OPEN ACCESS

Journal of Life Sciences

(A Quarterly, Refereed, & Peer Reviewed Journal of Life Sciences)
Published by: AASTEMER, Mumbai, (MS) India
Journal homepage: https://jls.aastemer.org/
ISSN (Online): xxxx-xxxx
Volume 1, Issue 1, December 2025; Pages 12 – 18
DOI: 10.5281/zenodo.17458070

Impact of Cooking on the Nutritional Composition of *Moringa Oleifera* Pods

Vidyaratna Mane, Vandana Dongare, Akshata Desai, Prajakta Choudhari,* Suryakant Wadakar

Department of Biotechnology, Smt. Kasturbai Walachand Arts and Science College, Sangli 416416 Maharashtra, India

Article history:

Received 16 July 2025
Received in revised form
25 September 2025
Accepted 29 September 2025
Available online 05 October 2025

Corresponding author Email:
gavadepj@gmail.com

Abstract

Moringa oleifera is a highly versatile plant known for its nutritional and medicinal benefits. This study analyzed the nutrient composition of *Moringaoleifera* pod powder before and after processing, focusing on total protein, carbohydrates, minerals, total fat, total calories, ash content, and crude fiber. Various analytical techniques, including the Biuret method, atomic absorption spectroscopy, Weende's method, and the Anthrone method, were employed. It was found that, the changes in the nutrient content of *Moringaoleifera* pods before and after processing: Moisture content: Before - 7.7 mg; After - 3 mg, Ash content: Before - 14.67 mg; After - 3.67 mg, Carbohydrate content: Before - 4.92 mg; After - 4.06 mg, Protein content: Before - 3.13 mg; After - 2.34 mg, Fat content: Before - 7.86 mg; After - 4.05 mg, Crude fiber content: Before - 1.50 mg; After - 2.72 mg, Energy value: Before - 102.94 k cal; After - 62.05 k cal.also rich in minerals Potassium (K): Before 4.34 ppm, After 7.01 ppm, Sodium (Na): Before 0.64 ppm, After 0.73 ppm, Calcium (Ca): Before 1.40 ppm, After 1.17 ppm, Zinc (Zn): Before 37.79 ppm, After 19.77 ppm, Iron (Fe): Before 95.17 ppm, After 121.72 ppm, Copper (Cu): Before 6.02 ppm, After 0.00 ppm, Manganese (Mn): Before 88.75 ppm, After 0.00 ppm, Phosphorus (P): Before 1.243 ppm, After 1.009 ppm, Sulfur (S): Before 0.175 ppm, After 0.282 ppm. These findings highlight the impact of processing on *Moringaoleifera* pod powder, suggesting potential alterations in its nutritional profile that may influence its dietary applications.

Keywords: *Moringaoleifera*, nutrition, protein, carbohydrates, minerals.

Introduction

Moringaoleifera is a plant that comes from the *Moringaceae* family and is the most well-known member of its genus. It is the best known of the genus *Moringaoleifera*, which has 13 species.[1] Almost every part of *Moringaoleifera* (leaf, pod, bark, gum, flower, seed, seed oil, and root) has been used to treat various diseases.[2] Moringa is useful for treating conditions such as high blood pressure, anxiety, diarrhea, and as a diuretic. It is also used for dysentery and colitis.[3] It is a source of medicinal compounds and has components of high nutritive value such as protein, amino acids, carbohydrate minerals, vitamin and organic acids. *Moringaoleifera* contains higher amount of vitamin A than carrots, higher extent of vitamin C than oranges, more calcium and potassium content than milk and bananas respectively. Additionally, moringa is richer in iron than spinach by 9 times, also more in fibre than oats by 4 times, and a protein quality similar to that of egg and milk protein, which is more easily digested and absorbed.[4] Phytochemicals present in Moringa leaves include tannins, sterols, terpenoids, flavonoids, saponins, anthraquinones, alkaloids, and reducing sugars. Additionally, they contain anti-cancerous agents like glucosinolates, isothiocyanates, glycoside compounds, and glycerol-1-9-octadecanoate.[5]

The pods of *Moringa* are fibrous and are valuable for treating digestive problems and preventing colon cancer. Research shows that immature pods contain approximately 46.78% fiber and 20.66% protein content. The amino acid content is 30% in pods, 44% in leaves, and 31% in flowers. Moreover, the immature pods and flowers have similar amounts of palmitic, linolenic, linoleic, and oleic acids.[6]

Pregnant women and lactating mothers can safely consume drumsticks. They contain folic acid, which prevents birth defects, and iron, which prevents anemia. Drumsticks can help with morning sickness and low energy during pregnancy. Lactating women can drink drumstick leaves juice with ghee to promote breast milk production.[7]

Recent studies show that different extracts of *Moringaoleifera* have various effects. These include antimicrobial,[8] antifungal,[9] anti-inflammatory, antioxidant, anticancer, fertility-enhancing,[10] wound-healing, and other medicinal properties.[8]

Moringaoleifera ethanolic root extract contains N-benzylethylthioformate, a compound that fights many types of microbes and fungi.[9] The methanolic leaf extract can help prevent urinary tract infections caused by bacteria like Klebsiella pneumoniae, Staphylococcus and minerals, making them a nutrient-dense super food that has been used as medicine for a long aureus, *Escherichia coli, and Staphylococcus saprophyticus*.[11] Drumsticks (*Moringaoleifera*) are low in calories but packed with important vitamins time. This adaptable plant offers many health benefits, showing its versatility and making it a great addition to any diet. In this post, we will look at the nutritional value of drumsticks per 100 grams.

Material and Methods

Sample Preparation

Fresh *Moringaoleifera* pods were sourced from a local farm market. Plant material authenticated at botany Department, Kwcsangli. Pods of uniform size and maturity were selected to ensure consistency in the analysis. Pods were dried before cooking. Pods were cooked, then ground into fine powders both before and after cooking. The powders were stored in airtight containers.

Moisture Content Determination

The method outlined by 12 was used to determine the moisture content of the dried Moringa pod powder. Two petri dishes were each filled with 3 g of powder: one with powder before cooking and the other with powder after cooking. Both petri dishes were then weighed to record the initial weights. The samples were dried in an oven at 100°C for 4 hours. After drying, the petri dishes were weighed again to obtain the final weights. The moisture content of each sample was calculated using the following equation:

Moisture Content (%) = (initial weight of sample - final weight of sample)/(Final weight of sample) × 100

Protein Content (Biuret Method)[13]

Collected two moringa powder samples: before cooking and after cooking. Weighed exactly 10 grams of each sample using an analytical balance. Dissolved each 10 g sample in distilled water, stirring thoroughly until completely mixed. Centrifuged each sample solution to remove larger particles. Filtered the supernatant through muslin cloth to obtain clear solutions. Pipetted 0.5 ml, 1.5 ml, 2 ml, and 2.5 ml of standard moringa solution into separate, clean, and dry test tubes. Adjusted the final volume of each solution to 2.5 ml by adding distilled water. Added 5 ml of Biuret reagent to each test tube containing the moringa solution. Mixed thoroughly to ensure even reaction. Allowed the solutions to stand at room temperature for 30 minutes to ensure complete reaction.Measured the absorbance of each sample, including both the uncooked and cooked moringa samples, using the

colorimeter at 620 nm.

Fat Content

Homogenized 1 gram each of pre-cooked and post-cooked powder with chloroform and methnol in a 2:1 concentration (using a total volume of 20 ml of the solvent mixture). Agitated both mixtures in an orbital shaker at room temperature for 15–20 minutes. Filtered both homogenates using a filtration assembly.Washed the solvent with 4 ml of 0.9% NaCl solution into each 20 ml homogenate and mixed well. Centrifuged each homogenate at 2000 rpm for 10 minutes. Collected the organic phase containing lipids from each sample and added 2.3 ml of this phase to a pre-weighed evaporating dish. Evaporated the solvent at 50°C and reweighed the dish to determine the lipid content. (AOAC)

Ash Content Determination

Using a technique developed by 14, Collected samples of Moringaoleifera pod powder before cooking and after cooking. Weighed exactly 3 grams of each sample and placed them into separate crucibles, heated the samples at 530°C for 3 hours in a muffle furnace. Weighed the residue left after heating to determine the ash content of each sample.

Ash content (%) = (Initial weight of sample - final weight of sample)/(final weight of sample) × 100

Crude Fiber Content

Weighed 2 grams each of the pre-cooked and post-cooked samples and placed them into separate 250 ml flasks. Added 200 ml of 1.25% sulfuric acid (H_2SO_4) to each flask containing the samples. Boiled both mixtures for 30 minutes. Filtered each mixture using filter paper. Rinsed each residue with hot water until the rinse water was no longer acidic (checked with pH paper). Transferred each residue to a 250 ml beaker. Added 200 ml of 1.25% sodium hydroxide (NaOH) to each beaker and boiled for another 30 minutes. Filtered each mixture again and rinsed with distilled water until the rinse water was neutral (checked with pH paper). Moved each residue to a separate crucible. Dried the crucibles with the residues in an oven at 230°C for 2 hours. Cooled the crucibles in a desiccator and weighed them. (AOAC)

Crude Fiber Content (%) = (initial weight of sample - final weight of sample)/(final weight of sample) × 100

Carbohydrates estimates (Anthron method)

Weighed 100 mg each of the pre-cooked and post-cooked moringa powder samples into separate boiling tubes. Hydrolyzed both samples by placing them in a boiling water bath for 3 hours with 5 ml of 2.5 N HCl, then allowed them to cool to room temperature. Neutralized each solution with solid sodium carbonate until effervescence ceased. Adjusted the volume of each solution to 10 ml and centrifuged the mixtures. Collected the supernatant from each and took 0.5 ml and 1 ml aliquots for analysis. Prepared standards for both samples by taking 0.2, 0.4, 0.6, and 0.8 ml of the working standard solution into separate tubes. Marked a blank tube to serve as a control. Made up the volume in each tube to 1 ml by adding distilled water. Added 4 ml of anthrone reagent to each tube. Heated the tubes for 8 minutes in a boiling water bath. Cooled the tubes rapidly and measured the color intensity, which ranged from green to dark green, at 630 nm. Drew a standard graph by plotting the concentration of the standard on the x-axis versus absorbance on the y-axis. Calculated the amount of carbohydrate present in the sample tube using the graph.[13]

Caloric Value Estimation

The total calories were estimated by multiplying the amounts of: Crude protein by its energy value of 4. Crude fat by its energy value of 9. Carbohydrates (excluding crude fiber) by its energy value of 4.12

Calories = (Protein (g) × 4) + (Fat (g) × 9) + (Carbohydrate (g) × 4

Mineral procedure

Sr. no.	Parameter	Formula	Producer
1	Preparation & Processing of Plant sample.	Washing – In Four plastic pots. 1. In Detergent Soln. 0.2 gm Vim in 100 ml tap water. 2. In acid soln. 4 ml HCl + 1 lit tap water. 3. In Single D/W. 4. In Double D/W.	After washing oven dry plant leaf & petiole sample separately at 60 to 70°C & grind & stored in polythene bags in open laboratory.
2	Digestion - Diacid	Stock Diacid - 300 ml Nitric acid + 100 ml Perchlori-cacid.	1 gm petiole sample + 20 ml diacidsoln.till clear, colour-less cool & make volume to 100 ml
3	Potassium % Apr. (2.00 to 3.02) Oct. (1.14 to 2.20)	Reading in ppm × 0.05 (Calculation with dilution factor)	Dil. diacid 1 to 50.Read abs. on flamephotometer.
4	Sodium % Apr. (Lessthan0.5) Oct. (Lessthan0.5)	Reading in ppm × 0.5 (Calculation with dilution factor)	Dil. diacid 1 to 50.Read abs. on flamephotometer
5	Calcium % Apr. (0.98 to 1.36) Oct. (0.74 to 1.14)	Reading in ppm × 0.25 (Calculation with dilution factor)	Dil. diacid 1 to 50. Read abs. on flamephotometer
6	Zinc ppm Apr. (33 to 88) Oct. (53 to 132)	Reading in ppm × 100	Direct diacid ext. run on AAS.
7	Ferrous ppm Apr. (Gre.than 25) Oct. (Gre. than 25)	Reading in ppm × 100	Direct diacid ext. run on AAS
8	Copper ppm Apr. (5.0 to 10.0) Oct. (5.0 to 10.0)	Reading in ppm × 100	Direct diacid ext. run on AAS
9	Mangenese ppm	Reading in ppm × 100	Direct diacid ext. run on AAS
10	Phosphrous % Apr. (0.29 to 0.65) Oct. (0.38 to 0.75)	$\frac{\text{Abs} \times 0.05}{0.077}$ Slope – 0.077	5 ml Diacid ext. + 5 ml vandomolybdate + dil. to 25 ml D/W + Yellow colour + After 30 min. read abs. at 420 nm.
11	Sulphur % Apr. (0.09 to 0.13) Oct. (0.14 to 0.27)	$\frac{\text{Abs} \times 0.01}{0.002}$ Slope – 0.002	5 ml diacid +1ml 6N HCl+ 1 ml Gum acasia + Before reading add 0.5 gm Bari. Chloride & stir 1 min. white turbidity. formed. Imme. Read abs.at 420 nm.

Result:

Nutritional analysis

Proximate analysis and mineral analysis as shown in Table no. 1 and 2.

Sr.no.	Proximate composition	Before cooking of *Moringaoleifera* pod (%)	After cooking of *Moringaoleifera* pod (%)
1	Moisture	7.7	3
2	Ash	14.67	3.67
3	Carbohydrates	4.92	4.06
4	protein	3.13	2.34
5	Fat	7.86	4.05
6	Crude fiber	1.50	2.72
7	Energy value	102.94	62.05

Moringaoleifera pods are highly nutritious, providing a rich source of vitamins and minerals both before and after cooking. The nutritional analysis of *Moringaoleifera* pods highlights the importance of preparation methods. While raw pods are nutrient-dense and rich in vitamins and antioxidants,[15] cooking them can improve their flavor, texture, and digestibility, making them more enjoyable and accessible.

Moringaoleifera pods are a rich source of essential minerals, contributing to their nutritional value and health benefits. These minerals play crucial roles in various bodily functions, including bone health, muscle function, immune support, and overall metabolic processes.

The cooking process can affect the mineral content of moringa pods, with some minerals showing slight reductions, while others, like iron, may become more bioavailable.

Table no. 2: Minerals analysis of *Moringaoleifera* pod

Sr.no	**Mineral**	**Before cooking of *Moringaoleifera* pod (ppm)**	**After cooking of *Moringaoleifera* pod (ppm)**
1	Potassium (K)	004.34	007.01
2	Sodium (Na)	000.64	000.73
3	Calcium (Ca)	001.40	001.17
4	Zinc (Zn)	37.79	19.77
5	Iron (Fe)	95.17	121.72
6	Copper (Cu)	6.02	0
7	Manganese (Mn)	88.75	0.00
8	Phosphorus (p)	1.243	1.009
9	Sulphur (S)	0.175	0.282

Discussion

The study on the impact of cooking on the nutritional composition of *Moringaoleifera* pods reveals significant changes in various nutrient levels before and after processing. Before cooking, the moisture content of the moringa pods was measured at 7.7%, while after cooking, it significantly decreased to 3%. Interestingly, thermally processed moringa pods showed a higher moisture content than their raw counterparts. This increase in moisture can be attributed to the absorption of water during the thermal processing stage, which could heighten the risk of microbial growth. Consequently, the elevated moisture levels in thermally processed pods suggest that appropriate storage measures are essential to mitigate spoilage risks.[16] The ash content, which serves as an indicator of mineral composition and overall food quality, showed a slight reduction in thermally processed moringa

pods, measuring 3.67% compared to 13.67% in the raw pods. This decrease suggests that thermal processing may result in some mineral loss. Moringa, known for its leaves, pods, seeds, and roots, is a rich source of essential nutrients, including proteins, vitamins (A, C, E, and B-complex), minerals (such as calcium, iron, and potassium), and dietary fiber. It is particularly renowned for its high protein content and a wide array of antioxidants.[15]

Cooking resulted in a decline in several important nutrient components, including protein (from 3.13 mg to 2.34 mg), total fat (from 7.86 mg to 4.05 mg), and total calories (from 102.94 kcal to 62.05 kcal). This suggests that cooking may lead to the loss of some beneficial macronutrients. Increase in Crude Fiber: Interestingly, the crude fiber content increased from 1.50 mg to 2.72 mg post-processing, indicating that some processing methods may enhance the fiber content, potentially benefiting digestive health. Mineral Variability: The mineral content exhibited mixed results; while levels of potassium (K), sodium (Na), and iron (Fe) increased after cooking, there were notable decreases in zinc (Zn) and copper (Cu) levels. Specifically, iron content rise from 95.17 ppm to 121.72 ppm, which could be advantageous for dietary iron intake. Decreased Ash Content: The ash content, which reflects the mineral content, showed a significant reduction from 14.67 mg to 3.67 mg, indicating that the overall mineral content may have been diminished by the cooking process, despite some individual minerals showing increases. Iron content in drumsticks has increased from 95.17 ppm to 121.72 ppm, making them a valuable addition to the diet of pregnant women and lactating mothers. These nutritious vegetables provide essential folic acid, which helps in preventing birth defects, and their higher iron content plays a crucial role in combating anemia. Drumsticks can also alleviate morning sickness and boost energy levels during pregnancy. For lactating women, consuming juice made from drumstick leaves combined with ghee may enhance breast milk production.[7]Further studies indicate that the Moringa seed kernel extract can effectively inhibit Bacillus cereus, Staphylococcus aureus, Mucor species, and Aspergillus species, though its efficacy is diminished against Pseudomonas aeruginosa and Escherichia coli. This reveals the potential for using Moringa seed extract in treating infections caused by susceptible species.[17] Moreover, low-dose aqueous extracts from *Moringaoleifera* leaves have been shown to possess anti-diabetic properties by slowing glucose absorption through the intestinal membrane. Research from 2018 indicated that Moringa leaf powder could reduce glucose absorption in diabetic mice, suggesting its potential as an antidiabetic treatment, although further research is essential before it can be fully endorsed as a viable therapeutic option.[15] Emerging evidence also suggests that *Moringaoleifera* may play a role in cancer prevention. A study in 2013 demonstrated that crude aqueous extracts from Moringa leaves could inhibit the growth of A549 lung cancer cells by increasing oxidative stress, leading to DNA fragmentation and inducing apoptosis. These findings underscore the need for further in vivo studies to explore Moringa's anti-tumor effects and identify the active anti-cancer compounds.[19] Lastly, *Moringaoleifera* extracts have been associated with lowering blood pressure and cholesterol levels. Compounds like thiocarbamates and isothiocyanate glycosides in Moringa pods and seeds exhibit anti-hypertensive effects. An in vivo study demonstrated that mustard oil glycosides present in Moringa leaves could reduce blood pressure through tissue relaxation, albeit through mechanisms different from traditional vasodilators like atropine. However, the safety of these compounds warrants further investigation.[20] (Lin et al., 2010). Overall, the nutritional profile of Moringa, rich in proteins and minerals, further underscores its potential as a functional food with diverse health benefits.

Conclusion

Overall, the findings indicate that while cooking can enhance some aspects of the nutritional composition of *Moringaoleifera* pods, such as crude fiber and certain minerals, it can also lead to the loss of key macronutrients like proteins and fats. This suggests that the preparation method can significantly influence the dietary applications of *Moringaoleifera* pods, and those looking to maximize its health benefits should consider these changes in nutrient composition when planning its use in diets. Further research may be warranted to explore optimal cooking methods that preserve nutritional quality while enhancing safety and digestibility.

References

1. Tobias F.L. Moringaoleifera el Árbol de la Nutrición. [(Accessed on 25 January 2021)];Cienc. Y Salud Virtual. 2012 2:130–138.
2. Stohs S.J., Hartman M.J. Review of the Safety and Efficacy of Moringaoleifera. Phytother. Res. 2015;29:796–804.

3. Zhang Y., Peng L., Li W., Dai T., Nie L., Xie J., Ai Y., Li L., Tian Y., Sheng J. Polyphenol Extract of Moringaoleifera Leaves Alleviates Colonic Inflammation in Dextran Sulfate Sodium-Treated Mice. Evid. Based Complement. Altern. Med. 2020;2020:6295402.
4. Rockwood, J. L., Anderson, B. G., &Casamatta, D. A. (2013). Potential uses of Moringaoleifera and an examination of antibiotic efficacy conferred by M. oleifera seed and leaf extracts using crude extraction techniques available to underserved indigenous populations. International Journal of Phytotherapy Research, 3(2), 61-71.
5. Berkovich, L., Earon, G., Ron, I., Rimmon, A., Vexler, A., & Lev-Ari, S. (2013). MoringaOleifera aqueous leaf extract down-regulates nuclear factor-kappaB and increases cytotoxic effect of chemotherapy in pancreatic cancer cells. BMC complementary and alternative medicine, 13, 1-7.
6. A.T.OyeyinkaandS.A.Oyeyinka,"_Moringaoleifera_ as a food fortificant: recent trends and prospects," Journal of the Saudi Society of Agricultural Sciences, vol. 17, no. 2, pp. 127136, 2018.
7. Sánchez-Machado, D. I., Núñez-Gastélum, J. A., Reyes-Moreno, C., Ramírez-Wong, B., &López-Cervantes, J. (2010). Nutritional quality of edible parts of Moringaoleifera. Food analytical methods, 3, 175-180.
8. Mishra G., Singh P., Verma R., Kumar S., Srivastav S., Jha K.K., Khosa R.L. Traditional uses, phytochemistry and pharmacological properties of Moringaoleifera plant: An overview. Der Pharmacia Lett. 2011;3:141–164.
9. Upadhyay P., Yadav M.K., Mishra S., Sharma P., Purohit S. Moringaoleifera: A review of the medical evidence for its nutritional and pharmacological properties. Int. J. Res. Pharm. Sci. 2015;5:12–16.
10. Venkatesh N., Devi K.G., Venkateswarlu G., Sudhakar A.M.S. effect of hydroalcoholic extract of Moringaoleifera leaves on fertility hormone and sperm quality of male albino rats. Int. J. Curr. Med. Pharm. Res. 2019;1:83–87.
11. Maurya S.K., Singh A.K. Clinical Efficacy of Moringaoleifera Lam. Stems Bark in Urinary Tract Infections. Int. Sch. Res. Not. 2014;2014:906843. doi: 10.1155/2014/906843.
12. Rajput H., Prasad S., Srivastav P., Singh N., Suraj L., Chandra R. Chemical and phytochemical properties of fresh and dried Moringaoliferiea (PKM-1) leaf powder. Chemical Science Review and Letters . 2017;6(22):1004–1009
13. David TPlumer. An Introduction to practical biochemistry 1971,1978and1987 page no. 159, 179-180
14. Akubugwo I., Obasi N., Ginika S. Nutritional potential of the leaves and seeds of black nightshade-Solanumnigrum L. Varvirginicum from Afikpo-Nigeria. Pakistan Journal of Nutrition . 2007;6(4):323–326. doi: 10.3923/pjn.2007.323.326.
15. Khan, AsmaSaghir& Ali, Quratulain. (2023). Moringa - The Miracle Tree: An Overview of its Nutritional and Medicinal Properties. Asian Journal of Biochemistry, Genetics and Molecular Biology. 15. 32-44. 10.9734/ajbgmb/2023/v15i3337
16. Mohammad Shareef, RB Kshirsagar, AR Sawate, Syed Zubair, Waghaye SY, BM Patil and Mohammad NisarStudies on physicochemical characteristics of drumstick (Moringaoleifera) PODSJournal of Pharmacognosy and Phytochemistry 2019; 8(2): 433-435
17. Anzano A., De Falco B., Ammar M., Ricciardelli A., Grauso L., Sabbah M., Capparelli R., Lanzotti V. Chemical Analysis and Antimicrobial Activity of Moringaoleifera Lam. Leaves and Seeds.Molecules. 2022;27:8920. doi: 10.3390/molecules27248920
18. Khan W ,Parveen R, Chester Ket al. Hypoglycemic potential of aqueous extract of Moringaoleifera leaf and in vivo GC-MS metabolomics. Front Pharmacol2017.
19. TilokeC ,Phulukdaree A, Chuturgoon AA. The antiproliferative effect of Moringaoleifera crude aqueous leaf extract on cancerous human alveolar epithelial cells. BMC Complement Altern Med2013; 13: 1–8.
20. Lin X ,Racette SB, LefevreMet al. The effects of phytosterols present in natural food matrices on cholesterol metabolism and LDL-cholesterol: a controlled feeding trial. Eur J Clin Nutr2010; 64: 1481–7.