**Evaluation of Amino Acids and Anti-Nutrients Content of *Ogi* From Malted Millet, Soybeans and Fig Leaves Composite Flour**

**Abstract**

*The study evaluates the amino acid and anti-nutrient content of malted millet, soybean, and fig leaf composite flour for ogi production. Ogi* is known to be the common weaning food used by nursing mothers who cannot constantly afford the foreign weaning foods. Most raw materials used in the production of *ogi* are deficient in certain nutrients. 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. 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), Aspertic 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. The study concluded that adding fig leaf flour and soybean flour to malted millet-based ogi improves its nutritional quality.

**Keywords:** Anti-Nutrients, Composite Flour, Ogi, Amino Acid

**1.INTRODUCTION**

“Weaning is the gradual process of introducing an infant to food other than breast milk. The weaning period is a crucial time” (Majingo and Regina, 2018). This is when children are introduced to solid food, and such dietary change can be challenging for them as well as the caregivers 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 a newborn grows older, the demand for nutrients 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 who cannot afford them employ the use of locally produced fermented cereal (which cereals) 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 a need to improve the nutritive value by supplementing with fresh cow’s milk, pawpaw, egg yolk, edible oil and fruits ([Ajanaku](https://scialert.net/fulltext/?doi=ajft.2012.82.88" \l "867517_ja) *[et al](https://scialert.net/fulltext/?doi=ajft.2012.82.88" \l "867517_ja)*[., 2012](https://scialert.net/fulltext/?doi=ajft.2012.82.88" \l "867517_ja)). Ozoka et *al* (2018) suggested that “emphasis on prioritising exclusive breastfeeding for the first 6 months of life is highly essential and appropriate complementary feeding of a healthy diet and breastfeeding 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 these deaths can be prevented. Ogi, a widely consumed fermented cereal porridge in Nigeria and the West African region is typically crafted from maize, sorghum, or millet [1]. It holds a special preference among the elderly as a traditional breakfast cereal and weaning food for infants. Ogi is a popular breakfast cereal gruel in West Africa with high acceptability, low cost and shelf-life stability characteristics(Adebukunola et al. 2015; Eke-Ejiofor et al. 2017). 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 water-soluble carbohydrate (starch extract) from cereal grains with poor storage stability because of its high moisture level”. The consumption of *ogi* by families and infants may pose some nutritional challenges if not complemented since a single cereal like maize is deficient in the amino acid lysine(Joshi et al. 2019; Adepeju et al. 2024). Mixing the cereals as well as the inclusion of spices may enhance the nutritional value as well as improve the taste shell life and health benefits of the products (Olaniran and Abiose, 2019; Akinsola et al. 2021).

Charles *et al.* (2016) reported that *ogi* is usually made from maize grains while Ozabore et al. (2020) reported the production of *ogi* from brown and white sorghum. The two sorghum varieties (brown and white) have been shown 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 foodstuff 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 in malnutrition. As a result, the uses of other plant-based nutrient sources are explored in an 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 fibre, 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 snacks or desserts as well and 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.*

**2.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 in Table 1.

The weaning 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 Analyser (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).

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

Saponin 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 out 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 were analysed 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.

**3.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 – 5.46 mg /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 synthesised in the body and must be supplied in an adequate amount through diets.

The amino acid contents of the samples were evaluated and presented. The results showed a significant (p>0.05) difference for all the samples with a significant increase in amino acid content value. This increase could be a result of an 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 acids 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 were significantly different from 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 not differ from one another at (p>0.05).

[Anti-nutritional factors](https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/antinutritional-factor) 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  [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 utilisation 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 to decrease the digestibility and palatability of protein because they form insoluble complexes with it (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), [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 the 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 the 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 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 phytates are secondary metabolites found in plants which chelate proteins and minerals, thereby inhibiting the bioavailability of proteins and minerals for normal body functioning. their low presence in this study is of high advantage because of 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 crayfish. 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 levels. (Ijarotimi*et al*, 2022) also reported that Saponins are referred to as anti-nutrients, however, clinical studies have shown that they possess beneficial effects on the 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 differences in cultivar, grains used and processing techniques.

Oxalates are phytochemicals that act as anti-nutrients which inhibiting the absorption of calcium and enhancing the formation of kidney stones (Okoye *et al,* 2018). The oxalate content observed in the present study is significantly (*P* < 0.05) lower compared to the National Immunization Schedule (NIS) recommended values (< 2.50 mg/g). The results for oxalate content from this study are 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 was lower than that 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 the oxalate content of this show that the oxalate content is within the 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 |
| Limitodakle podatak  | < 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

**4.CONCLUSION AND RECOMMENDATIONS**

**Conclusion**

The study concluded that adding fig leaf flour and soybean flour to malted millet-based *ogi* improves its nutritional quality. 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. The low antinutrient contents of the weaning food (*ogi*) suggest that the weaning food (*ogi*) will be safe for consumption. The Amino acid profile increased with the increase in the blends. 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.

**Disclaimer (Artificial intelligence)**

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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Details of the AI usage are given below:

1.

2.

3.

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