**EVALUATION OF AMINO ACIDS AND ANTI-NUTRIENTS CONTENT OF *OGI* FROM**

**MALTED MILLET, SOYBEANS AND FIG LEAVES COMPOSITE FLOUR**

Abstract

*Ogi* is known to be the common weening food used by nursing mothers who cannot constantly afford the foreign weening foods. Most raw materials use in the production of *ogi* are deficient in certain nutrients. In this research, Malted millet, Soy beans and Fig leaves composite flour produced for *ogi* was evaluated for its amino acid and anti-nutrients content. The amino acid contents of the samples were determined. Lysine (4.12 – 5.46 mg/100g), Tryptophan (0.21 – 0.28 mg/100g), Leucine (4.69 – 5.89 mg/100g) Iso-leucine (4.48 – 5.44 mg/100g), Valine (3.09 – 4.13 mg/100g), Phenyl-Alanine (2.09 – 3.85 mg/100g), Histidine (0.52 – 1.15 mg/100g), Threonine (1.32 – 4.45 mg/100g), Methionine (3.39 – 4.58 mg/100g), Cysteine (0.93 – 0.99 mg/100g), Tyrosine (1.34 – 2.13 mg/100g), Glycine (1.69 – 1.97 mg/100g), Arginine (3.02 – 3.17 mg/100g), Aapartic acid (4.02 – 5.78 mg/100g), Glutamic acid (3.01 – 4.95 mg/100g), Serine (0.42 – 0.95 mg/100g), Proline (1.43 – 3.18 mg/100g) and Alanine (1.99 – 4.09 mg/100g) respectively. Some of the values of the EAA met the recommended daily allowance as recommended by FAO/WHO (1998). The other samples recorded varying increasing amounts respectively. The anti-nutritional factors decreased as the level of substitution of soybean and fig leaves increased and ranged from 0.49 – 0.9 mg/100g for tannin, 0.44 – 1.12 mg/100g for oxalate, 1.45 – 1.98 mg/100g for trypsin-Inhibitor, 0.94 – 1.82 mg/100g for phytate and 1.39 – 3.02 mg/100g for saponins and were below critical limits

INTRODUCTION

According to Majingo and Regina 2018, weaning is the gradual process of introducing an infant to food other than breast milk. The weaning period is a crucial time. This is when children are introduced to solid food and such dietary change can be challenging for them as well as the care givers who are saddled with the responsibility of providing sufficient and nutritious food that would support healthy development.

Malnutrition is excess or insufficient nutrient intake in diets over time and is a major concern to most countries in Africa, [Ajanaku *et al*. (2012](https://scialert.net/fulltext/?doi=ajft.2012.82.88#867517_ja)). Omotesho *et al*. (2019) reported that Nigeria currently faces the biggest burden of under-nutrition in Africa, with the largest population of malnourished children. Naturally, as newborn grows older, the demand for nutrient increases and breast milk alone cannot adequately sustain the baby’s demand. To address this, many mothers who can afford them, begin the introduction of other weaning foods such as imported cereal foods, and those that cannot afford them employ the use of locally produced fermented cereal food porridge made from the staple. However, this watery porridge has very little [nutritive value](http://www.scialert.net/asci/result.php?searchin=Keywords&cat=&ascicat=ALL&Submit=Search&keyword=nutritive+value) compared to the imported cereal foods, so there is the need to improve the nutritive value by supplementing with fresh cow’s milk, pawpaw, egg yolk, edible oil and fruits ([Ajanaku *et al*., 2012](https://scialert.net/fulltext/?doi=ajft.2012.82.88#867517_ja)). Ozoka *et al* (2018) suggested that emphasis on prioritizing exclusive breast feeding for the first 6 months of life is highly essential and appropriate complementary feeding of healthy diet and breast feeding till 2 years would be encouraged to curb infant malnutrition. According to Oluwaseyi *et al* (2020), proper breastfeeding and complementary feeding practices have been listed as part and about 19% of this death can be prevented. As reported by Charles *et al* (2016), *Ogi* is a common indigenous complementary food and sometimes called pap. Ozabor*et al.* (2020) reported that *ogi* is a traditional fermented cereal-based beverage popularly consumed as weaning food. In Nigeria it is called *Akamu* in Igbo, *Ogi* in Yoruba and *Koko* in Hausa. It is an extract of wet soluble carbohydrate (starch extract) from cereal grains with poor storage stability because of its high moisture level.

Charles *et al.* (2016) reported that *ogi* is usually made from maize grains while Ozabor *et al* (2020) reported the production of *ogi* from brown and white sorghum. The two sorghum varieties (brown and white) showed to serve as a good weaning food for infants but brown sorghum *ogi* seems to be more nutritious. Also, Inyang and Idoko (2006) reported that *ogi* made from malted millet up to 10% malt level is recommended for children of the weaning age and adults alike due to its high quality and acceptability. Inyang and Idoko (2006) also reported that millet grain is a superior food stuff containing at least 9% protein and a good balance of amino acids.

Substituting *ogi* for breast milk as a weaning food is common among nursing mothers in Nigeria. However, *ogi* is not rich in the required nutrients for good child growth and development when compared to breast milk, resulting to malnutrition. As a result, the uses of other plant based nutrient sources are explored in attempt to improve the nutritional content of *ogi.*Adebayo *et al* (2018), stated that soybean is one of the plants explored for its potential beneficial nutrients. Soybean consists of more than 36% protein, 30% carbohydrates, and excellent amounts of dietary fiber, vitamins, and minerals. It also consists of 20% oil, which makes it the most important crop for producing edible oil. (Fabiyi 2006).

Fig (*Ficuscaricalinn*) is one of the oldest known fruit trees in the world that grows in the wild. Figs can be eaten fresh and dried, or canned and are often used in the preparation of jam. As a fresh fruit, it has a luscious taste. Figs grow in the wild across different states of Nigeria. They are also found in the wild across different communities in Benue state. According to Shomkegh*et al.* (2016). Igoli and Shomkegh (2013) reported that different parts of fig are used for culinary purposes. The fruits are consumed directly as snack or desserts as well as they can be processed into other forms of foods. Osowe*et al.* (2021) in a study also revealed that the leaf powder of *F. carica, F. exasperata, and F. thonningii* contains a significant number of minerals and phytochemicals with high antioxidant activity. As a result, the leaf powder of *F. carica, F. exasperata,* and *F. thonningii* could be employed as a natural feed supplement in animal nutrition

The preparation of complementary foods that are nutritious from millet has attracted a lot of attention with several innovative approaches being adopted to improve the quality of *ogi* amongst other foods. This study is therefore undertaken to assess the effects of Fig leaves and soybean flour blends on the quality of millet based *ogi*

**MATERIALS AND METHODS**

**2.1 Source of Materials**

The Millet grains and Soybean seeds were purchased from Wurukum market in Makurdi Local Government area of Benue state, the fresh Fig leaves were harvested from the wild in Abofutu, Ogore in Obi local government area of Benue state, Nigeria. All laboratory materials and reagents used were of analytical grade.

**2.2 Sample Preparation**

Malted millet flour was produced according to Bolarinwa *et al* (2015). Soybean flour was produced from soybean grains according to the method described by Omah *et al.* (2021). Fig leaves flour was prepared according to the method described by Olabode *et al*. (2015). The blend formulation was done at different graded proportions of 100:0:0, 93:2:5, 86:4:10, 79:6:15, 72: 8:20 in a rotary mixer (Philips, type HR 1500/A Holland) as presented on table 1. The complementary food (*ogi*) was prepared according to the method described by Bolarinwa *et al* (2015).

 Pearl Millet grains

Sorting

Weighing

Washing

Steeping (18h)

Draining

Malting (72 h)

Drying (60OC, for 48h)

Dry Milling

Sieving (250µm aperture)

Packaging

Malted millet flour

Figure 1: Flow Chart for the Production of Malted Pearl Millet Flour

Source: Bolarinwa *et al* (2015)

Soybean grain

Sorting

Soaking (for 24 h)

Boiling (1 h)

Dehulling

Oven drying (at 50 ⁰C for 24 h)

Cooling

 Milling

 Sieving (250µm aperture)

Soybean Flour

Figure 2: Flow Chart for the Preparation of Soybean Flour

Source: Omah *et al,* (2021)

Fresh Fig leaves

Sorting

Washing

Oven drying (50oC, 6 h )

Milling (attrition mill)

Sieving (250 µm)

Fig Leaves Flour

Packaging

**Figure 3:** **Flow Chart for the Preparation of Soybean Flour**

 Source: Olabode *et al*. (2015)

**Table 1:** **Blend Formulation** **of Malted Millet, Fig Leaves and Soybeans composite flour**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sample**  | **Malted Millet flour (g)** | **Fig Leaves flour (g)** | **Soybeans flour(g)** |
| A | 100 | 0 | 0 |
| B  | 93 | 2 | 5 |
| C  | 86 | 4 | 10 |
| D  | 79 | 6 | 15 |
| E  | 72 | 8 | 20 |

**Key:**

A = 100:0:0 = malted millet, fig leaves and soybean flour blends

B = 93:2:5 = malted millet, fig leaves and soybean flour blends

C = 86:4:10 = malted millet, fig leaves and soybean flour blends

D = 79:6:15 = malted millet, fig leaves and soybean flour blends

E = 72:8:20 = malted millet, fig leaves and soybean flour blends

Complementary flour blends (50g)

Reconstituting with clean water (100ml).

Pour into 150ml boiling water

Cooking for 2 to 5 min

Smooth *ogi*

**Figure 4:** **Preparation of *Ogi* from Malted Millet, Soybeans and Fig Leaves composite flour.**

Source: Bolarinwa *et al* (2015)

**ANALYSIS**

**Determination of Amino Acid Profile of Malted Millet, Soybean and Fig LeavesComposite**

**Flour**

The amino acid profile was determined using Technicon Sequential Multi- Sample Amino Acid Analyzer (TSM 1Technicon Instrument Basingstoke, China) as described by AOAC (2015).

**Anti-Nutrients of Malted Millet, Soybeans and Fig Leaves composite flour**

Phytic acid and Tannin contents were determined as described by Onwuka, (2005).

Trypsin inhibitor assay (TIA) was determined as described by Ijarotimi*et al* (2013).

Oxalates content determination was carried out using the method of AOAC (2015).

Saponins Content Determination were evaluated as described by Obadoni and Ochuko (2001).

**Sensory Analysis of Complementary *Ogi***

Sensory evaluation of the developed complementary *ogi* was carried using the method described by Iwe, 2002 The sensory qualities that were evaluated included appearance, taste, aroma, thickness/consistency, mouth feel and overall acceptability

**Statistical Analysis**

All data obtained in this study was analyzed using SPSS (Statistical Package for Social Sciences) Version 16. Duncan’s new multiple range tests were used to compare and separate means. Significance will be accepted at p<0.05 according to the method described by Puteh, 2017.

**Results and Discussion**

**Amino Acids Composition of Malted Millet, Soybeans and Fig Leaves Composite Flour**

Amino acids profiles were evaluated and the results are as presented in Table 3. The result shows that the values were in the following ranges; Lysine (4.12 – 5.46mg/100g), Tryptophan (0.21 – 0.28mg/100g), Leucine (4.69 – 5.89mg/100g) Iso-leucine (4.48 – 5.44mg/100g), Valine (3.09 – 4.13mg/100g), Phenyl-Alanine (2.09 – 3.85mg/100g), Histidine (0.52 – 1.15mg/100g), Threonine (1.32 – 4.45mg/100g), Methionine (3.39 – 4.58mg/100g), Cysteine (0.93 – 0.99mg/100g), Tyrosine (1.34 – 2.13mg/100g), Glycine (1.69 – 1.97mg/100g), Arginine (3.02 – 3.17mg/100g), Aspertic acid (4.02 – 5.78mg/100g), Glutamic acid (3.01 – 4.95mg/100g), Serine (0.42 – 0.95mg/100g), Proline (1.43 – 3.18mg/100g) and Alanine (1.99 – 4.09mg/100g) respectively. The content of Lysine was significantly (p>0.05) different across all samples with sample E having the highest value of 5.46 followed by sample A 4.12. Tryptophan and Leucine contents were higher in sample E with a value of 0.28 and 5.89mg/100g and lower in sample A with value of 0.21 and 4.69mg/100g respectively.

There was significant difference in tryptophan content of all the samples tested except sample C and D. Samples B and C were not significantly different for the Leucine content in the samples tested, but was significant (p>0.05) different among other samples. Only samples B and C were not significantly (p>0.05) different for iso-leucine content, the valine content was significant (p>0.05) different across the samples tested. Samples D and E were not significantly for the Phenyl Alanine test carried out, only sample A was significantly (p>0.05) different for the Histidine content in the sample. The threonine and Methionine contents were not significant (p>0.05) different in samples C and D and samples A and B respectively, but significant (p>0.05) different among other samples. Cysteine and Tyrosine content was significantly (p>0.05) different among samples tested except in samples Cs and Ds. Glycine was significantly (p>0.05) different among samples tested, Arginine on the other hand was not significant (p>0.05) different in any sample. Aspartic acid content was not significant (p>0.05) in samples Band C, Glutamic acid was not significant in sample Dand E, Serine was not significant in sample C, D and E but were significantly (p>0.05) different among other samples tested. Proline content was not significant between samples B and C, and D and E. Alanine content of the tested samples was only significantly (p>0.05) different in samples A and B while samples C, D and E were not significantly different.

(Ameh *et al,* 2023) reported that amino acids are the chemical building blocks that make up proteins and provide the structure for all living things as proteins participate in the vital chemical processes that sustain life. All amino acids in food have different roles that helps the body to grow and function optimally. However, essential amino acids are of main concern as they are not synthesized in the body and must be supplied in adequate amount through diets.

The amino acid contents of the samples were evaluated and presented. The results showed significant (p>0.05) difference for all the samples with a significant increase in amino acid content value. This increase could be as result of increase in the concentration of protein in the blends. The amino acid compositions showed that Leucine, aspartic acid and Isoleucine are the most abundant essential amino acid and were more dominant in the samples with the higher amount of FLF and SBF (Sample E). The significant increase in amino acid content may be due to the high amino acid content of SBF used in the blend formulation.

When compared, the Tryptophane, Leucine, Phenyl Alanine Histidine, Cysteine, Glycine, Arginine, Aspartic acid, Serine, Proline, Glutamic acid and Proline were lower than the results obtained by (Ameh *et al,* 2023) for Maize-Based *Ogi* Enriched with Bambara-nut and Soybean Flours. The values for the other parameters (Lysine, Iso-leucine, Valine, Threonine, Methionine, Tyrosine and Alanine obtained in this study were however higher than the report of (Ameh *et al*, 2023). The tryptophan content of this study was lower than (20.38 mg/g) reported by (Uchechukwu et al, 2018). Also, when compared, the Isoleucine, Methionine, Phenylalanine, Leucine, Valine, Lysine, value from this study were lower than (54.78 mg/g); (50.07 mg/g), (50.85 mg/g), (109.55 mg/g), (68.29 mg/g), (93.95 mg/g), reported by Uchechukwu *et al* (2018). The difference in amino acid content in the different studies may be due to the different ingredients in the blend formulation, method of processing and blend formulation ratio.

Leucine and Isoleucine were the most abundant essential amino acid among samples evaluated while Aspartic acid and Glutamate were the most abundant non-essential amino acid among samples evaluated. This trend was in agreement with (Ameh *et al,* 2023).

Lysine is a major limiting amino acid in cereal grain, this may suggest why the lysine content was lowest (4.12 g/100 g protein) in the control sample (100 % Millet *ogi*) but was improved upon the addition of SBF.

Generally, samples (sample E) with the highest amount of SBF in the blend formulation witnessed the highest amount of amino acid content. This could be attributed to soy protein influence on the blend formulations. In all, the Millet – FLF and SBF will meet the reference standard for all essential amino acids at five to six times feeding with 100g of the weaning food per day. Therefore, infant foods formulated from such blends will to meet the essential amino acid needs of the infants

**Anti Nutritional Content of Malted Millet, Soybeans and Fig Leaves Composite Flour**

The results for the antinutrients are as presented in Table 2. The values obtained for Tanin, Oxalate, Trypsin-Inhibitor, Phytate and Saponins were between 0.49 – 0.9mg/100g, 0.44 – 1.12mg/100g, 1.45 – 1.98mg/100g, 0.94 – 1.82mg/100g and 1.39 – 3.02mg/100g respectively. Significant difference occurred for Tannin among the samples but was not significant in samples B and C for oxalate. The results for trypsin inhibitor were significant between samples B and C, and between samples D and E but was significantly different with sample A at (p>0.05). There was no difference in the values of the samples A and B for phytates, however, samples C, D and E differed significantly from each other. The results for Saponin did no differ from one another at (p>0.05).

[Anti - Nutritional factors](https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/antinutritional-factor%22%20%5Co%20%22Learn%20more%20about%20Antinutritional%20factors%20from%20ScienceDirect%27s%20AI-generated%20Topic%20Pages) are deleterious compounds present in the [grain](https://www.sciencedirect.com/topics/food-science/cereal) which interfere with the absorption of biomolecules and hamper their bioavailability to the [human beings](https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/human) and [monogastric](https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/monogastric) animals (Sewa *et al*, 2020). Low [digestibility](https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/digestibility) hampers full utilization of [grain](https://www.sciencedirect.com/topics/food-science/cereal) [legume protein](https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/legume-protein). In part, the problem may result from the more rapid discharge, relative to other foods, of digesting pulses from the intestinal tract and reduced [protein hydrolysis](https://www.sciencedirect.com/topics/food-science/protein-hydrolysis) by gut enzymes, (Michaels, 2016). Antinutrients have the capacity of decreasing the digestibility and palatability of protein because they form insoluble complexes with them (Mbata *et al*., 2009). (Sewa *et al,* 2020) reported that there are several antinutritional factors present in wheat, such as [phytate](https://www.sciencedirect.com/topics/food-science/phytate%22%20%5Co%20%22Learn%20more%20about%20phytate%20from%20ScienceDirect%27s%20AI-generated%20Topic%20Pages), [protease inhibitor](https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/protease-inhibitor), [tannins](https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/tannin), [lectins](https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/lectin), [alkaloids](https://www.sciencedirect.com/topics/food-science/alkaloid), oxalate, etc. Phytate, being the most important among all, reduces the bioavailability of [micronutrients](https://www.sciencedirect.com/topics/food-science/micronutrient) such as iron and zinc. (Uchechukwu *et al,* 2018) stated that Phytates are known to form complexes with iron, zinc, calcium, and magnesium making them less available and thus inadequate in food samples especially for children. Tannins are naturally occurring plant polyphenols. Their main characteristic is to bind and precipitate protein interfering with its digestion and absorption.

Antinutrients investigated in this study include; tannin, oxalate, trypsin-inhibitor, phytate and saponin. Phytic acid, also known as inostitolhexaphosphate (IP6) or phytate as salt, is reported to be more than 80% in the maize germ and is known to inhibit mineral absorption due to its chelating ability, leading to the formation of insoluble metal-phytate complexes, (Akinsola *et al.* 2021). it also reduces the bioavailability and digestibility of proteins and carbohydrates, (Akinsola *et al.* 2021).,

The results obtained in this study for Tannin and Phytate were lower when compared with 18.9 - 27.6 % and 25.7 - 39.4% reported by (Bolarinwa *et al* 2015).

The results obtained for tannin in this study were also lower than (23.8-26.7%) reported by (Idris *et al* 2005) for Sorghum cultivars and (23.8-27.4%) reported by (Onoja *et al,* 2014) for sorghum-soy-plantain flour. Uchechukwu *et al* (2018) also reported 0.50 mg/100g - 2.96 mg/100g in 100:0 maize-pigeon and 60:40 fermented maize-pigeon *ogi* flour. In a separate study (Ogbonna *et al*. 2012) reported higher tannin content (35.8%) for malted sorghum flour. Lower tannin content observed in this study could be due to degradation of tannin during processing. In a separate report, (Bolarinwa *et al,* 2016) reported a tannin content of (0.11 - 0.20) mg/g for malted millet – plantain *ogi* flour which was lower than the data from this study. This report compared favorably with results from this present study. The various previous results compared showed that the tannin and phytate content obtained was low. This is an indication that there will more bioavailability of the nutrients. Tannins impart a bitter taste to the grains making them unpalatable and also interfere with protein digestibility (Bolarinwa *et al*, 2015).

Ijarotimi*et al* (2022) reported that phytate are secondary metabolites found in plants which chelates proteins and mineral thereby inhibiting the bioavailability of proteins and minerals for normal body functioning. The phytate content of malted millet-FLF-SBF reported in this study is lower than the phytate content (39.4%) of raw oat cereal reported by (Norhaizan and Norfaizadatul 2009), and 36.6% for malted sorghum flour (Idris *et al.* 2014). The results obtained for phytates in this study are also less than (1.70 - 2.78) mg/g reported by (Akinsola *et al.* 2021) and (1.84 – 2.67 mg/100g) of gruel produced from sorghum, soy bean plantain blends reported by (Onoja *et al* 2014). Uchechukwu *et al* (2018) also presented a result on phytate content of 13.36 mg/100 g in 60:40 maize-pigeon pea *ogi* and 2.54 mg/100 g in 100:0 maize-pigeon from a study, these values are higher than values from this study. The results of phytate content of product samples from this study were also compared with 3.71mg/100g - 69.22mg/100g reported by (Ijarotimi*et al*, 2022) and were found to be lower. (Uchechukwu *et al,* 2018) reported that 10–50mg phytate per 100g will not cause a negative effect on the absorption of zinc and iron. In this study, the phytate contents of the different product blends at the end of the investigations fall is within the safe consumption range. The tannin content of all the different fermented products in this study are equally generally low, and lower than the lethal dose of 0.7–0.9 mg/100 g (Pikuda&Ilelaboye, 2013). This study showed a reduction in the tannins and phytic acid content, and trypsin inhibitor activity with increased fermentation period. (Tharifkhan*et al,* 2021) has posited that phytate are secondary metabolites found in plants which chelates proteins and mineral thereby inhibiting the bioavailability of proteins and minerals for normal body functioning, their low presence in this study is of high advantage because the high bioavailability of nutrients

The saponin content reported in this study is higher than (1.41 – 2.16) mg/g by (Bolarinwa *et al* 2016), this may be as a result of substitution with SBF as Saponin is one of the anti-nutritional factors present in soybeans. (Uchechukwu *et al* 2018) reported 0.10% (100:0 maize-pigeon) and 10.77% (70:30 maize-pigeon). This result is higher than the data from this study. The results from this study were also higher than 0.70–0.79 mg/g reported by (Abraham *et al,* 2016) for *Ogi* produced from maize, millet and sorghum supplemented with cray fish. When compared also, the results reported 53.82% - 177.09% by (Ijarotimi*et al*,2022) were higher than those from this study. (Ansari and Mahapatra 2021), asserted that the variation in result data may be attributed to differences in origin and species of grains, however, this is beneficial, because it may promote low cholesterol and blood glucose level. (Ijarotimi*et al*, 2022) also reported that Saponin are referred to as anti-nutrients, however, clinical studies have showed that they possess beneficial effects on human body ranging from anti-cholesterol, antidiabetic and anticancer

The data obtained for trypsin-inhibitor in this study were compared with (Uchechukwu *et al* 2018) who reported higher values of 0.10% (100:0 maize) to 10.77% (70:30 maize-pigeon) *ogi* at the end of fermentation (48 hr souring), and were found to be lower than the report of (Uchechukwu *et al*2018). The trypsin inhibitory activity results from this study are equally lower than 0.10mg/g - 10.77mg/g obtained by (Ameh *et al,*2023) for Maize-Based *Ogi*enriched with Bambaranut - Soybean flours. The difference in values may be due to difference in cultivar, grains used and processing techniques.

Oxalates are phytochemical that acts as anti-nutrient which inhibits the absorption of calcium and enhances the formation of kidney stones, (Okoye *et al* 2018). The oxalate content observed in the present study are significantly (*P* < 0.05) lower compared than the NIS recommended values (< 2.50 mg/g). The results for oxalate content from this study is higher than 0.02 mg/100 g and 0.11 mg/100 g reported by (Awoyale *et al* 2024). oxalate values (0.33–0.95 mg/100 g) reported by (Gwer *et al*. 2020) for weaning food produced from millet, soybeans, and moringa leaves flour, were within the range of this study. Also, the oxalate content of *Ogi* powder (0.0018–0.0162 mg/ 100 g) by (Ijarotimi*et al,* 2022) from yellow and white maize, finger millet, popcorn maize, and white and red sorghum were lower than those of this study. This variation may be attributed to differences in processing methods and the type of cereal grains used. The study showed, comparing with previous established works that the antinutrient content of the malted millet -FLF - SBF *ogi* powder is within the safety limit. The results of oxalate content of this shows that the oxalate content is within tolerance level and consumers are not at any risk.

**Table 2:** **Anti-Nutritional Composition of Malted Millet, Soybeans and Fig Leaves Composite Flour (mg/100g)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Samples | Tannin | Oxalate | Trypsin-Inhibitor | Phytate | Saponin |
| FLFSBFA | 1.45a±0.010.94b±0.070.94b±0.02 | 0.33g±0.011.17a±0.061.12b±0.01 | 2.22a±0.171.33g±0.011.45f±0.06 | 3.06a±0.010.88g±0.000.94f±0.02 | 8.40a±0.080.95f±0.041.39e±0.07 |
| B | 0.87c±0.01 | 1.02c±0.03 | 1.65e±0.06 | 0.95e±0.01 | 2.29d±0.08 |
| C | 0.77d±0.00 | 0.99d±0.01 | 1.78d±0.08 | 1.22d±0.05 | 2.87c±0.04 |
| D | 0.68e±0.00 | 0.66e±0.05 | 1.98c±0.01 | 1.42c±0.04 | 2.94c±0.00 |
| E | 0.49f±0.00 | 0.44f±0.01 | 1.98b±0.00 | 1.82b±0.06 | 3.02b±0.04 |
| Limit | < 30.00/100g | < 2.50 mg/100g | - | < 70.00 mg/100g | - |

(Values are means ± standard deviations of duplicate determinations. Means in same column with same superscripts are not significantly p>0.05 different

**Key:**

A = 100:0:0 = malted millet, fig leaves and soybean flour blends FLF = Fig leaves flour

B = 93:2:5 = malted millet, fig leaves and soybean flour blends SBF = Soybean flour

C = 86:4:10 = malted millet, fig leaves and soybean flour blends

D = 79:6:15 = malted millet, fig leaves and soybean flour blends

E = 72:8:20 = malted millet, fig leaves and soybean flour blends

**Table 3: Amino Acids Composition of Malted Millet, Soybeans and Fig Leaves Composite Flour (mg/100g)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Samples | A | B | C | D | E | RDA,FAO/WHO(1998) |
| Lysine | 4.12e±0.02 | 4.13de±0.01 | 4.16c±0.01 | 4.92b±0.00 | 5.46a±0.00 | 5.80g/100g |
| Tryptophan | 0.21d±0.00 | 0.24c±0.01 | 0.25b±0.00 | 0.25b±0.01 | 0.28a±0.00 | 1.10g/100g |
| Leucine | 4.69d±0.03 | 4.82c±0.01 | 4.84b±0.01 | 4.89b±0.00 | 5.89a±0.00 | 6.61g/100g |
| Iso-leucine | 4.48d±0.08 | 4.71c±0.01 | 4.75c±0.03 | 5.19b±0.04 | 5.44a±0.01 | 2.80g/100g |
| Valine | 3.09e±0.01 | 3.11d±0.00 | 3.16c±0.01 | 3.19b±0.00 | 4.13a±0.01 | 3.50g/100g |
| Phenyl Alanine | 2.09e±0.01 | 2.72d±0.01 | 2.79c±0.04 | 2.81b±0.00 | 3.85a±0.01 | 63 mg/g, |
| Histidine | 0.52b±0.03 | 1.05a±0.08 | 1.10a±0.00 | 1.15a±0.01 | 1.15a±0.00 |  |
| Threonine | 1.32d±0.03 | 2.35c±0.01 | 2.98b±0.00 | 3.97b±0.06 | 4.45a±0.00 | 3.40g/100g |
| Methionine | 3.39d±0.07 | 3.48dc±0.01 | 3.73c±0.00 | 3.99b±0.01 | 4.58a±0.00 | 29 mg/g. |
| Cysteine | 0.93c±0.01 | 0.96b±0.01 | 0.97ab±0.02 | 0.97ab±0.00 | 0.99a±0.01 |  |
| Tyrosine | 1.34d±0.00 | 1.42c±0.01 | 1.48b±0.00 | 1.49b±0.00 | 2.13a±0.00 |  |
| Glycine | 1.69e±0.03 | 1.74d±0.01 | 1.85c±0.03 | 1.92b±0.01 | 1.97a±0.01 |  |
| Arginine | 3.02c±0.01 | 3.05b±0.01 | 3.07b±0.01 | 3.12b±0.00 | 3.17a±0.01 |  |
| Aspertic-Acid | 4.02e±0.01 | 4.50d±0.02 | 4.99c±0.00 | 5.29b±0.01 | 5.78a±0.01 |  |
| Glutamic-Acid | 3.01e±0.01 | 3.40d±0.07 | 3.45c±0.00 | 3.99b±0.01 | 4.95a±0.01 |  |
| Serine | 0.42d±0.01 | 0.92c±0.01 | 0.93b±0.01 | 0.95a±0.00 | 0.95a±0.00 |  |
| Proline | 1.43e±0.04 | 2.47d±0.02 | 2.57c±0.00 | 2.75b±0.01 | 3.18a±0.02 |  |
| Alanine | 1.99d±0.01 | 3.42c±0.01 | 3.99b±0.01 | 3.96b±0.05 | 4.09a±0.00 |  |

(Values are means ± standard deviations of duplicate determinations. Means in same row with same superscripts are not significantly (p>0.05) different). RDA: Lysine, Tryptophan, Leucine, Iso-Leucine, Valine, Threonine FAO/WHO (1998) reported by Ameh *et al* (2023) Phenyl-Alanine, Methionine FAO/WHO (1998) reported by Uchechukwu*et al* (2018)

**Key:**

A = 100:0:0 = malted millet, fig leaves and soybean flour blends

B = 93:2:5 = malted millet, fig leaves and soybean flour blends

C = 86:4:10 = malted millet, fig leaves and soybean flour blends

D = 79:6:15 = malted millet, fig leaves and soybean flour blends

E = 72:8:20 = malted millet, fig leaves and soybean flour blends

**CONCLUSION AND RECOMMENDATIONS**

**Conclusion**

The study of the effects of the addition of Fig leaves flour and Soybeans flour addition to millet based *ogi* was done and the following conclusions were drawn;

1. That the inclusion of FLF and SBF to malted millet based weaning food (*ogi*)is seen to improve the nutritional quality of the weaning food (*ogi*) positively.
2. The low antinutrient contents of the weaning food (*ogi*) suggests that the weaning food (*ogi*) will be safe for consumption
3. The Amino acid profile increased with the increase in the blends
4. The most preferred *ogi* was the sample A control (100:0:0) followed by sample E (72:8:20) flour blends in terms of organoleptic properties and nutritional contents

**Recommendations**

Based on the results obtained from this study, the following recommendations are made:

1. FLF and SBF should be included in the formulation of weaning foods (*ogi*).
2. It is recommended that sample E (72:8:20) be used for formulation of *Ogi* for enhanced acceptability and nutritional value.

References

Abraham S.I, Ifeanyi N. and Stephen S.  (2016), Effect of crayfish inclusion on the chemical and sensory properties of ogi prepared from maize, millet and sorghum *Int. Journal Nutr. Food sci.,*5 (6) p. 378

Adebayo C.O., Coker A.A. andTsavhemba, S. (2018) Improved Soybean Production Technologies in Benue State, Nigeria, *Nigerian Agricultural Journal*: 0300-368x volume 49 number 1. Pp.65-70

Ajanaku K.O., Ajanaku C.O., Edobor-Osoh A. andNwinyi O.C., (2012). Nutritive Value of Sorghum Ogi Fortified with Groundnut Seed (*Arachis hypogaea*L.). *American Journal of Food Technology, 7: 82-88*

Akinsola A.O, Onabanjo O.O, Idowu M.A and Ade-Omowaye B.I.O (2021), Traditional Complementary Foods: A Critical Review. *Greener Journal. Agricultural Science*.; 7(9): 226-242.

Ameh, C.O., Abu, J.O andBunde-Tsegba C. M (2023) Chemical and sensory properties of maize ogi enriched with flours and protein isolates from bambaranut and soybean *Applied Sciences Research Periodicals*december, vol. 1, no. 9, pp. 39-60

Ansari, M.H.  and Mahapatra D.K.  (2021), A short overview on anti-diabetic natural products: Reviewing the Herbotherapeutic Potentials Natural Products Pharmacology and phytochemicals for health care, *Apple Academic Press* pp. 1-22

AOAC (Association of Official Analytical Chemists) (2015), Official Methods of Analysis of AOAC International, 19th Edition, AOAC International, Maryland, USA.

Bolarinwa I, Olaniyan S. A, Adebayo l. O. & Ademola A.A, (2015) Malted Sorghum-soy Composite Flour: Preparation, Chemical and Physico-Chemical Properties, *J Food Process Technol*, 6:8

Charles Bristone, Evaristus Ogbonna Chibue, MamuduHaliduBadauze, &LadiHyelsintaKatsala (2016), Production of powdered maize Ogi (indigenous complementary food) flours complemented with soybean and sorghum malt, *MAYFEB Journal of Agricultural Science* Vol 3 - Pages 1-14

Fabiyi E. F. (2006). Soyabean Processing, Utilization and Health Benefits. *Pakistan Journal of Nutrition, 5: 453-457*

Idris H. W., Hassan A. D., Babiker E. E. & El-Tinay A. H (2005) Effect of malt pretreatment on anti-nutritional factors and HCl extractability of minerals of sorghum cultivars. *Pakistan Journal of Nutri*tion 4: 396-401.

Ijarotimi, O. S. &keshinro, O. O. (2013). Determination of nutrient composition and protein quality of potential complementary foods formulated from the combination of fermented popcorn, African Locust and Bambara Groundnut seed flour. *Polish Journal of Food and Nutrition Sciences,* 63(3): 155–166.

Inyang C U. & Idoko C A. (2006), Assessment of the Quality of *Ogi* Made from Malted Millet.*African Journal of Biotechnology*.;5: 2334-2337.

IslamiyatFolashadeBolarinwa, John Olajide, Sulaiman Adebisi & Olaniyan Olalekan Faromiki (2016) Production and Quality Evaluation of Complementary Food from Malted Millet, Plantain and Soybean Blends, *International Journal of Scientific & Engineering Research, Volume 7, Issue 5, May-2016 663 ISSN 2229-5518*

Iwe, M.O. (2002) Handbook of Sensory Methods and Analysis. Rojoint Communication Services Ltd, Uwani-Enugu.

MajingOloko and Regina Ekpo (2018) Exploring Traditional Weaning practices in North Western Nigeria; Food, Knowledge and Culture: A Step towards Safe guarding Community Food Security*Academic Journal of Interdisciplinary Studies*

Mbata, T. I., Ikenebomeh, M. J., & Alaneme, J. C. (2009). Studies on the microbiologial, nutrient composition and antinutritional contents of fermented maize flour fortified with bambara groundnut (*Vigna subterranean* L.). *African Journal of Food science*, **3**(6), 165–171.

Michaels T.E, (2016) In [encyclopedia of Food Grains (second edition)](https://www.sciencedirect.com/referencework/9780123947864/encyclopedia-of-food-grains)

Norhaizan M. E. &Norfaizadatul A. A. (2009) Determination of phytate, iron, zinc, calcium contents and their molar ratios in commonly consumed raw and prepared food in Malaysia. *Malaysian Journal of Nutrition* 15: 213-222

Obadoni, B.O. &Ochuko, P.O. (2001) Phytochemical Studies and Comparative Efficacy of the Crude Extracts of Some Homeostatic Plants in Edo and Delta States of Nigeria. Global *Journal of Pure and Applied Science*, 8, 203-208.

Ogbonna A. C., Abuajah C. I., Ide E. O., & Udofia U. S (2012) Effect of Malting conditions on the nutritional and anti-nutritional factors of sorghum grist. *Food Technology* 6: 64-

Okoye J.I. & Ene G.I.  (2018), Effects of processing on the nutrient and anti-nutrient contents of tiger nut (*cyperusesculentus* lativum) *Journal of Food Technology and. Food Chemistry*.  Pp. 1-101

Olabode Zainab, Charles Taiwo Akanbi, Babatunde Olunlade& Abiodun Aderoju Adeola (2015) Effects of drying temperature on the nutrients of moringa (moringa oleifera) leaves and sensory attributes of dried leaves infusion, *Direct Research Journal of Agriculture and Food Science (*DRJAFS) vol.3 (5), pp. 117-122.

OluwaseyiAkpor, TunrayoOluwadare, Omotola Taiwo, Bukola Aladenika&OgbenereborAkpor, (2020) Feeding and weening practices among mothers of under-five children in selected Primary Care Health centers in Ado-Ekiti, Nigeria, *Slovak Journal of Food Science*

Omah E.C, Nwaudah E. I, Asogwa I. S and Eze C. R (2021). Quality Evaluation of Powdered Ogi Produced from Maize sorghum And Soybean Flour Blends In Nigeria, *African Journal of Food, Agriculture and Nutrition*. Dev.; 21(10):

Omotesho, O. A., Adenuga, A. H., Dogo, O. J. &Olaghere, I. L. (2019). Assessment of malnutrition and its determinants among under-five children of rural households in Benue State Nigeria, Invited paper presented at the *6th African Conference of Agricultural Economists,* September 23-26,, Abuja, Nigeria

Onoja U. S, Akubor P. I, Gernar D. I. &Chinmma C. E (2014) evaluation of complementary food formulated for staples and fortified with calcium, iron and zinc. *Journal of Nutrition and Food Science* 4: 1-6

Onwuka, G. I. (2005). Food analysis and instrumentation: theory and practice (1st ed.). Lagos: naphthali prints

Osowe C. O., Olowu O. P. A., Adu, O. A. Oloruntola O. D. &Chineke C. A. (2021) Proximate and Mineral Composition, Phytochemical Analysis, and Antioxidant Activity of Fig Trees (Ficus spp.) Leaf Powder, *Asian Journal of Biochemistry, Genetics and Molecular Biology* 9(1): 19-29; Article no. AJBGMB.72261 ISSN: 2582-3698

Ozoka Nneka Crystal (2018) Burden of malnutrition in children under 5 years in Nigeria: problem definition, ethical justifications and recommendations*, Journal of Tropical Diseases*

Pikuda, O. O., &Ilelaboye, N. O. (2013). Proximate and chemical composition Of ogi prepared from whole and powdered grains (maize,.Sorghum and millet). *Annals of Biological Research*, *4*(7), 239–242.

Puteh. Fadilah (2017), Quantitative Data Analysis: Choosing Between SPSS, PLS and AMOS in Social Science Research, International Interdisciplinary *Journal of Scientific Research*, Vol. 3 No. 1 July

Sewa Ram, Sneh Narwal, Om Prakash Gupta, Vanita Pandey & Gyanendra Pratap Singh (2020) Anti-Nutritional factors and bioavailability: approaches, challenges, and opportunities, [*Wheat And Barley Grain Biofortification*](https://www.sciencedirect.com/science/book/9780128184448)*.*

Shomkegh S. A., Mbakwe R. & B. I. Dagba (2016) Utilization of Wild Plants for Medicinal Purposes in Selected Tiv Communities of Benue State, Nigeria: An Ethnobotanical Approach. *European Journal of Medicinal Plants* 14(4): 1-14, 2016,

Shomkegh, Simon Alyegba, Mbakwe Roy &Dagba, Benjamin Ioryem (2013) Ethnobotanical Survey of Edible Wild Plants in Tiv Communities of Benue State, Nigeria, *Journal of Natural Sciences Research*, Vol.3, No.7.

Tharifkhan S.A, Perumal A.B. & Elumalai A., (2021), Improvement of nutrient bioavailability in millets: emphasis on the application of enzymes *Journal of Science. Food and Agriculture.,* 101 pp. 1-10, [10.1002/jsfa.11228](https://doi.org/10.1002/jsfa.11228)

[Uchechukwu Okafor I.](https://pubmed.ncbi.nlm.nih.gov/?term=Okafor%20UI%5BAuthor%5D),[AdebunkolaOmemu M.,](https://pubmed.ncbi.nlm.nih.gov/?term=Omemu%20AM%5BAuthor%5D) [Adewale Obadina O.,](https://pubmed.ncbi.nlm.nih.gov/?term=Obadina%20AO%5BAuthor%5D)[Mobolaji Bankole O.](https://pubmed.ncbi.nlm.nih.gov/?term=Bankole%20MO%5BAuthor%5D) & [Samuel Adeyeye A. O.](https://pubmed.ncbi.nlm.nih.gov/?term=Adeyeye%20SA%5BAuthor%5D) (2018) Nutritional Composition and Antinutritional Properties Of Maize *ogi* Co-Fermented with Pigeon Pea, *Food Science and Nutrition.*  Mar; 6(2): 424–439

[WasiuAwoyale](https://loop.frontiersin.org/people/1104071)Funmilayo Racheal Fadeni& Busie Maziya-Dixon (2024) Influence of adding edible termite flour to *ogi* powder: its chemical and phytochemical composition *Frontiers in Nutrition*