**Production and characterization of potato (*Solanum tuberosum)* chips produced with Moringa leaves powder and soya bean flour**

**ABSTRACT**

**Aims :** This work aimed at producing and characterizing potato chips containing moringa powder and soya bean flour to adddress micro and macronutrient deficiencies.

**Methodology :** Samples of potato chips with various concentrations of *Moringa oleifera* leaves powder and soya bean flour were prepared and their nutritional parameters, antioxidant contents and sensory properties were investigated.

**Results**: Carbohydrate and moisture contents decreased with the incorporation of either soya bean or *M. oleifera* leaves or both. Fibers and ash contents increased markedly with addition of *M. oleifera* leaves powder and combination of the two ingredients as compared to the control sample. The addition of either soya bean and *M. oleifera* increased the protein and fat contents with the highest effect observed with 15% soya bean and 15 :15 % *M. oleifera* and soya bean. The addition of *M. oleifera* especially from 15% (0.11 ±0.02 mg/100g) and combination (15 :15%) of the two ingredients (0.58 ±0.03 mg/100g) significantly increased the β-carotene content as compared to the 100% potato chips (from 0.01±0.01mg/100g). With reference to the 100% potato chips, supplementation with any of the two ingredients or their combination led to increase of mineral such as iron, calcium and
potassium with the highest mineral obtained with 15 :15 % *M. oleifera* and soya bean (6.0±0.02, 21.97±0.02 and 171.14±1.72 mg/100g, respectively).Potato chips containing soya bean were highly accepted when compared to those containing *M. oleifera*.

**Conclusion**: Moringa and soybean-enriched potato chips display distinct nutritional, antioxidant, and sensory properties. Combined moringa and soy bean-based potato chips demonstrated high nutrient and antioxidant contents that support their potential consideration in the prevention or management of related health affections such as anemia and oxidative stress related disorders within our communities.

**Keywords:** *Moringa, Potato chips, Physico-chemical properties, Soya bean.*

**1. INTRODUCTION**

The production of food items enriched with nutrients from locally available plant material is essential for enhancing the nutritional profile of processed foods particularly in regions and countries facing malnutrition. Food security and malnutrition represent important issues with serious health implications in Cameroon, affecting mostly vulnerable populations. The prevalence of malnutrition varies from one region to the other. In the form of undernutrition, it has a prevalence of 29 % in the Northwest Region, with 32 % stunting and 6.5% wasting (Eyong *et al.,* 2024). Strikingly, this high prevalence of stunting and wasting is associated with high levels of anemia affecting up to 30 % of these individuals (Ejoh *et al*., 2024). More over as other developing countries Cameroon is facing high change in food and lifestyle with increase in metabolic and chronic diseases such as diabetes and cardiovascular disorders (Echouffo-Tcheugui and Kengne, 2011). Mechanistically these diseases are related to elevated oxidative stress and increase supplementation in antioxidants has shown beneficial effects in their management (Chandimali *et al*., 2025).

Potato scientifically known as *Solanum tuberosum* is an important worldwide crop that ranks fourth as the world's largest food crop after maize (corn), wheat, and rice. *S. tuberosum* can be processed into many products with different nutritional attributes and implications (Furrer *et al*., 2018). In Cameroon, the production of *S. tuberosum* has been very steady since 1997 with a global annual production reaching 350,000 tons in 2015 (Tambi and Bobuin, 2023). Potato contains compounds and nutrients including phenolic acids, anthocyanin, flavonoids, vitamin B6, vitamin B3, pantothenic acid, potassium, manganese, phosphorous; copper, and fibres (Anjum *et al.,* 2018). It is easily processed into potato products such as crisps, flakes, canned and mashed potatoes, ready meals, and fried chips (Naziri *et al*., 2024).

On one hand, Moringa oleifera commonly known as Moringa is an edible tree found worldwide that originated from the Himalayas but is also found in the dry tropics, and is increasingly being used for nutritional supplementation. M. oleifera leaves are rich in nutrients such as provitamin A, vitamin C, calcium, potassium, iron, and protein (Abbas *et al*., 2018). It is used for the management of diseases including respiratory illnesses, ear and dental infections, hypertension, diabetes, and cancer treatment. In fact, it has demonstrated potential health benefits which include anti-oxidant, anti-diabetic, anti-microbial, anti-inflammatory, and anti-cholesterol properties (Paikra *et al.,* 2017 ; George *et al*., 2021). On the other hand, *Glycine max* commonly called soya bean is a food with high nutritional value and it is probably the world’s most valuable crop and most used item in livestock feed globally. Soya bean is a source of dietary protein for millions of people and it is used in the manufacture of many items. Owing to this high nutritional value, it is used as a nutritional supplement for pregnant women, lactating mothers, and children (Fabiyi, 2009). Moringa and soya bean due to their nutritional and health benefits are therefore suitable as enhancers for the formulation of foods important in the fight against nutrient-related diseases.

Potato contributes to national food security (Woin *et al*., 2019). Local processing of potatoes can greatly contribute to combating urban malnutrition and food insecurity in Cameroon (Nossi *et al*.,2020). Despite the ability of potatoes to contribute to national food security, it however does not meet the Recommended Daily Intake of micronutrients notably iron levels in humans. On the other hand,*M*. oleifera being an underutilized crop in some areas (Melo *et al.,* 2013) yet containing an exceptional concentration of nutrients (Abbas *et al*., 2018) can be incorporated into food to address nutrient deficiencies (Chan *et al*., 2021; Trigo *et al*., 2023). Also, soya bean being a rich source of high-quality protein and fat, and a good source of energy can therefore be used to address protein-calorie malnutrition (Fabiyi, 2009). This study was therefore designed to produce and characterize potato chips containing Moringa and soya bean as a contribution to the fight against nutrient-related health issues.

### 2. MATERIALS AND METHODS

**2.1.Vegetal material and other ingredients**

Potato (*Solanum tuberosum)* and soya beans (*Glycine max)* were purchased from market sellers at the Bamenda Food Market (North West Region of Cameroon) in April 2024.

Soya bean flour was prepared as described by Raghuvanshi and Bisht (2010) with some modifications. Briefly, whole soya beans were cleaned, grilled for 5 minutes and milled using a household blender. The obtained flour was stored in plastic bags at room temperature until use.

Moringa (Moringa oleifera) leaves were harvested in Bamenda in April 2024, washed, dried under shadow at room temperature. After grinning into fine powder using a household blender and sieved before packaging (Harika *et al*., 2024). The plant materials were identified by Prof. Njouonkou Andre Ledoux, a botanist from the Faculty of Science of the University of Bamenda.

The other ingredients : salt, sugar, milk powder, vegetable oil and cinnamon powder were purchased from market sellers at the Bamenda Food Market (North West Region of Cameroon) in the same period.

### 2.2. Potato chips production

The production of potato chips was done according to the method described by Kiranawati *et al.* (2020) with some modifications. Potatoes were trimmed, washed with potable water, peeled, and sliced into pieces of 6 to 8 mm thickness. The sliced potatoes were boiled (100oC) for 35 minutes and the excess water was removed. The potatoes were pounded to a uniform consistency product.

Then seven samples were then produced as indicated in Table 1:

**Table 1 : Potato chips formulation**

|  |  |  |  |
| --- | --- | --- | --- |
| Sample | Potato flour% | Soy flour(%) | Moringa(%) |
| A | 100 | 0 | 0 |
| B | 90 | 10 | 0 |
| C | 85 | 15 | 0 |
| D | 90 | 0 | 10 |
| E | 85 | 0 | 15 |
| F | 80 | 10 | 10 |
| G | 70 | 15 | 15 |

Thereafter, the following ingredients: salt (1 g), sugar (2 g), milk powder (3 g), vegetable oil (3 mL), and cinnamon powder (0.2 g) were added and after thorough homogenization, 2 g of the mixture were toasted at 140°C for 3 minutes using a toasting machine (Russell Hobbs) to produce chips. The products were allowed to cool before packaging and storage at room temperature.

## 2.3. Nutritional characterization of potato chips

The protein, fiber and moisture contents of the potato chips were determined using the Kjeldahl, gravimetric and drying methods. All macronutrients were quantified as a percentage, representing g per 100 g of dry matter.

**2.3.1 Protein quantification**

One gram of each sample was digested with 10 mL of concentrated sulfuric acid (H2SO4) and a catalyst mixture comprising 0.7 g potassium sulfate and 0.035 g copper sulfate to convert organic nitrogen into ammonium sulfate. After digestion, the obtained solution was distilled with 40 mL of NaOH to release ammonia (NH3), which was then absorbed in a solution of 25 mL of 0.1 N hydrochloric acid (HCl). Phenol disulfonic acid was added to the mixture to develop a colored complex whose absorbance was measured at 410 nm and compared to a calibration curve prepared with known standards at the concentrations 1, to 100 mg/L of nitrogen. The nitrogen content was calculated, and the protein content was estimated. This was done according to the Kjeldahl method (Afnor, 1984) coupled with the method described by Devani *et al*. (1989).

**2.3.2 Fiber content**

The sample (2g) was boiled in 200 mL of 0.128M H2SO4 solution for 30 min under reflux. Then washed with hot water severally using a two-fold muslin cloth to trap the particles which were returned to the flask and boiled again in 200 mL of 0.313M NaOH solution for another 30 min using a few drops of N-octanol as an anti-foaming agent. The obtained sample was washed again with hot water and allowed to drain dry before being transferred to a weighed crucible where it was dried in an oven at 130ºC for 2h. It was subsequently charred in a muffle furnace at 550 ºC for 3 h and finally cooled in a desiccator and reweighed. By difference in weight, the weight of the fiber was calculated (AOAC, 2016).

**2.3.3 Moisture contain**

The sample (2g) was weighed into a dry crucible of known weight and dried at a temperature of 105ºC for 3 h. The sample was cooled in a desiccator and weighed using an electronic analytical balance. Tmorhe whole process was repeated until a constant mass was obtained. The difference in mass (weight of % moisture lost) was then calculated (AOAC, 2016).

**2.3.4 Lipids quantification**

Lipid levels were quantified using the Soxlhet method. Fats were exhaustively extracted from the various samples (5 g each) using petroleum ether in a Soxhlet extractor for 16h. The samples were then filtered in a weighed bakerand petroleum ether removed by evaporation at 80 – 100 °C . After cooling in a dessicator, the baker was weighed and the amount of fat determinated (Harika *et al*., 2024).

**2.3.5** **Carbohydrate content**

Carbohydrate content was obtained by difference considering the other nutrients (ash, fats, proteins) as reported by Mezgebo *et al*. (2018). The percentages of protein, lipids, crude fibre and ash were subtracted from 100 to obtain the carbohydrate content in percent.

**2.3.6 Total calories**

Total calories were calculated as mentioned by Saha *et al*. (2025). The energy in calories was obtained from protein, carbohydrates and fat as 4 Kcal can be produced from 1g of carbohydrate and 1g of proteins and 9 Kcal.

**2.3.7 Ash content**

Ash content was quantified by incinerating 1 g samples at 550°C for 2 h in a muffle furnace, followed by gravimetric analysis (Carpenter, 2010).

**2.4. Determination of mineral and antioxidant contents**

Mineral analysis of potato chips consisted of determination of iron, zinc, potassium and calcium content. It was determinedby Atomic Absorption Spectrophotometer (AAS) as described by Ogbemudia *et al*. (2017). The antioxidant components evaluated were total carotenoids and total phenolic compounds. The total carotenoids were obtained using the AOAC spectrophotometric method as described by Islam and Schweigert (2015) method. Briefly, 10 g of sample were weighed and ground with 10 mL petroleum ether in pestle mortar. Then, 10 mL of 50% acetone were added and shaked vigorously. 5 mL sodium sulphate were then added. A yellow layer was formed and the liquid above yellow layer was taken with pipette and the optical density measured at 450 nm using a spectrophotometer.

The total phenolic compounds were determined using the Folin–Ciocalteu method as reported by Soh *et al*. (2022). Briefly, 0.4% Na2CO3 and 2% NaOH were mixed with the extracted sample. After the addition of 1 N Folin–Ciocalteau reagent, the samples were incubated for 1 h under darkness conditions and the absorbance was read at 750 nm. The total phenolic content was calculated in mg gallic acid equivalents (GAE) per g (mg GAE/100 g of chips) using standard gallic acid calibration graph (concentrations: 2.0–22.0 mg/mL).

## 2.5. Sensory evaluation

The sensory panel was made up of 40 untrained panelists both male and female within the age range of 18-50 years. Each judge was given a sensory evaluation sheet having a 9-point hedonic scale with 1 and 9 corresponding to the appreciation of dislike and like extremely respectively (Nain *et al.,* 2019). Sensory attributes evaluated were: colour, taste, aroma, texture, mouthfeel, crispiness, and overall acceptability.

## 2.6. Statistical analysis

The data obtained were expressed as mean ± standard deviation and were subjected to the Analysis of Variance (ANOVA) followed by the Fischer Test for assessment of any difference among samples. All analyses were done using Statgraphics Plus Version 5.0 statistical package. Differences at the *P*<0.05 were considered significant.

**3. RESULTS and Discussion:**

## 3.1. Appearance of potato chips and sensory attributes

The appearance of the potato chips produced using the incorporation of Moringa leaf powder and/or soya bean.



**A**

**B**

**C**

**D**

**E**

**F**

**G**

**Fig. 1. Different potato chips obtained after processing**

A (100% potato), B (90% potato : 10% soya bean), C (85% potato : 15% soya bean), D (90% potato : 10% moringa), E (75% potato :15% moringa :10% soya bean), F (80% potato : 10% moringa : 10% soya bean), G (70% potato : 15% moringa : 15% soya bean).

The sensory evaluation of potato chips produced with various mixture of soya bean flour and Moringa leaves powder is presented in Table 2. There was a variation in panelists’ perceptions across different attributes with perceptions for samples B (90% potato with 10% soya bean), and C ( 85% potato with 15% soya bean) align with those of sample A ( 100% potato) for all the parameters. They were rated as ‘Like very much’ to ‘Like moderately’. Yet, for samples D, E, F and G, colour perception, aroma, texture were rated as ‘Neither like nor dislike’ to ‘Dislike slightly’ and were significantly different from sample A *(P<.05*). Crispiness and taste were rated as ‘Like moderately’ for sample D. However, there was a non significant decrease in crispiness compared to sample A, B and C and a significant decrease in taste compared to the same samples. Concerning the overall acceptability, sample B had the highest acceptability (8. 25±0.72), followed by sample C (7.7±1.17) and A (7.5±1.24).

These results showed the highest acceptability for the sample made up of 90% potato with 10% soya bean and this is comparable to the good acceptance from sensory evaluation of a soybean chip containing 1% Moringa leaves described by Harika *et al*. (2024). Out of the potato chip samples, those produced with soya bean flour maintained the sensory attributes while the inclusion of Moringa flour tended to lower these properties. The decreased appreciation of Moringa-based potato chips is consistent with the bitterness taste due to the glucosinolates and saponins present in the leaves of this plant (Divya *et al*., 2024).

**Table 2: Sensory properties of the processed potato products.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Sample** | **Colour** | **Aroma** | **Texture** | **Crispiness** | **Taste** | **Overall acceptability** |
| A | 7.7±0.73a | 6.95±1.43a | 7.55±1.57a | 7.45±1.23a | 7.7±0.92a | 7.5±1.24a |
| B | 8.0±0.92a | 7.15±1.46a | 7.8±0.01a | 7.55±1. 23a | 7.95±0.94a | 8. 25±0.72a |
| C | 8.35±1.18a | 7.85±1.03a | 7.35±1. 26a | 7.45±1.34a | 7.5±1.32a | 7.7±1.17a |
| D | 5.2±1.91bc | 5. 2±1.82b | 5.75±1.41b | 6.85±1.41a | 7.1±2.49b | 7.0±1.59ab |
| E | 5.4±1.79bc | 5. 2±1.61b | 5.4±1.78b | 5.45±1.50b | 4.85±2.08b | 4.9±1.48c |
| F | 5.85±1.72b | 5.1±1.74b | 5.5±1.73b | 4.35±1.73c | 4.65±2. 21b | 4.95±1.96c |
| G | 4.7±2.18c | 5.1±1.68b | 4.8±1.85b | 4.2±1.99c | 3.75±2.27b | 4.05±2.04c |

Mean ± SD, values within the same column with different superscript letters are significantly different from each other (*p<.05*). A (100% potato), B (90% potato : 10% soya bean), C (85% potato : 15% soya bean), D (90% potato : 10% moringa), E (75% potato :15% moringa :10% soya bean), F (80% potato : 10% moringa : 10% soya bean), G (70% potato : 15% moringa : 15% soya bean).

## 3.2. Nutritional composition of potato chips

## The proximate composition of potato chip samples is presented in Table 3.

There was a significant decrease in the carbohydrate content with the incorporation of either soya bean or Moringa leave flour or both from 79.7.± 0.11 % in sample A to 61.08±0.14 % in sample G. According to results obtained by Harika *et al*., (2024), sample F (80% potato with 10% moringa and 10% soya bean) presenting 66.57±0.77 % carbohydrate, sample C (85% potato with 15% soya bean) showing 64. 28±0.26% carbohydrate and sample G (70% potato with 15% moringa and 15% soya bean) are low-calorie chips as it can be observed that the carbohydrates percentage is decreasing in the final product compare to sample A (100%potato). Moreover the substantial decrease in carbohydrates particularly upon incorporation of Moringa as observed by Kiranawati *et al*. (2020) could favor the utilization of such formula by people who necessitate the consumption of less starchy foods such as diabetic patients (Reynolds and Mitri, 2024).The decrease in carbohydrate content is accompanied by a significant increase *(P<.05*) in fibers content (from 0.01±0.01 % in sample A to 2.99±0.02 in sample G) which can be beneficial as fiber can improve the nutritional value of the chips, contributing to an improved digestive health and other health benefits like the reduction of blood glucose level and total cholesterol (Saha *et al*., 2025). Except for potato chips with 15% Moringa and 15% soya bean (sample G), supplementation with soya bean or Moringa decreased the moisture content of the potato chips. Globally, the addition of either soya bean or Moringa during potato chips production increased significantly *(P<.05*) the protein and fat contents with the highest content observed with 15% soya bean (sample C) for fats and 15% Moringa and 15 % soya bean (sample G) for proteins. This can be explain by the richness of soya bean in proteins and fats as it is considered as one of the food items containing the most complete proteins (around 40%) and second highest fat content (about 20%) among cereals and legumes (Raghuvanshi and Bisht, 2010).

As compared to other samples, potato chip samples containing soya bean (samples C and B) displayed significant higher amounts of total calories. This shows that incorporating high proteins and fats ingredient like soya bean significantly increases the energy content of te final product. As such, sample C showed a good energy value (Nolla *et al*., 2025) while having a low carbobydrate content.

**Table 3. Nutrient content of the processed potato products.**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Sample** | **Carbohydrates (%)** | **Proteins (%)** | **Fats (%)** | **Fibers (%)** | **Moisture (%)** | **Ash (%)** | **Total Calories** |
| A | 79.7±0.11f | 6.62 ±0. 27a | 7.56±0.56a | 0.01±0.01a | 5.67±0. 22d | 0.44±0.02a | 413. 33±1.96c |
| B | 72.69±0.12d | 10.88±0.10d | 9.07±0.12b | 0.96±0.01b | 5.06±0.04d | 1.35±0.04b | 415.91±0.92c |
| C | 64. 28±0.26b | 12.56±0.07f | 13.94±0.07d | 0.97±0.01b | 4.78±0.02c | 3.47±0.41c | 432± 1.95d |
| D | 70.14±0.11c | 7.92±0.07b | 10.01±0.05c | 1.01±0.01b | 5.74±0.03d | 5.18±0.04d | 402±0.44b |
| E | 74.67±0. 42e | 8.00±0.01b | 8. 20±0.16a | 1.34±0.01c | 2.16±0.01a | 5.62±0.33d | 404.53±1. 25b |
| F | 66.57±0.77b | 9.62±0.32c | 12.02±0.04d | 1.77±0.06d | 3.80±0.09b | 6. 22±0.43d | 412.93±2.08c |
| G | 61.08±0.14a | 11.27±0.08e | 13.04±0.03d | 2.99±0.02e | 5.35±0.33e | 6. 26±0. 27d | 390.80±0.55a |

Mean ± SD, values within the same column with different superscript letters are significantly different from each other (*p<.05*). A (100% potato), B (90% potato : 10% soya bean), C (85% potato : 15% soya bean), D (90% potato : 10% moringa), E (75% potato :15% moringa :10% soya bean), F (80% potato : 10% moringa : 10% soya bean), G (70% potato : 15% moringa : 15% soya bean).

**3.3 Mineral content of the processed potato products**

As presented in Table 4, there was a general significant increase (*P*<.05) in mineral content such as iron, calcium and potassium. There was a concentration increase of all minerals except zinc from sample D to sample G underscoring the mineral increase in potato chips with the addition of Moringa alone or the mixture of both Moringa and soya bean. In contrast, the sample, lacking Moringa and soya bean, consistently had the lowest mineral content.

Ash constitutes the inorganic portion of a given food obtained from the burning of the organic constituents. It is directly proportional to the food's total mineral content ( Adamczyk *et al*., 2024). The increase of the protein, fat, fibers, ash and mineral contents in obtained potato chips could be due to the richness of Moringa and the combination Moringa - soya bean in these nutrients. Consistently authors have revealed a high content of soya bean and Moringa in fibers, proteins, and minerals (Abbas *et al*., 2018; Bayero *et al*., 2019). Comparatively, Moringa is rich in minerals namely K, S, Ca, and Fe with Ca and Fe being highly bioaccessible (Peñalver *et al*., 2022). The increase in mineral content of potato chips containing Moringa and soya bean underscores the effectiveness of Moringa and in mixture with soya bean flour in enhancing food nutritional value and thus a viable strategy for boosting essential minerals.

**Table 4. Mineral content of the processed potato products.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Sample | Fe (mg/100g) | Zn (mg/100g) | Ca (mg/100g) | K (mg/100g) |
| A | 4.95±0.04b | 1.66±0.10d | 19.13±0.36c | 165.89±0.58a |
| B | 4.42±0.19b | 1.23±0.03b | 18.48±0.19b | 168.59±0.07b |
| C | 4.08±0.06a | 1.15±0.02a | 18.03±0.02a | 167.54±0.46b |
| D | 5.25±0.06c | 1.62±0.02d | 20.5±0.07d | 169.98±0.61c |
| E | 5.84±0.11e | 1.36±0.01c | 21.10±0. 12e | 169.9±0.94c |
| F | 5.55±0.03d | 1.54±0.04d | 21.67±0.10f | 171.69±1.15c |
| G | 6.0±0.02e | 1.61±0.01d | 21.97±0.02g | 171.14±1.72c |

Mean ± SD, values within the same column with different superscript letters are significantly different from each other (*p<.05*). A (100% potato), B (90% potato : 10% soya bean), C (85% potato : 15% soya bean), D (90% potato : 10% moringa), E (75% potato :15% moringa :10% soya bean), F (80% potato : 10% moringa : 10% soya bean), G (70% potato : 15% moringa : 15% soya bean).

## 3.4. Antioxidant content of potato chips

The evaluated antioxidant content of the processed chips included β-carotene and total phenolics content (Table 5). As far as β-carotenes are concerned, the addition of Moringa powder and a combination with soya bean significantly (*P*<.05) concentration-dependently increased the β-carotene content of the potato chips. Sample G showed the highest value of Beta- carotene (*P*<.05), follow respectively by samples F and E. The other samples had similar values (*P*>.05). In general, addition of soya bean alone did not have any effect on Beta–carotene of potato chips while the presence of Moringa led to an increase.

As far as phenolic compounds are concerned, Sample C indicated the lowest (*P*<.05) total phenolic content and sample G the highest (*P*<.05). In addition, soya bean alone lowered (*P*<.05) the total phenolic content while it was increasing significantly (*P*<.05) in presence of Moringa.

The essential source of antioxidants in potato chips seems to be Moringa powder rather than soya bean flour as the latter alone displayed a low antioxidant contents in the present processed food. In fact Moringa leaves have been shown to possess noticeable amounts of antioxidants including phenolic compounds and the pro-vitamin A : β-carotene (Ali *et al*., 2022; Peñalver *et al*., 2022). Phenolic compounds are a large group of secondary metabolites containing hydroxyl group on the aromatic ring and displaying different biological functions such as anti-inflammatory, antioxidant, antimicrobial, anticancer, antidiabetic, neuroprotective, and cardioprotective properties (Sauceda *et al*., 2017). Consequently, the present potato chips especially those produced with 15% moringa and with moringa/soya bean (10:15 %) could be promising options for individuals suffering from or at risk of vitamin A deficiency or oxidative stress related diseases.

**Table 5. β-carotene and total phenolic content of processed potato snacks.**

|  |  |  |
| --- | --- | --- |
| **Sample** | **β-carotene (mg/ 100g)** | **Total phenolic content (mg GAE/g)** |
| A | 0.01±0.01a | 14.47±0.31c |
| B | 0.01 ±0.0a | 7.43 ±0.04b |
| C | 0.02 ±0.01a | 5.59±0.03a |
| D | 0.03 ±0.01a | 16.05±0.11d |
| E | 0.11 ±0.02b | 19. 27±0.04e |
| F | 0.32 ±0.05c | 16.69±0.0.13d |
| G | 0.58 ±0.03d | 20.75±0.17f |

Mean ± SD, values within the same column with different superscript letters are significantly different from each other (*p<.05*). A (100% potato), B (90% potato : 10% soya bean), C (85% potato : 15% soya bean), D (90% potato : 10% moringa), E (75% potato :15% moringa :10% soya bean), F (80% potato : 10% moringa : 10% soya bean), G (70% potato : 15% moringa : 15% soya bean).

**5. CONCLUSION**

All together potato chips prepared with the combination (15 : 15%) of Moringa leaves and soya bean powder though moderately appreciated by the panelists display some synergistic traits in enhancing the (micro and macro) nutrient and antioxidant contents. These combined moringa and soy bean-based potato chips constitute promissing basis for possible exploitation as enriched foods for prevention or management of anemia and oxidative stress related health affections within our communities. However, the actual synergistic interaction between the bioactive compounds in both Moringa leaves and soya bean powder still necessitates further investigations.

**Disclaimer (Artificial intelligence)**

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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