VOL. 11 NO. 3,
FEBRUARY, 2026
E-ISSN 3026-8702
P-ISSN 3026-8745

African Scholar Publications & Research International
www.africanscholarpub.com

Journal of Clinical and Metabolism Studies (JCMS)

Effects of Sprouting Duration and Heat Processing on Nutrient Composition and Antinutritional Factors of Moringa Oleifera Seeds

Abafi Majiyebo Joseph[1]; Mohammed Abdulmalik Kudu[1]; Musa Shafii Abubakar[1]; Abdulraheem Gafar Tope[3]; Abdulraheem Aliyu[2]; Bridget Bernard[1]; Lawrence Blessing Arumula[4]; & Micheal George Apasi[1]

[1]Department of Chemical Sciences, Federal Polytechnic, Bida, Niger State, Nigeria.
[2]Department of Biochemistry, Ibrahim Badamasi Babangida University, Lapai.
[3]Department of Biological Sciences, Federal Polytechnic, Bida, Niger State, Nigeria.
[4]Department of Nutrition and dietectics Federal Polytechnic Bida, Niger State, Nigeria
Corresponding Author: abafiyebojoseph@gmail.com
DOI: https://doi.org/10.70382/ajcms.v11i3.035

Abstract

This study examined the influence of germination time and subsequent heat processing on the nutritional composition and antinutritional constituents of *Moringa oleifera* seeds. Seeds were germinated for 24, 48 and 72 h and then subjected to either boiling or controlled low-temperature roasting. Proximate composition, mineral profile and selected antinutritional compounds were quantified using established analytical procedures.Germination markedly improved nutrient density, reflected in progressive increases in protein, lipid and mineral contents, together with substantial reductions in tannins, phytate, alkaloids and oxalate. Protein rose from 27.6 % in untreated seeds to 39.1 % after 72 h of germination, while lipid content increased from 24.0 % to 34.0 %. Iron concentration nearly doubled over the same period. Concurrently, tannins and phytate declined by approximately 50 %, indicating improved nutritional accessibility.Thermal processing produced additional reductions in antinutritional factors, although its effects on nutrients differed by treatment. Boiling effectively eliminated detectable tannins and phytate and reduced oxalate to low levels, but caused measurable losses in protein and lipid

fractions. In contrast, roasting preserved a larger proportion of macronutrients while still lowering antinutrient concentrations.Overall, the results indicate that combining controlled germination with moderate dry heating represents a practical strategy for enhancing the nutritional quality and potential food value of moringa seed flour. Such processing approaches may support the development of nutrient-dense complementary foods and plant-based formulations in resource-limited settings.

Keywords: *Moringa oleifera*; germination; thermal processing; nutrient composition; mineral content; antinutritional compounds

Introduction

Moringa oleifera is a versatile tree, and its seeds are an underused source of edible oil and plant protein. Studies from different regions show that moringa seeds are high in lipids, especially oleic acid, as well as protein and minerals. Consequently, there is growing interest in incorporating moringa seeds into complementary foods and plant-based products (Falowo et al., 2018; Leone et al., 2015; Saa et al., 2022). In areas where high-quality protein is scarce, such as parts of Africa and South Asia, moringa seeds may serve as a valuable local nutrient resource. Despite their nutritional potential, moringa seeds also contain antinutritional compounds including phytate, tannins, oxalate, and alkaloids. These substances can chelate minerals, interact with proteins, and reduce nutrient digestibility, thereby lowering overall bioavailability (Coello et al., 2020; Saa et al., 2022). Lowering these antinutritional factors is therefore important for improving the suitability of moringa seed flour in food applications.

Germination is a simple and accessible method to improve the nutritional quality of seeds and legumes. During germination, endogenous enzymes become active, use stored reserves, create new compounds, and change the seed's structure. These changes usually lead to better protein availability, easier mineral extraction, and lower antinutrient levels (Liu *et al*., 2025). Studies on moringa seeds show similar results: hydropriming and sprouting increase protein and lipid content while reducing phytic acid, oxalate, and alkaloids (Frimpong *et al*., 2025). Other studies have shown that sprouting, especially with soaking or roasting, raises fibre and protein levels and greatly lowers antinutritional factors (Saa *et al*., 2022).

Heat processing represents another practical strategy for improving the safety and acceptability of plant seeds. Boiling can reduce soluble antinutrients through leaching into cooking water, whereas roasting improves flavour, reduces moisture, and helps preserve key nutrients. In legumes, thermal treatments generally reduce phytate, tannin, and oxalate levels while improving mineral availability (Abera et al., 2023). Comparable findings have been reported for moringa seeds, where boiling and soaking

markedly reduce antinutritional factors, and roasting better preserves protein and lipid fractions (Haruna & Zannah, 2023).

Given these supportive effects combining sprouting with mild heat treatment may provide a practical means of improving the nutritional value of moringa seed flour. This study therefore evaluated how different sprouting durations and heat treatments influence proximate composition, mineral content, and antinutritional factors of *Moringa oleifera* seeds, with the aim of identifying suitable processing methods for food applications in contexts such as Nigeria.

STATEMENT OF THE PROBLEM

Moringa oleifera seeds are a promising source of plant protein, oil, and minerals; however, they remain underutilised in food systems. One major limitation is the presence of antinutritional factors such as phytate, tannins, oxalate, and alkaloids, which reduce nutrient bioavailability and may impair digestibility. Although traditional processing methods such as germination and heating can modify seed composition, there is limited locally generated information on how different sprouting durations and heat treatments influence nutrient and antinutrient profiles of moringa seeds. This knowledge gap hinders the development of processing strategies that could improve the suitability of moringa seed flour for complementary foods and other plant-based products. Addressing this gap is important for promoting the use of locally available nutrient sources in regions where access to high-quality protein and micronutrients remains limited.

General Objective

To evaluate the effects of sprouting duration and selected heat treatments on the nutrient and antinutrient composition of Moringa oleifera seeds.

Specific Objectives

- To determine the effect of sprouting for 24, 48 and 72 hours on the proximate composition of moringa seeds.
- To assess the influence of sprouting on mineral content and selected antinutritional factors.
- To examine the effects of boiling and roasting on the nutrient composition of moringa kernels.
- To compare the effectiveness of sprouting and heat treatments in reducing antinutritional factors.
- To identify processing conditions that may improve the suitability of moringa seed flour for food formulation.

Materials

Mature *Moringa oleifera* seeds were obtained from local farmers in Niger State, Nigeria. The seeds were manually dehulled and cleaned to remove broken seeds and foreign materials.

Untreated seeds were retained as the raw control. All chemicals and reagents used were of analytical grade.

Procedure

Approximately 100 g of seeds were soaked in distilled water at a seed-to-water ratio of 1:5 for 12 h at ambient temperature. After soaking, the seeds were drained and spread on sterilised trays lined with moist cheesecloth. Sprouting was carried out at room temperature for 24, 48, or 72 h. Moisture was maintained by lightly misting the samples twice daily. At each interval, the germinated seeds were rinsed, dried in an oven at 60 °C to constant weight, and milled into flour. The resulting flours were stored in airtight containers at 4 °C until analysis.

Heat Treatments

For boiling, 100 g portions of seeds were cooked in distilled water at a seed-to-water ratio of 1:10 at 100 °C for 10, 20, or 30 min with occasional stirring. After heating, the cooking water was drained, and the seeds were air-dried, followed by oven drying at 60 °C before milling.
Roasting was performed by spreading seeds in a single layer on aluminium trays and heating them in a forced-air oven at 90 °C for 10, 20, or 30 min. Samples were stirred midway through heating to ensure uniform exposure. All treatments were carried out in duplicate.

Analytical Methods

Proximate composition, including moisture, ash, crude protein, lipid, and crude fibre contents, was determined using standard procedures of the Association of Official Analytical Chemists (AOAC, 2019). Moisture was measured by oven drying to constant weight (Method 925.09), ash by muffle furnace incineration (Method 923.03), protein by the Kjeldahl method (Method 2001.11) using a nitrogen conversion factor of 6.25, lipids by Soxhlet extraction with petroleum ether (Method 920.39), and crude fibre by acid–alkali digestion (Method 962.09). Carbohydrate content was calculated by difference.
Mineral elements (Ca, P, Fe, Na, K, Mg, and Zn) were determined using atomic absorption spectrophotometry following wet digestion. Antinutritional factors, including tannins, phytate, alkaloids, saponins, and oxalate, were quantified using established colourimetric procedures.

Statistical Analysis

All analyses were conducted in duplicate, and results were expressed as mean ± standard deviation. Data were analysed using one-way analysis of variance (ANOVA), and treatment means were separated using Tukey's test at a significance level of $p < 0.05$.

Effects of Sprouting on Nutrient and Antinutrient Composition

Sprouting significantly altered the proximate composition of moringa seeds (Table 1). Protein content increased from 27.6 % in the raw control to 37.4 % after 24 h and reached 39.1 % after 72 h. Lipid content also rose, peaking at 34.1 % after 24 h and remaining higher than the

control even after prolonged. In contrast, crude fibre and carbohydrate contents declined noticeably, while ash content increased slightly. The overall energy value increased from 374.6 to 467.5 kcal/100 g after 24 h of sprouting.

Mineral concentrations also increased with sprouting (Table 2). Calcium, phosphorus, iron, sodium, potassium, magnesium and zinc were all higher in sprouted samples than in the control. For example, iron rose from 12.3 mg/100 g in the raw seeds to 24.2 mg/100 g after 72 h, while potassium increased from 498 mg/100 g to 687 mg/100 g. These increases likely reflect improved mineral extractability resulting from the breakdown of phytate complexes during sprouting rather than true mineral synthesis.

Antinutritional factors decreased markedly during sprouting (Table 3). Tannin levels declined from 265.3 mg/100 g in the control to 132.7 mg/100 g after 72 h. Phytate decreased from 87.8 to 45.0 mg/100 g, alkaloids from 19.2 to 15.7 mg/100 g, and oxalate from 105.0 to 32.3 mg/100 g over the same period, while saponin levels showed only minor changes. Similar reductions in phytate, tannins and related antinutrients during sprouting of moringa seeds have been reported in controlled studies, often alongside improvements in protein digestibility and functional quality (Frimpong *et al*., 2025; Saa *et al*., 2022; Liu *et al*., 2025).

Table 1. Proximate composition of sprouted *Moringa oleifera* seeds (mean ± SD).

Parameter	Sprouted			
	24 h	48 h	72 h	Control
Moisture (%)	3.11±0.08	4.15±0.08	3.09±0.30	5.00±0.06
Ash (%)	7.90±3.49	7.32±2.34	7.56±1.22	6.30±1.40
Carbohydrate (%)	13.23±2.37	12.20±2.20	14.15±1.23	21.06±3.11
Crude fiber (%)	4.20±0.05	4.24±0.04	6.10±0.04	16.00±0.09
Lipids (%)	34.15±3.33	34.00±2.44	30.01±1.32	24.02±2.34
Protein (%)	37.41±4.05	38.25±3.41	39.09±1.49	27.62±2.33
Energy (kcal/100 g)	467.52	465.58	441.43	374.55

Table 2. Mineral composition of sprouted *Moringa oleifera* seeds (mg/100 g; mean ± SD).

Mineral	Sprouted			
	24 h	48 h	72 h	Control
Calcium (mg/100 g)	271±0.00	300±0.01	323±0.00	310±0.00
Phosphorus (mg/100 g)	192±0.01	394±0.02	437±0.01	131±0.02
Iron (mg/100 g)	15.35±0.02	18.29±0.00	24.18±0.02	12.29±0.01
Sodium (mg/100 g)	47±0.00	65±0.01	88±0.00	25±0.01
Potassium (mg/100 g)	541±0.01	618±0.00	687±0.00	498±0.00
Magnesium (mg/100 g)	318±0.01	356±0.01	407±0.01	309±0.01
Zinc (mg/100 g)	4.20±0.00	6.54±0.01	7.25±0.01	4.94±0.01

Table 3. Antinutrient composition of sprouted *Moringa oleifera* seeds (mg/100g; mean ± SD).

Antinutrient	Sprouted			
	24 h	48 h	72 h	Control
Tannins (mg/100 g)	215.6±0.02	151.9±0.00	132.7±0.01	265.3±0.01
Phytate (mg/100 g)	78.33±0.00	69.76±0.02	45.00±0.02	87.83±0.01
Alkaloids (mg/100 g)	17.3±0.01	16.8±0.01	15.7±0.01	19.2±0.01
Saponins (mg/100 g)	9.2±0.01	9.0±0.01	8.0±0.01	9.8±0.00
Oxalate (mg/100 g)	93.0±0.00	73.8±0.01	32.3±0.01	105.0±0.01

Effects of Heat Processing

Heat treatments produced contrasting effects on the nutrient composition of Moringa oleifera seeds (Table 4). Boiling led to measurable reductions in protein and lipid contents compared with the raw control, with a 30 min boil lowering protein from 32.5 % to 27.9 % and lipids from 17.7 % to 14.6 %. The slight increase observed in crude fibre may reflect concentration effects resulting from the leaching of soluble components during cooking. In contrast, roasting at 90 °C for 30 min largely preserved protein (≈31 %) and lipids (≈16 %) while reducing crude fibre to about 5 %. Apparent increases in carbohydrate content in heat-treated samples likely reflect reductions in other constituents rather than true carbohydrate synthesis.

Heat processing also had a pronounced effect on antinutritional factors (Table 5). Phytate and tannins were not detected after at least 20 min of either boiling or roasting, indicating that thermal processing effectively inactivates or removes these compounds. Comparable reductions of phytate and tannins following moist heat treatments have been widely reported for legumes and oilseeds, where thermal processing promotes degradation of phytate complexes and improves mineral availability (Abera *et al*., 2023).

Oxalate levels in moringa seeds decreased substantially following processing, falling from 14.98 mg/100 g in raw seeds to 5.60 mg/100 g after 30 min boiling and to 7.84 mg/100 g after roasting. The greater reduction observed during boiling is consistent with the high solubility of oxalate and its tendency to leach into cooking water, a mechanism documented in several seed and vegetable systems subjected to moist heat treatment (Abera *et al*., 2023; Ortolá *et al*., 2024).

Table 4. Proximate composition of raw and heat-processed Moringa oleifera seeds.

Parameter	Raw	Boiled 30 min	Roasted 30 min
Protein (%)	32.49	27.87	≈31
Lipids (%)	17.70	14.58	≈16
Crude fiber (%)	9.47	11.05	5.24
Ash (%)	3.85	3.5 (approx)	3.5 (approx)
Carbohydrate* (%)	≈36	≈43	46.63

Table 5. Antinutrient levels in raw and heat-processed Moringa oleifera seeds.

Antinutrient	Raw	Boiled 30 min	Roasted 30 min
Oxalate (mg/100 g)	14.98	5.60	7.84
Phytate (mg/100 g)	Detectable	Not detected	Not detected
Tannins	Detectable	Not detected	Not detected

DISCUSSION

Moringa oleifera seeds produced clear improvements in nutritional composition, particularly through increases in protein and lipid contents, accompanied by reductions in carbohydrate and crude fibre. Such changes are consistent with the metabolic processes that occur during sprouting, where stored carbohydrates are mobilised to sustain respiration and early growth, resulting in a relative enrichment of proteins and lipids (Liu et al., 2025). The accompanying rise in mineral concentrations is likely related to enhanced release of bound minerals as phytate complexes are hydrolysed, improving mineral extractability rather than reflecting true mineral synthesis (Coello et al., 2020; Liu et al., 2025). This observation supports the objective of determining how sprouting duration affects proximate and mineral composition of moringa seeds.

A major nutritional advantage observed in this study was the progressive reduction in antinutritional factors during sprouting. Declines in phytate, tannins, oxalate and alkaloids are consistent with the activation of endogenous enzymes such as phytase and polyphenol oxidase, which hydrolyse these compounds and reduce their binding capacity (Liu et al., 2025). Comparable reductions in antinutrients alongside increases in protein and lipid contents have been reported for moringa seeds subjected to hydropriming and controlled sprouting (Frimpong et al., 2025). Likewise, factorial investigations of defatted moringa flour have shown that soaking, sprouting and roasting can raise protein levels and reduce saponins, phytate, oxalate and alkaloids substantially, while eliminating trypsin inhibitors (Saa et al., 2022). The consistent decline in tannins and oxalate with increasing duration in the present work, therefore, reinforces the effectiveness of sprouting as a simple approach to improve nutrient bioavailability and reduce bitterness in moringa seed products. This aligns with the objective of assessing processing effectiveness in reducing antinutritional factors.

Beyond basic nutrient changes, sprouting may also influence functional properties. Sprouting has been shown to stimulate the synthesis of phenolic compounds and antioxidant constituents in moringa sprouts, enhancing their potential as functional ingredients rather than merely nutrient sources (Cirlini et al., 2022; Núñez-Gastélum et al., 2023). Earlier work also noted that sprouting of moringa seeds can increase protein and lipid fractions while reducing polyphenols, tannins and saponins, further supporting the role of sprouting in improving both digestibility and functional value (Saa et al., 2019).

These findings demonstrate that sprouting is an effective initial step for enhancing the nutritional quality of moringa seeds. Subsequent mild heat treatment, such as roasting, further reduces residual antinutrients while preserving macronutrients, resulting in synergistic

benefits. This combined processing approach can yield moringa flour with increased nutrient density, reduced bitterness and improved functional properties, making it suitable for complementary foods and plant-based formulations for African and Asian populations. This supports the objective of identifying processing conditions that improve suitability of moringa seed flour for food formulation.

Thermal processing altered both nutrient composition and antinutrient levels in the moringa seeds, but the effects differed depending on the treatment used. Boiling resulted in noticeable reductions in crude protein and lipid contents. This outcome is most plausibly linked to the loss of soluble nitrogenous compounds and lipid fractions into the cooking water during prolonged heating. Roasting, by contrast, preserved macronutrients to a greater extent, which is expected given that dry heating limits direct contact with water and therefore reduces leaching. The decline in crude fibre observed after roasting may reflect structural changes in the seed matrix, including partial breakdown of cell-wall polysaccharides during heating.

Both boiling and roasting reduced detectable phytate and tannins, suggesting that thermal treatment either degrades these compounds or makes them less extractable. Similar reductions have been reported in a range of legumes and oilseeds following moist heat treatment, where a combination of leaching and thermal breakdown contributes to the loss of antinutrients (Abera et al., 2023). The stronger reduction in oxalate during boiling compared with roasting is also consistent with the high solubility of oxalate and its tendency to diffuse into cooking water.

Heating may also influence bioactive constituents beyond the traditional nutrient profile. For example, moringin, a characteristic isothiocyanate in moringa seeds, is known to degrade rapidly under hot-water conditions, which may partly explain why boiling can reduce some desirable phytochemicals in addition to antinutrients (Lu et al., 2021). At the same time, moderate dry heating can sometimes increase the measured antioxidant capacity of plant materials by improving the extractability of phenolic compounds or altering their structure (Ortolá et al., 2024). These contrasting effects suggest that processing choices should be guided not only by nutrient retention but also by the intended functional properties of the final product.

When the effects of heat are considered alongside those of sprouting, a complementary pattern emerges. Sprouting improves protein, lipid and mineral profiles while reducing antinutrients, largely through metabolic mobilisation and enzymatic degradation processes (Liu et al., 2025; Frimpong et al., 2025; Saa et al., 2022). Mild roasting applied after sprouting could therefore act as a stabilising step, further lowering residual antinutrients without large nutrient losses. Such a sequence may offer a practical route for producing moringa flour that balances nutrient density, safety and sensory acceptability. In this context, combining sprouting with controlled dry heating appears more promising than relying on either treatment alone, particularly for applications in complementary foods or plant-based formulations intended for regions where nutrient density is a priority.

CONCLUSION

The present study demonstrates that both sprouting and heat processing substantially influence the nutritional composition of *Moringa oleifera* seeds. Germination for up to 72 hours enhanced protein, lipid and mineral contents while reducing major antinutritional factors, including phytate, tannins, oxalate and alkaloids. Heat treatments further lowered antinutrient levels; however, boiling resulted in greater reductions in protein and lipid contents than roasting.

These findings indicate that simple processing approaches can improve the nutritional quality of moringa seed flour. Sprouting appears to be an effective primary treatment for enhancing nutrient density, while mild roasting may serve as a suitable secondary step to reduce residual antinutrients without excessive nutrient loss. The combined use of these treatments therefore offers a practical strategy for producing moringa-based ingredients suitable for complementary foods and other plant-derived formulations. Further work should evaluate the influence of these processing methods on amino acid composition, digestibility, sensory attributes and storage stability, as these factors will be important in determining the acceptability and broader application of moringa seed products.

RECOMMENDATIONS

Sprouting for up to 72 hours is recommended as an effective primary processing method for improving the nutritional quality of *Moringa oleifera* seeds. Where additional treatment is required, mild roasting is preferable to prolonged boiling because it better preserves macronutrients while still reducing residual antinutrients. Processed moringa seed flour may be incorporated into complementary foods and plant-based formulations to enhance nutrient density, particularly in settings where affordable protein and micronutrients are needed. Further research should examine amino acid composition, digestibility, sensory properties and storage stability to support wider food applications and product development.

REFERENCES

Abera, S., Yohannes, W., & Chandravanshi, B. S. (2023). Effect of processing methods on antinutritional factors and their interaction with minerals in kidney beans. *International Journal of Analytical Chemistry*, 2023, 6762027. https://doi.org/10.1155/2023/6762027

Cirlini, M., Caligiani, A., Palla, G., Sforza, S., & Dall'Asta, C. (2022). Sprouts of *Moringa oleifera*: Germination, polyphenols and antioxidant activity. *Molecules*, 27(24), 8774.

Coello, K. E., Frías, J., Martínez-Villaluenga, C., Peñas, E., Cartea, M. E., & Abilleira, R. (2020). Potential of germination to improve the nutritional and bioactive properties of *Moringa oleifera*. *Foods*, 9(11), 1639. https://doi.org/10.3390/foods9111639

Falowo, A.B., Mukumbo, F.E., Idamokoro, E.M., Afolayan, A.J., & Muchenje, V. (2018). Multi-functional application of *Moringa oleifera Lam*. in nutrition and animal food products: A review. Food Research International, 106, 317–334.

Frimpong, R.-A.Y., Affrifah, N.S., Amissah, J.G.N., Agyei-Amponsah, J., Kerler, J., & Saalia, F. K. (2025). Impact of priming and sprouting on the quality and functionality of *Moringa oleifera* seed flour. *International Journal of Food Science*, 2025, 3909494. https://doi.org/10.1155/2025/3909494

Grosshagauer, S., Pirkwieser, P., & Kraemer, K. (2021). The future of moringa foods: A food chemistry perspective. *Frontiers in Nutrition*, 8, 751076. https://doi.org/10.3389/fnut.2021.751076

Haruna, M. A., & Zannah, U. B. (2023). Nutritional evaluation of differently processed *Moringa oleifera* seed before and after oil extraction. *FUDMA Journal of Agriculture and Agricultural Technology*, 9(3), 1–9.

Leone, A., Spada, A., Battezzati, A., Schiraldi, A., Aristil, J., & Bertoli, S. (2015). Cultivation, genetic, ethnopharmacology, phytochemistry and pharmacology of *Moringa oleifera*: An overview. *International Journal of Molecular Sciences*, 16(6), 12791–12835. https://doi.org/10.3390/ijms160612791

Liu, Y., Kai, Y., Huang, D., Liu, S. Q., & Lu, Y. (2025). Germination impact on moringa seeds and sprouts: Biochemical changes and food applications. *Comprehensive Reviews in Food Science and Food Safety*, 24(6), e70296. https://doi.org/10.1111/1541-4337.70296

Lu, Y., Vos, R. D. M., Zhang, Y., & Chen, H. (2021). Degradation kinetics and mechanism of moringin in aqueous solution. *Food Chemistry*, 364, 130424. https://doi.org/10.1016/j.foodchem.2021.130424

Núñez-Gastélum, J. A., Hernández-Mendoza, A., González-Córdova, A. F., & Vallejo-Córdoba, B. (2023). Seed germination and sprouts production of *Moringa oleifera*: A potential functional food. *Journal of the Saudi Society of Agricultural Sciences*, 22(4), 223–230. https://doi.org/10.1016/j.jssas.2022.11.003

Ortolá, M. D., Pageo, S., García-Mares, F. J., Juan-Borrás, M., & Castelló, M. L. (2024). Characterisation of partially defatted moringa seed flour obtained at different temperatures. *LWT*, 198, 115901. https://doi.org/10.1016/j.lwt.2024.115901

Saa, R. W., Fombang, E. N., Radha, C., Ndjantou, E. B., & Njintang, N. Y. (2019). Treatments and uses of *Moringa oleifera* seeds in human nutrition: A review. *Food Science & Nutrition*, 7(6), 1911–1919. https://doi.org/10.1002/fsn3.1059

Saa, R. W., Fombang, E. N., Radha, C., Ndjantou, E. B., & Njintang, N. Y. (2022). Effect of soaking, germination, and roasting on proximate composition and antinutrients of defatted *Moringa oleifera* seed flour. *Journal of Food Processing and Preservation*, 46(3), e16329.