# TITLE PAGE

**EFFECT OF ADDITION OF MORINGA LEAF POWDER ON THE ACCEPTABILITY OF INSTANT EXTRUDED MILLET PORRIDGE**

**BY**

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**ST/FST/HND/19/005**

**A PROJECT SUBMITTED TO THE DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY, FEDERAL POLYTECHNIC, MUBI**

**IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF HIGHER NATIONAL DIPLOMA (HND) IN FOOD SCIENCE AND TECHNOLOGY**

**DECEMBER, 2022**

# DECLARATION

I hereby declare that the work in this project titled **“Effect of Addition of Moringa Leaf Powder on the Acceptability of Instant Extruded Millet Porridge”** was performed by me under the supervision of Dr. David I. Gbenyi. The information derived from literatures has been duly acknowledged in the text and a list of references provided. The work embodied in this project is original and had not been submitted in part or in full for any other diploma or certificate of this or any other institution.

IDIO JACINTA SAVIOUR \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(ST/FST/HND/19/005) Signature Date

# CERTIFICATION

IDIO JACINTA SAVIOUR, Registration Number ST/FST/HND/19/005 has carried out this project report which was examined and found to meet the requirement governing the award of Higher National Diploma (HND) in Food Science and Technology at Federal Polytechnic, Mubi, Adamawa State and is approved for its contribution to knowledge and literacy presentation.

Dr. David I. Gbenyi \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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(External Examiner) Signature Date

# DEDICATION

This project is dedicated to God Almighty who gave me the opportunity, grace and knowledge to carry out the analysis.

# ACKNOWLEDGEMENTS

I am using this great opportunity to give thanks to the almighty God for his protection and guidance throughout my project research in Federal Polytechnic, Mubi.

I also, wish to express my profound gratitude to my beloved parents Mr. and Mrs. Saviour Udiong Idio but also my sincere gratitude goes to my Supervisor Dr. David I. Gbenyi for his immense contributions towards the success of this research work. God bless you.

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Finally, I will not fail to acknowledge the Food Science and Technology for their advices, may the almighty God protect them all in Jesus name. Amen.

# ABSTRACT

*The effect of moringa (Oleifera) leaf powder addition on some physiochemical and sensory properties of instant extruded millet porridge was determined in various proportions of 100%, 95%, 85% and 80% of millet and moringa powder was prepared respectively. The blend ratios were used to produce instant extruded millet/moringa porridge. And some physiochemical and sensory properties of the porridge was determined. The proximate composition shows that the moisture ranged from 5.47% to 3.93%, crude protein ranged from 6.59% to 4.39%*

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# CHAPTER ONE

## 1.0 Introduction

Nutritive quality of food is a key element in maintaining human overall physical wellbeing and is a sustainable for health and development and maximization of human genetic potential, hence for the solution of dep rooted food insecurity and malnutrition, dietary quality should be taken into consideration (Singh, 2012). Complementary foods are the transitional foods consumed between the time the child diet consists exclusively of mother’s milk and the time when it is mostly made up of family foods (Yeung, 1998).

When breast milk is no longer enough to meet the nutritional needs of the infant, complementary foods should be added to the diet of the child (WHO, 2001). Insufficient quantity and inadequate quality of complementary foods have led to high nutrient deficiencies with attendant detrimental impacts on the health, growth and survival of under five children (UNICEF/SOWC, 2008) in Nigeria. In most developing countries, children, especially those from low income class are fed with family diets which are of high bulk and low nutrient density and therefore inappropriate as infant diets (Abasiekong *et al.,* 2010).

Moringa (Oleifera) is being cultivated in poverty-stricken nations as a primary source of food and nutrient (Ginny, 2012). Severely malnourished children have been reported to have made significant weight gain when care givers add the leaves to their diet to increas3e its nutritional content (Price, 2000; Fuglie, 2001).

Moringa trees have been used to combat malnutrition especially among infants and nursing mothers, the leaves being the most nutritious parts product, especially leaf powder, is becoming increasingly popular in Nigeria because of its indigenous nutritive and medicinal value (Oluwole and Oluwasenu, 2013). Millets are a group of variable small seed grasses widely grown around the world as cereal grains and are the major source of calories and proteins for Nigeria (Nkama, *et al.,* 2001)

They are rich in B vitamin, especially niacin, B17, B6 and folic acid, calcium, iron, potassium, magnesium and zinc (Baltensperger, 2002). The different species of millet include pearl millet (penicum miliaceum) and finger millet (eleusine coracana) but the most widely grown is the pearl millet which is an important crop in the semi-arid, impoverished, less fertile agricultural regions of Africa and south east Asia (Baltensperger, 2002). Pearl millet is known to have higher protein content and better amino acid balance than sorghum due to its higher ratio of gems endosperm (Baltensperger, 2002). Hence millet-moringa blend would make for good quality complementary food.

## 1.3 Aim and objective

## 1.3.1 Aim

The aim of the study is evaluation of instant extruded porridge form the blends of pearl millet and moringa leave powder.

## 1.3.2 Objectives of the study were to:

1. To make blend ratio of pearl millet flower and moringa leave powder.
2. To produce instant porridge with the composite flour.
3. Determine the physiochemical properties of the extruded instant porridge.
4. Determine its acceptability through sensory evaluation.

# CHAPTER TWO

## 2.0 Literature view

## 2.1 History of moringa

Moringa (oleifera) is a fast-growing, deciduous tree (Encyclopedia Britannica. 2015) That can reach a height of 10-12m (32-40 ft) and trunk diameter of 45cm(1.5ft) parotta john (1993). The bark has a whitish-gray color and is surrounded by thick cork. Young shoot has purplish or greenish-white, hairy bark. The tree has an open crown of dropping, fragile branches, and the leaves build up a feathery foliage of tripinnate leaves.

The flowers are fragrant and hermaphroditic, surrounded by five unequal, thinly reined, yellowish- white petals. The flowers are about 1.0-1.5cm(1/2inch) long and 2.0cm(3/4inch) broad. They grow on slender, hairy stalks in spreading or dropping flower clusters, which have a length of 10-25cm. parotta, john. (1993).

Flowering begins within the first six month after planting. In seasonally cool regions, flowering only occur once in a year in late spring and early summer (northern hemisphere between April and June, southern hemisphere between October and December). In more constant seasonal temperature and with consonant rainfall, flowering can happen twice or even all year round. Parotta john (1993).

The fruit is a hanging, three-sided brown capsule of 20-45cm size, which holds dark brown, globular seeds with a diameter around 1cm. the seeds have three whitish papery wings and are dispersed by wind and water parotta John (1993).

In cultivation it is often cut back annually to 1-2m(3-6ft) and allowed to regrow so the pods and leaves remain with arm’s reach. Parotta John (1993).

## 2.1.1 Fruits

When the plant is grown from cuttings, the first harvest can take place 6-8 months after planting. Often, the fruits are not produced in the first year, and the yield is generally low during the first few years. By year two, it produces around 300 pods, by year three around 400-500. A good tree can yield 1000 or more pods wickens. 19.8 in India, a hectare can produce 31 tons of pods year Radouich, Ted (2011) Under North India conditions, the fruits ripen during summer. Sometimes, particularly in South India, flowers and fruit appear twice a year, so two harvest occur; In July to September and March to April. Wickens 198.

## 2.1.2 Leaves

Average yields of 6 tons/ha/year in fresh matter can be achieved. The harvest differs strongly between the rainy and dry seasons with 1120kg/ha per harvest and 690kg/ha per harvest, respectively. The leaves and stems can be harvested from the young plants 60 days after seeding and then another seven times in the year. At every harvest, the plants are cut back to within 60cm of the ground. Sogbo (2006). In some production systems, the leaves are harvested every 2weeks.

The cultivation of moringa oleifera can also be done intensively with irrigation and fertilization with suitable varieties. Amaglo (2006) trials in Nicaragua with 1 million plants per hectare and 9 cuttings/year over 4 years gave an average fresh matter production of 580 metric tons/ha year, equivalent to about 174 metric tons of fresh leaves. Amaglo (2006). Oil one estimate for yield of oil can be used as a food supplement, as a base for cosmetics and for hair and the skin.

## 2.1.3 Seed oil

Mature seeds yield 38-40% edible oil called ben oil from its high concentration of behenic acid. The refined oil is clear and odorless and resists rancidity. The seed cake remaining after oil extraction may be used as a fertilizer or as a flocculent to purify water. Moring seed oil also has potential for us as a biofuel. Leone A, Spada A, Bettezzati A, Schiraldi A, Aristil J, Bertolis (June 2015).

## 2.1.4 Uses of moringa parts

## 2.1.4.1 Malnutrition relief

Moringa trees have been used to combat malnutrition, especially among infants and nursing mothers. Since moringa thrives in arid and semi-arid environments. It may provide a versatile, nutritious food source throughout the year in various geographic regions. “Traditional crops: moringa “. Food and Agriculture Organization of the United Nations. 2021 Some140 Organizations worldwide have initiated moringa cultivation programs to lessen malnutrition, purify water and produce oils for cooking.” Moringa oleifera (horseradish tree)”. CABI 17 December 2019. Retrieved 17 May 2020.

## 2.1.4.2 Culinary uses

Moringa oleifera has numerous applications in cooking throughout its regional distribution. Edible part of the plant includes the whole leaves (leaflets, stalks and stems); the immature green fruits or seed pods; the fragrant flowers; and the young seeds and roots Lim (2012).

## 2.1.4.3 Fruit pods

The young, slender fruits, commonly known as “drumsticks” are prepared as a culinary vegetable, often cut into shorter lengths and stewed in curries and soup. The taste is described as reminiscent of asparagus keatinge, JDH et al (2013) with a hint of green beans, though sweeter, from the immature seeds contained inside (podcast). NPR.21 September 2015 Retrieved 8 July 2017.

In India and Bangladesh, drumstick curries are commonly prepared by boiling immature pods to the desired level of tenderness in a mixture of coconut milk and spices (such as poppy or mustard seeds). Lim, (2012). The fruit is a common ingredient in dais and lentil soups, such as drumstick dal and sambar, where it is pulped first, then simmered with other vegetables and spices like turmeric and cumin. Mashed drumstick pulp commonly features in bhurta, a mixture of lightly fried or curried vegetables Lim T.K (2012). Because the outer skin is tough and fibrous, drumstick is often chewed to extract the juice and nutrients with the remaining fibrous material discarded. Other describe a slightly different method of sucking out the flesh and tender seeds and discarding the tubes of skin (podcast). NPR 21 September 2015. Retrieved 8 July 2017.

## 2.1.4.4 Leaves

The leaves can be used in many ways, perhaps most commonly added to clear broth-based soups such as the Filipino dishes Tindal and Utah. Tender moringa leaves, finely chopped, are used as garnish for vegetable dishes and salads, such as the Kerala dish thoran. It is also used in place of or along with coriander Lim (2012). For long-term use and storage, moringa leaves may be dried and powdered to preserve their nutrients. Sun, shade, freeze and oven drying at 50-60°c are all acceptable methods all be it variable in their retention efficacy of specific micro and macro nutrients. Ibrahim, MN et al (2017). The powder is commonly added to soups, sauces and smoothies Lim, TK (2012). Owing to its high nutritional density, moringa leaf powder is valued as a dietary supplement and may be used to enrich food products ranging from dairy, such as yoghurt and cheese, oyeyinka, AT; Oyeyinka SA (2018). To baked goods such as bread and pastries Lim TK (2012) oyeyinka, ATS Oyeyinka SA (2018). With acceptable sensory evaluation.

## 2.1.4.5 Seeds

In Nigeria, the seeds are prized for their bitter flavor, they are commonly added to sauces or eaten as a fried snack. The edible seed oil maybe used in condiments or dressings Lim TK (2012) Ground. Debittered moringa seed is suitable as a fortification ingredient to increase the protein, iron and calcium content of wheat flours. Oyeyinka AT (2018).

## 2.2 History of millet

Millets are a group of highly variable small seeded grasses, widely grown around the world as cereal crops or grains for human food as fodder. There is evidence of the cultivation of millet in the Korean peninsula dating to the middle jeulum pottery period (around 3,500 – 2,000 BC). In India, millet have been mentioned in some of the oldest yajurueda texts, identifying foxtail millet (priyangava), barnyard millet (aanava) and black finger millet (shyaamaka), thus indicating that millet consumption was very common, predating to the Indian bronze age (4,500BC). Even until 50 years ago millets was the major grain grown in India from a staple food and integral part of local food cultures, just like many other things, millets have come to be looked down upon by modern urban consumers as “coarse grain” something that their village ancestor may have lived on, but that they had left behind and exchanged for a more “refined diet “. Unfortunately, this said refined diet lacks the nutrients critically important for us (food should be as local and wholesome as possible).

Following the western model of development, India and other developing nations have lost out on a lot of useful and meaningful things food habits have been one of the biggest changes we are quickly forgetting our indigenous foods and chasing standardization. Millets too have been discarded as being too primitive to be used, forgetting the roots. These changes, coupled with state policies that favor rice and wheat have led to a sharp decline in millet production and consumption.

Before Green Revolution, millet made up around 40percent of all cultivated grains (contributing more than wheat and rice). However, since the revolution, the production of rice has increased doubly and wheat production has tripled.

There is a hypothesis that a tilt in government policies that work against millets, which grow very well in diverse, small-scale, low-input farming system and are great for small farmers livelihood, is because they do not offer any profit for acro-chemical corporations, large food companies etc. So, the promotion of rice and wheat, which lend themselves to high investments in machinery, hybrid seeds, fertilizers, pesticides etc. were a much more lucrative economic strategy.

In defense of the food policy strategists and governments one might add that at the time, many believed that chemical agriculture would improve yields and food security in the long run. Even though India is the world leaders in term of production of millets in total grain production had dropped from 40-20 percent, leading to some serious agricultural, environmental and nutritional consequences. Rice has replaced millets as to be eaten directly, while wheat flour has replaced flours made out of millets, and is now used extensively to make Indian breads.

## 2.2.1 Importance of different types of millets

According to Rohit Jain, Co-founder of Banyan roots and organic store selling products at reasonable and sustainable price points,” there are two broad categories of millet, namely major and minor millets. While pearl millet, sorghum, finger millet and foxtail millets, other such as sama, godo, china etc. are considered minor millets. Many of the minor millets are endangered as they are getting depleted and some of them have even totally been eliminated”.

Each millet has an importance of its own. While some millets, such as finger millet are full of calcium, some like jowar have potassium and phosphorous, and foxtail is fibrous while godo is rich in iron. The report advisable to keep rotating the kind of millets we are eating. We should also remember that we should not mix millets and should only eat grain in a meal as each grain has its own requirement as the medium for digestion and mixing them can create imbalances in body.

## 2.2.2 Some important points regarding millets

Due to its high resistance against harsh conditions, millets are sustainable to the environment, to the farmer growing it and provide cheap and high nutrient options for all.

* Nearly 40 percent of the food produced in India is wasted every year. Millets do not get destroyed easily, and some of the millets are good for consumption even after 10-12 years of growing, thus providing food security and playing an important role in keeping a check on food wastage.
* Millet is fibrous in content has magnesium, niacin (vitamin B3), is gluten free and has a high protein content.

**2.3 Composition of *Moringa oleifera* Leave**

Moringa leaves are a rich source of essential nutrients such as vitamins, minerals, and amino acids. They are particularly high in vitamins A, C, and E, as well as minerals such as calcium, potassium, and iron. The leaves also contain a range of antioxidants such as flavonoids, polyphenols, and ascorbic acid, which have been shown to have various health benefits.

One recent study investigated the phytochemical content of Moringa leaves using high-performance liquid chromatography (HPLC) and found that the leaves contain a range of bioactive compounds such as quercetin, kaempferol, and caffeic acid. These compounds have been shown to have antioxidant, anti-inflammatory, and antimicrobial properties (Aslam et al., 2021).

Another study focused on the amino acid composition of Moringa leaves and found that they are particularly high in essential amino acids such as leucine, isoleucine, and valine. These amino acids are important for muscle growth and repair, and are also important for maintaining healthy skin, hair, and nails (Yang et al., 2020).

In addition to their nutritional value, Moringa leaves have also been investigated for their potential medicinal properties. One study found that Moringa leaves have antidiabetic properties and can help to regulate blood sugar levels (Hussain et al., 2021). Another study found that Moringa leaves have hepatoprotective properties and can help to protect the liver from damage (Mudassar et al., 2020).

Overall, the composition of Moringa leaves is highly diverse and contains a range of essential nutrients and phytochemicals. These compounds have been shown to have various health benefits, including antioxidant, anti-inflammatory, and antimicrobial properties, as well as potential medicinal properties such as antidiabetic and hepatoprotective effects.

**2.4 Composition of Millet**

Millet is a rich source of vitamins, particularly vitamin B complex, which includes thiamin, riboflavin, niacin, and pyridoxine. It is also a good source of minerals such as iron, magnesium, phosphorus, and potassium. In addition, millet is a rich source of dietary fiber, which helps to promote satiety, regulate blood sugar levels, and promote digestive health.

Recent research has also focused on the phytochemical composition of millet. Phytochemicals are biologically active compounds that are found in plant-based foods, and have been shown to have various health benefits. One study investigated the phytochemical composition of millet using high-performance liquid chromatography (HPLC) and found that millet contains a range of phytochemicals such as phenolic acids, flavonoids, and tannins (Li et al., 2021).

Another study investigated the amino acid composition of millet and found that it is a good source of essential amino acids such as lysine, methionine, and tryptophan. These amino acids are important for muscle growth and repair, and are also important for maintaining healthy skin, hair, and nails (Adebowale et al., 2020).

Millet has also been investigated for its potential medicinal properties. One study found that millet has anti-inflammatory properties and can help to reduce inflammation in the body. In addition, millet has been shown to have hypoglycemic effects, and can help to regulate blood sugar levels (Adebowale et al., 2020).

Overall, the composition of millet is highly diverse and contains a range of essential nutrients, dietary fiber, and phytochemicals. Millet has been shown to have various health benefits, including anti-inflammatory and hypoglycemic effects.

**2.5 Extrusion**

Extrusion is a process that involves the use of heat, pressure, and mechanical forces to transform food ingredients into various shapes and forms. Extrusion has been used in the food industry for many years, and is commonly used to produce products such as breakfast cereals, snacks, and pet foods. In this literature review, we will discuss the latest research on extrusion, focusing on its applications, benefits, and limitations. Extrusion has many applications in the food industry. One of the main benefits of extrusion is that it can be used to produce a wide range of food products with varying textures and shapes. Extrusion can also be used to improve the nutritional value of foods by increasing their protein and fiber content. In addition, extrusion can be used to enhance the functional properties of food ingredients, such as their water-holding capacity and emulsifying ability.

Recent research has focused on the use of extrusion to produce plant-based protein products. One study investigated the effect of extrusion on the protein quality and digestibility of pea protein, and found that extrusion increased the protein digestibility and improved the amino acid profile of the pea protein (Liu et al., 2021). Another study investigated the use of extrusion to produce meat analogs using soy protein, and found that extrusion improved the texture and sensory properties of the meat analogs (Li et al., 2021).

Extrusion has also been used to produce functional ingredients for food applications. One study investigated the use of extrusion to produce resistant starch from cornstarch, and found that extrusion increased the resistant starch content and improved the functional properties of the cornstarch (Sharma et al., 2021). Another study investigated the use of extrusion to produce encapsulated fish oil powders, and found that extrusion improved the stability and bioavailability of the fish oil (Sun et al., 2021).

Despite the many benefits of extrusion, there are also some limitations to the process. One of the main limitations is the potential for the formation of acrylamide, a potential carcinogen, during extrusion. However, research has shown that the formation of acrylamide can be minimized through the use of proper extrusion conditions (Li et al., 2020).

# CHAPTER THREE

## 3.0 Material and method

## 3.1 Collection of samples

The millet grain was purchased from Mubi main market and the moringa leaves were also obtained from market Mubi main market Adamawa State, Nigeria.

## 3.2 Preparation of samples

**3.2.1 Preparation of millet flour**

The millet grain was cleaned and cleared of dust, bad grains, foreign materials and washed using attrition mills and then sun-dried for 6 hours under the sun and, pearl, dry-milled into flour and sieved through 250 mesh sieve as seen in the flow diagram in figure 1 below.

The moringa leaves were harvested and the damaged and diseased ones were discarded manually the leaves were washed to remove dirt and soaked in 1% saline solution (NaCl) for 5mins to get rid of microbes. The leaves were drained of excess water and dried in a shade to avoid loss of nutrients. The dried were ground and sieved using a 0.5mm pore sieve.

Millet

🡫

Cleaning

🡫

Draining

🡫

Sun-drying

🡫

Dry milling

🡫

Sieving

🡫

Millet flour

**Figure 1: Flow chart for representation of millet flour**

Moringa leaf

🡫

Washing

🡫

Drain in basket

🡫

Dry at room temperature (25days)

🡫

milled (Attrition milling machine)

🡫

moringa leaves powder

🡫

Sieve to 4mm mesh size

🡫

Moringa flour

**Figure 2: Flow chart for preparation of moringa leave powder**

## 3.3 Formulation of blends

The blend ratio (%) for the complementary food were formulated using the modified method as described by Lim (2012). The millet flour and the moringa oleifera leaf powder were blended in the ratio of 100:0% (Sample A Control), 95%:5% (Sample B). 90%:10% (Sample C), 85%: 15% (Sample D), 80%: 20.0% (Sample E).

**Table 3.1: Ingredients formulation**

|  |  |  |
| --- | --- | --- |
|  | Millet powder (%) | (%) Moringa powder |
| A | 100 | 0 |
| B | 95 | 5 |
| C | 90 | 10 |
| D | 85 | 15 |
| E | 80 | 20 |

METHOD OF EXTRUSION

Weighing of materials

Feed formulation

Dry mixing

Determining of initial moisture content

Make up moisture to the required final

Put feed to the hopper

Allow the feed to run through the barrel and the product through the dirt

**Figure 3: Flowchart for extrusion of snack**

## 3.4 Proximate analysis

The following proximate analysis was carried out

**3.4.1 Moisture Content Determination**

The moisture content of the sample was determined using the digital moisture analyzer model no: LSC60D

Moisture content of food is of great importance to every food processor as a number of biochemical reaction and physiological changes in food depend very much on the moisture content of even greater significance, is the effect of moisture on the stability and quality of foods. Therefore, moisture determination is one of the vital components of food that should be evaluated.

## 3.4.2 Ash Content Determination

Ash in food constitutes the residue remaining after all the moisture has been removed as well as the organic materials (fats, protein, carbohydrates, vitamins, organic acids etc.) have been burnt away by igniting at a temperature of around 550°c. this result in the oxidation of organic constituents to volatile minerals considered as carbon dioxide. Ash residue is generally taken to be measure of the mineral content of the original food. The individual elements tend to vary depending on the particular element and on types of food. This will be done by furnace incineration method as described by (A.O A.C, 2008).

The percentage ash was expressed as

% Ash =

Where,

W1= weight of empty crucible

W2= weight of crucible + food before drying/ashing

W3= weight of crucible + ash

## 3.4.3 Fat Content Determination

Fat content of the sample was determined using the Soxhlet fat extraction apparatus described by A.O.A.C (2008). Determination of fat content of a food does not actually reflect the estimation of the true fat content but of the lipid fraction of the food, i.e those food constituents soluble in non-polar organic solvents such as benzene and petroleum ether. The lipid fraction includes fats (also known as triglycerides) phosphor lipids, waxes, steroids, terpenes and fat-soluble vitamins. In real terms fat makeup to about 99% of the lipid fraction of a food. Usually in food analysis total lipid content is what is determined rather than the true fat content and this has resulted in the terms fat and lipid becoming indistinguishable.

The weight of fat extracted was determined as expressed as % fat =

Where,

W3 = weight of empty extractions flask.

W2 = weight of extraction flask + fat content.

## 3.4.4 Protein content using Kjeldhal method

Amino acids are the building blocks of proteins they are therefore polymers of amino acids, most of which are α-amino acids having the general formula NH2CHR COOH. It is the only macro-nutrient in foods that contains Nitrogen. The Nitrogen in proteins thus becomes the basis of the estimation of proteins in foods. A conversing factor of the actual percentage of Nitrogen in food proteins was determined.

% protein = % N2x 6.25 (F)

% N2 = x x T. Bik

Where:

W = weight of sample

F = conversion factor = 6.25

N = Normally of titrant (0.02H2SO4)

V1 = Total digest volume (100ml)

V2 = Volume of digest analyzed (10ml)

T = titre value of sample

B = Titre value of blank

## 3.4.5 Carbohydrate determination

Carbohydrates are generally the most abundant singular food component in nature and widely distributed. The percentage carbohydrate will be determined by difference as described by Egna et al., (1981).

The known amount of protein, fat, ash, and moisture were subtracted from 100. The remaining amount was the carbohydrates content.

% available carbohydrate = 100 - (% moisture + % ash + % protein + % fat).

## 3.5 Determination of functional properties

Functional properties have been defined by Matil (1971) as those characteristics that govern the behavior of nutirents in food during processing, storage and preparation as they affect food quality and acceptability.

The following functional properties were carried out.

## 3.5.1 Bulk density

This was determined according to the method described by Onabanjo and Ighere (2014).

The bulk density (g/ml) =

## 3.5.2 Water absorption capacity

This was determined according to a prescribed method by Ruales et al. (1993). The amount of water absorbed (total minus free) was multiplied by its density for conversion to grams. Density of water is lg/ml.

Absorption capacity was expressed as grams of water absorbed (or retained) per gram of sample.

## 3.5.3 Wettability

The wettability is the time required for the sample to become completely wet.

## 3.5.4 Water solubility index

The amount of polysaccharides released from the granule on the addition of excess of water was determined. Water solubility index was the weight of dry solids in the supernatants from the water absorption index test expressed as percentage of the original weight of the sample.

## 3.5.5 Swelling index

The swelling index of the sample was determined by the method described by Okak and Potter, 2007). One gram of sample was measured into a 10ml measuring cylinder, then 5ml of distilled water was added into the sample and allowed to stand for one hour. The final volume after swelling was recorded this is calculated:

# 

# CHAPTER FOUR

# RESULTS AND DISCUSSION

## 4.1 Results

Table 1: Proximate composition of Extruded instant millet/moringa porridge

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sample | Moisture content | Crude protein | Fat | Ash | Carbohydrate |
| A | 1.9 | 5.59 | 2.82 | 4.0 | 85.69 |
| B | 0.50 | 10.21 | 5.16 | 3.1 | 81.03 |
| C | 0.51 | 24.51 | 7.55 | 1.7 | 65.73 |
| D | 1.9 | 14.23 | 10.23 | 3.1 | 70.54 |
| E | 2.6 | 43.9 | 1.36 | 3.4 | 88.25 |

Key:

A = 100% Millet flour: 0% moringa powder

B = 95% Millet flour: 5% moringa powder

C = 90% Millet flour: 10% moringa powder

D = 85% Millet flour: 15% moringa powder

E = 80% Millet flour: 20% moringa powder

Table 2: Sensory evaluation results

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Sample | Colour | Taste | Aroma | General Acceptability |
| A | 6.9 | 7.5 | 7.3 | 7.6 |
| B | 6.7 | 8.5 | 7.2 | 7.2 |
| C | 8.2 | 7.8 | 7.0 | 7.6 |
| D | 7.1 | 6.4 | 6.7 | 7.2 |
| E | 7.2 | 7.1 | 6.1 | 6.9 |

The result of the sensory profile evaluation by panel numbers for various attributes (acceptability, aroma, colour, and taste) of the porridges made from different ratios.

Table 3: Functional properties of extruded instant millet porridge.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Sample | Bulk density (g/ml) | Water absorption index (0/0) | Water solubility index (0/0) | Swelling index (g/g) |
| A | 5.2cm3 | 2.24 | 1.09 | 0.2 |
| B | 7.1cm3 | 1.50 | 1.26 | 0.5 |
| C | 7.3cm | 1.24 | 2.25 | 2.5 |
| D | 7.00cm | 1.50 | 2.80 | 3.0 |
| E | 7.2cm | 2.31 | 0.95 | 3.2 |

## 4.1 Proximate composition of the extruded instant millet/moringa porridge

Table 1 above shows the proximate composition of extruded instant millet porridge the moisture content ranged from 3.57 – 5.47%. This result is significantly lower than the commercial porridge standard with the moisture content of 7.55%. According to Barsali Joy.

Millet moisture content ranged from 11.1 to 25% therefore, the shelf life of the extruded product may be prolonged due to the low moisture content leading to improvement in keeping quality. Protein is one of the most important nutrients required in porridge. The protein content of the extruded instant millet porridge ranged from 4.39 – 32.23% which was higher than the minimum amount of 13.20% specified by codex alimentarious standard. The protein content of commercial porridge was 28.08% lower than some of the porridge prepared the specified protein content for instant porridge ranged from 13.20 FAO (2008).

Fat content of the extruded instant millet porridge ranged from 1.36 – 15.23% which was significantly higher than the commercial instant millet porridge with 2.5% but lower than the specified amount in the code alimetarious standard ranged 6.18 ±0.25%. Lower fat content had contributed to the increase in the shelf life of the formulation by decreasing the chances of rancidity Onvorach and Akinjede (2004).

Ash content is an important nutritional indicator of mineral content and important quality parameter for contamination, particularly foreign matter (for example petbles). Fennema (1996), the Ash content of the instant millet porridge range from 1.15 – 3.70% some of the results are significantly higher than the commercial porridge. According to Okoh et al (2005), the ash content of millet ranged from 9.25%.

Carbohydrate content in the extruded instant millet porridge ranged from 65.73 – 88.25%. The instant millet porridge was higher than the lower limit 74.20 0.20) of the codex alimentarious standard FAO/WHO (1994).

**4.2 Functional properties of the instant extruded porridge**

Table 2 above shows the functional properties of moringa a powder blends the bulk density ranged from 1.11 to 1.27g/ml, water absorption index ranged from 0.9 to 31%, water solubility index ranged from 0.95 to 2.8%, swelling index ranged from 0.2 to 3.2g/g.

**4.3 Sensory evaluation of the instant instant extruded porridge**

Table 3 above shows the sensory evaluation result of sensory profile evaluation by panel numbers for various attributes (acceptability, aroma, colour, and taste) of the porridge made from different ratio, showed that all the developed millet-based flour porridges were more preferred than the commercial instant flour millet used in the community as reported by Ogbe and Affiku (2009).

The results indicated that moringa can serve as a basis for nutritious instant flours in terms of taste, panelists reported that porridges blend with moringa powder sample E with then ratio 80%:20% were sweeter than the one of millet powder and other blends. This result was expected because of the nature of the moringa itself is in agreement with the observations of Asengev, Abil and Gernahi (2013), who reported that the millet based complimentary foods will not require the use of external sweeteners. There was no significant difference at 0.5% in terms of general acceptability but there was significantly different (p< 0.05) in colour, taste and aroma.

# CHAPTER FIVE

# FINDING, RECOMMENDATION AND CONCLUSION

## 5.1 Conclusion

A good nutritive instant porridge was prepared from blend of moringa powder and millet powder. Its nutritive value was compared with commercial food (millet porridge). The proximate analysis obtained yield a satisfactory result, the nutritive instant porridge produced may be satisfactory to meet the nutritional requirement for the rapid growth of infants of less privileged.

Insufficient quantity and inadequate quantity and inadequate quality of complementary foods have led to high nutrient deficiencies with attendant detrimental impacts on the health, growth and survival of under five children in Nigeria.

Therefore, it is possible to produce instant porridge from local materials such as moringa powder and dry millet powder which have good nutritional quality and are safe for human consumption.

In conclusion, the blending of moringa leaf powder had high protein content and better physio chemical properties which could be a potential and functional ingredient in the production of baked products and complimentary food products.

## 5.2 Recommendations

It is recommended that;

1. Assessment of the shelf life, the micronutrients, vitamin A and C content as well as the phytochemical composition of the instant extruded millet porridge.
2. Assessment of the effect and the health benefit by consumption.

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