooking water and placed in a plastic airtight container for evaluation.

2.5. Chemical Composition Analysis:

The samples underwent chemical quality evaluation using hot air oven for drying, and moisture was measured**.** The incineration method was used to calculate the total ash, The Roese-Gottlieb method was used to determine fat, while the Kjeldahl method was used to determine protein. Carbohydrate was determined by FAO chapter-2, Methods of food analysis, 2003, energy was determined by FAO chapter-3: Calculation of the energy content of food energy conversion factors, 2003

2.6. Organoleptic Quality analysis procedure:

The most common method for measuring food preferences is a questionnaire of manufactured foods or food categories, with a hedonic scale used to rate the degree of liking. The hedonic scale is an organoleptic quality rating scale on which the judge expresses his level of liking. The overall tests were carried out on a 9-point Hedonic scale. The organoleptic Hedonic scale was used in the following ratings: 1) Dislike extremely, 2) Dislike moderately, 3) Dislike moderately, 4) Dislike slightly, 5) Neither like nor dislike, 6) Likely slightly, 7) Like moderately, 8) Like extremely, 9) Like extremely. This test was conducted by semi-trained panellists who were teachers at Parul University's Department of Food Technology in Vadodara, Gujarat.

2.7. Microbiology analysis procedure:

Microbiological tests such as the total coliform count (TCC) and E. coli count were carried out in accordance with Indian standard procedures for the inspection of dairy products**.**

2.8. Mineral testing:

Mineral detection in food and feed can assist in determining the appropriate daily portion and supplement level. The amount of ash in a food is a measure of the total amount of minerals present, whereas mineral content is the amount of specific inorganic components present in a food, such as Ca, Na, K, and Cl. Nutritional labeling quality, microbiological stability, nutrition, and processing all rely on it.

Minerals like potassium (K) and calcium (Ca) determine by ASE/ SOP/ 005/19 flame photometry method.

3. Results and Discussion:

3.1. Organoleptic analysis of different formulation of noodles:

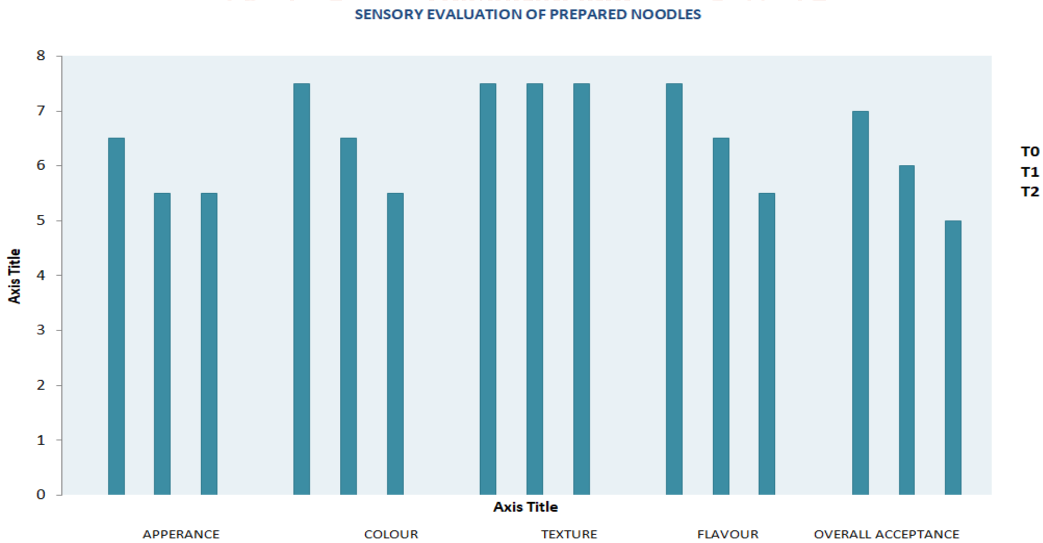
Flavor

Taste is very important in evaluating food products. The tongue is the human organ responsible for assessing taste which has receptors that can detect different flavors in food ingredients. The presence of the tongue can detect the taste of food products because the tongue has a good response to flavors in food such as sour, sweet, salty, and bitter. Taste is regarded as an important factor in deciding whether to accept or reject a food or beverage product. A concentration affects the taste value of wet noodles. Making wet noodles with 5% Moringa oleifera leaf powder, 70% sorghum flour, and 10% rice flour yields the highest test value and is the most preferred proportion. The taste value is known based on the results of the analysis. The use of Moringa oleifera leaf powder at 15% yields a very low yield, implying that the panelists dislike the product. As more Moringa oleifera leaf powder is added to the dough, the taste becomes slightly bitter. Thus, increasing the concentration of Moringa oleifera leaf powder affects taste preference, i.e. panelists dislike the taste. The increase in Moringa oleifera leaf powder concentration imparts an aftertaste to the noodle product.

Aroma:
A scoring scale can be used to assess the aroma of a food or beverage product. The aroma of the noodles changes due to the addition of Moringa oleifera leaf powder. This aroma appears because Moringa oleifera leaves contain compounds that evaporate easily, so when added to the noodle mixture, it evaporates and can be detected by a panelist. Moringa oleifera leaves contain compounds that are highly volatile (easily evaporated). Volatile compounds can easily enter the olfactory system (olfactory). Aromatic compounds are found in all plants or fruits and are frequently used as flavoring agents in manufactured foods and beverages. According to the test, panelists tended to prefer the aroma of the noodles when treated with Moringa oleifera leaf powder at the lowest concentration of 5%, as opposed to when noodles were produced as a control, which had the greatest aroma preference rating. Test panelists, however, did not enjoy the aroma of the noodles after the concentration of Moringa oleifera leaf powder was increased by 10% and 15%.

Color:
Color is a vision in food or beverage products that the eye can detect quickly and directly (eyes). The colour of food and drink creates an attractive impression. This means that there is a connection or a difference in the colour value of the resulting noodle product. Moringa oleifera leaf powder had a significant impact on each treatment. The test value decreased as the concentration of Moringa oleifera leaf powder (% used) increased. The treatment with the least amount of Moringa oleifera leaf powder produced the highest test value for the color. The more Moringa oleifera leaf powder is used in the dough, the less appealing the colour of the noodles. The resulting colour is becoming more intense.

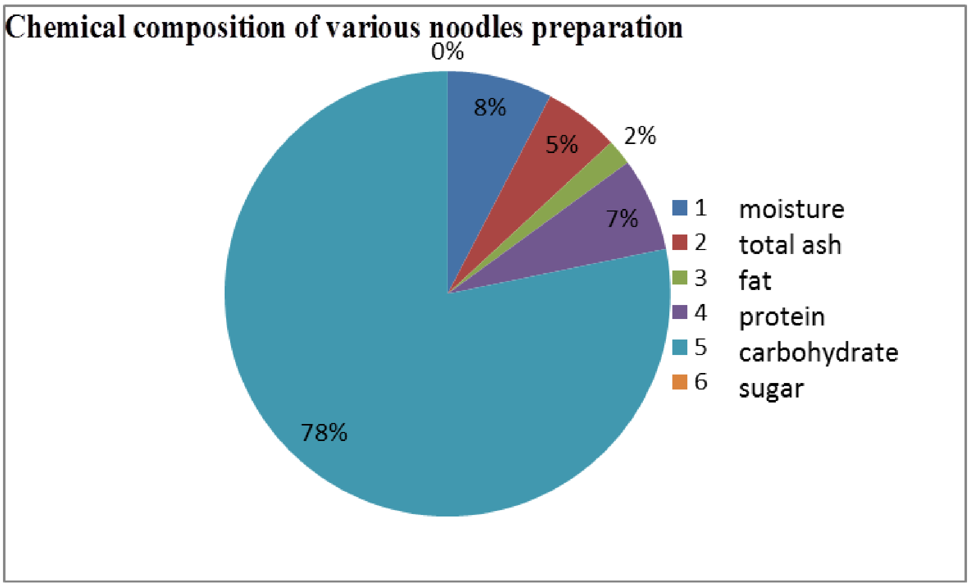
Texture:
The texture of the resulting noodles is valued differently. This means that there is a connection or a difference in the texture value of the resulting noodle product. The higher the concentration of Moringa oleifera leaf powder used in the dough, the more texture the noodle product has. Panelists preferred the addition of 5% Moringa oleifera leaf powder concentration over 10% and 15% additions.



3.2. Chemical composition of various noodles preparation:
Chemical composition of formulated noodles samples is presented in table 3.2.1 Moisture, total ash, protein, fat, carbohydrate, sugar and energy.

Constituents	Units	Results T0
Moisture	%	7.62
Total ash	%	5.48
Fat	g/100g	1.86
Protein	g/100g	6.80
Carbohydrate	g/100g	78.24
Sugar	g/100g	0.0
Energy	Kcal/100g	356.9

Table 3.2.1 Chemical composition of various noodles preparation



Graph 3.2.1 Chemical composition of various noodles preparation

3.3. Microbiological quality assessments of noodles:

3.3.1. Coliform count:

Coliform bacteria are classified as rod-shaped, Gram-negative, nonspore-forming, motile, or nonmotile bacteria. When cultured at 35–37°C, these bacteria may ferment lactose and produce acid and gas. They are frequently used as a gauge for the cleanliness of food and water.

3.3.2. E.coli count:

E. coli bacteria typically live in the intestines of healthy humans and animals. Most E. coli strains are either innocuous or very briefly cause diarrhea. However, other strains, including E. coli O157:H, can cause vomiting, severe stomach pains, and bloody diarrhea.

E. coli can be spread by contaminated food or drink, particularly raw vegetables and undercooked ground beef. E. coli O157:H7 infections in healthy persons often resolve within a week. A life-threatening kind of renal failure is more likely to affect young kids and older adults.

Microbial parameters	units	Results (T0)
E.coli count	Cfu per g	absent
Coliform count	Per 25 g	Absent

Table 3.3 Microbiological quality assessments of noodles

3.4. Mineral composition of various noodles preparation:

The proper daily portion and the amount of supplements required can be determined by checking for minerals in diet and feed. Ash content is a measurement of the total amount of minerals in a food, whereas mineral content is the quantity of individual inorganic ingredients like Ca, Na, K, and Cl that are present in a food. Nutritional labeling, quality, microbiological stability, nutrition, and processing all depend on it.

mineral	units	Results
Potassium (as K)	Mg/100g	353.3
Calcium (as Ca)	Mg/100g	232.4

Table 3.4 Mineral composition of various noodles preparation

4. Conclusions:

A higher concentration of Moringa oleifera leaf powder has a significant impact on the sensory properties of noodle. A higher concentration of moringa leaf powder reduces sensory acceptability while increasing antinutritional content, so it should be considered in product development. Moringa leaves, with a maximum usage limit of 5%, have the potential to increase essential nutrients and minerals in processed food.

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