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Research Paper

Bioactive components of moringa oleifera and colocasia leaves and their uses in indian multipurpose cuisine

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ABSTRACT

The aim of this research study is to understand the knowledge, attitude and practice along with the traditional food intake method. The study was carried out on 308 participants of age group from 18-68 years irrespective of gender and occupation through online survey and consumer preferences value added product like premix were experimented and the consumer acceptability was evaluated by sensory techniques. The extracts of leaves and bark significantly suppressed the growth of cultured human multiple myeloma cell lines, whereas the leaf extracts induced cytotoxic effects on human pancreatic carcinoma cells.In conclusion, the present review aims to address the nutritional importance of the plant and its cultivation, post-harvest management, and processing possibilities to prolong the shelf life of fresh corms. The knowledge was high among the participants about consumption of moringa and Colocasialeaves. Colocasia leaves are rich in protein, complementing the high carbohydrate content of the tubers.The leaves of Colocasia esculenta are rich in minerals such as calcium, phosphorus, iron, and vitamins like vitamin C, thiamine, riboflavin, and niacin. The nutritional and anti-nutritional components of taro are essential for maintaining food security and promoting rural development.

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1. INTRODUCTION

Studies have shown that there are many traditionalfoods available in the market nowadays and one of them is the Moinga and Colocasia leaves. Foods is very powerful medicine. It affects you on every level, so the quality of the food you consume determines your body's health. Researchers and scientists are currently studying the benefits of plant phenols and flavonoids in our diets. [1] Studies have shown that they are rich in essential nutrients such as minerals (potassium, zinc, iron, calcium and magnesium), fiber, vitamin C and provitamin A [1]. Phenolic components, such as phenols, flavonoids, tannins, and lignin, are responsible for the vibrant colors, antioxidant potential, flavors, bitterness, aromas, and acidic tastes in plants. [2] Moringa oleifera, a widely used medicinal herb in tropical regions, exhibits diverse therapeutic properties such as anti-inflammatory, anti-tumor, and antioxidant effects. [3] Moringa leaves are rich in vitamin C, calcium, β-carotene, potassium, protein, flavonoids, ascorbic acid, carotenoids, and phenolics. These compounds contribute to their nutritional and antioxidant properties, which can extend the shelf life of fatty foods [4]. Moringa leaves can be consumed in salads, curries, and as seasonings, showcasing their versatility and therapeutic potential. [5] Moringa oleifera is a rich source of antioxidants and vitamins they protect against oxidative stress. Studies suggest a negative correlation between cruciferous vegetable consumption and breast, lung, and colon cancer risk. Moringa leaf extracts have shown inhibitory effects on breast, pancreatic, and colorectal cancer cells, indicating its potential in cancer treatment [6]. Moringa oleifera, a medicinal plant, is abundant in minerals, vitamin E, and polyphenols. Its dried leaves offer protein, fiber, lignin, cellulose, tannins, and polyphenols. Additionally, Moringa leaves exhibit various therapeuticproperties [7]. Moringa oleifera contains phenolic compounds like flavonoids, phenolic acids, and glycosides. These compounds have anti-diabetic, cardioprotective, hypocholesterolemia, hepatoprotective, and anti-asthmatic properties. Moringa leaves also show potential in addressing neuro-dysfunctional diseases like Alzheimer's, epilepsy, and ischemic stroke [8]. Moringa oleifera leaves are being promoted as nutritional supplements to alleviate malnutrition, especially in African countries. These leaves contain amino acids and minerals that can help address nutritional deficiencies [9]. Moringa oleifera contains zeatin, quercetin, β-sitosterol, caffeoylquinic acid, and kaempferol. These compounds have antioxidant effects and potential for treating hyperthyroidism. The prevalence of type 2 diabetes mellitus (DM) is rising due to changes in diet and physical activity.

Interventions targeting the disease have shown positive outcomes in regulating blood glucose levels. These interventions restore enzyme expression, improve liver glycolytic activity, and enhance insulin signaling, thereby reducing gluconeogenesis and glycogen storage. [10] M.O leaves have pharmacological effects and can be used in salads, curries, and as seasoning. They provide nutrients, and can be prepared as a solution, powder, decoction, or infusion. The bioactive compounds enhance flavors. Immature leaves can be consumed directly or cooked, while mature leaves can be dried and powdered. [11] This study explored the potential of Moringa oleifera extracts from leaves, bark, and seeds as potential anti-cancer agents for breast and colorectal cancers [12]. In a study using human KB cells as a cancer model, Moringa Oleifera leaf extract showed strong anti-tumor activity. The extract had significant cytotoxic effects on multiple myeloma cell lines and effectively suppressed the growth of pancreatic carcinoma cells [13]. The literature highlights the diverse potential of Moringa Oleifera (MO) in nutrition, nutraceuticals, water purification, and biodiesel production. MO thrives in temperatures of 25-35°C, direct sunlight, at an altitude of 500m, and slightly acidic to alkaline soil. India, particularly Andhra Pradesh, leads in MO fruit production both in terms of area and quantity [14]. Taro starch, derived from Colocasia plants, has versatile applications in the food industry. It offers low amylose content, high swelling capacity, and stable water and oil retention. This review explores taro starch's composition, functional properties, phytochemical profile, prebiotic potential, probiotic encapsulation, and industrial uses [15]. Green leafy vegetables are nutrient-rich, providing macronutrients, micronutrients, and phytonutrients like calcium, iron, and vitamin A. They are low in fat and high in dietary fiber. Indian Council of Medical Research recommends 50g of green leafy vegetables and 250g of other vegetables daily. Colocasia, or Taro, is a nutrient-dense green leafy vegetable containing iron, zinc, potassium, and copper. It also has bioactive compounds like carotenoids, anthraquinones, and various acids. Colocasia leaves are mineral-rich, but high levels of oxalic and tannic

acid limit their dehydration for food applications [16]. Fresh Colocasia leaves are packed with nutrients, including amino acids, niacin, vitamin C, carotenoids, iron, and minerals. They have a high moisture content and protein levels. However, consuming excessive oxalic acid can lead to urinary tract stones. The study focuses on processing Colocasia leaves using household methods like blanching, soaking, microwave cooking, and cooking, which can be advantageous. Niacin plays a major role in metabolism regulation, preventing and treating hepatic and cardiovascular diseases by inhibiting oxidative stress and enzymes involved in liver triglyceride synthesis. [17] Taro foods are beneficial for individuals with cereal allergies and can be consumed by milk-sensitive infants/children. Studies indicate that babies fed taro-based poi experience reduced health conditions such as diarrhea, pneumonia, enteritis, and beriberi compared to those fed rice and bread. Taro can also serve as a biodegradable additive for plastics [18]. Consuming taro leaves can have anti-nutritional factors like oxalate, which may cause irritation in the mouth and throat. Proper processing, such as boiling, blanching, or steaming, can help reduce these antinutrients. However, cooking can also lead to a reduction in certain mineral elements. To ensure a balanced diet, it's recommended to supplement these minerals from other sources. [19] The nutritional significance and cultivation of taro, along with its post-harvest management and processing options, are crucial for ensuring food security and promoting rural development. Taro is also recognized as a medicinal vegetable, with potential benefits in treating conditions such as tuberculosis, ulcers, pulmonary congestion, fungal infections, and fever regulation [20]. Indeed, further studies are necessary to explore the properties of Moringa and Colocasia leaves, as well as understand the consumption patterns associated with them. This review aims to highlight the nutritional significance of the plant, its cultivation, post-harvest management, and processing techniques to extend the freshness of the corms. It's great to hear that participants already have good knowledge about consuming Moringa and Colocasia leaves!

2. METHODOLOGY

To develop the Moringa and Colocasia leaves premix, the essential components, including whole wheat flour, Moringa leaves, Colocasia leaves, Tamarind, Salt, Chili powder, Dry mango powder, Ajwain, Coriander leaves, Dhana powder, Cumin powder, and Black pepper powder, were obtained from a local wholesale market store. The premix was prepared using an OTG and sealing machine.

2.1. Packaging Materials

The utilization of polymers in various applications, including packaging, has experienced significant growth in recent years. Packaging plays a vital role in preserving the quality and safety of food products by protecting them from oxygen, light, steam, water, and bacterial contamination [21]. In the case of premix packaging, a stand-up zipper pouch made of Low-Density Polyethylene (LDPE) material is commonly employed. LDPE is favored due to its exceptional mechanical properties, effective barrier against water, lightweight nature, cost-effectiveness, and energy efficiency [22]. LDPE exhibits translucency, a waxy texture, and possesses low rates of water vapor and gas transmission. It also demonstrates good chemical resistance, flexibility, and a softening point below the boiling point of water, making it unsuitable for steam sterilization. LDPE can be processed through injection molding, blow molding, and extrusion techniques. It finds wide application in the form of films for food packaging and as bags for frozen products such as vegetables, poultry, and meat. LDPE falls into the category of thermoplastics, which includes polyolefins, vinyl plastics, acrylics, fluorocarbon polymers, and non-ethnic thermoplastics.

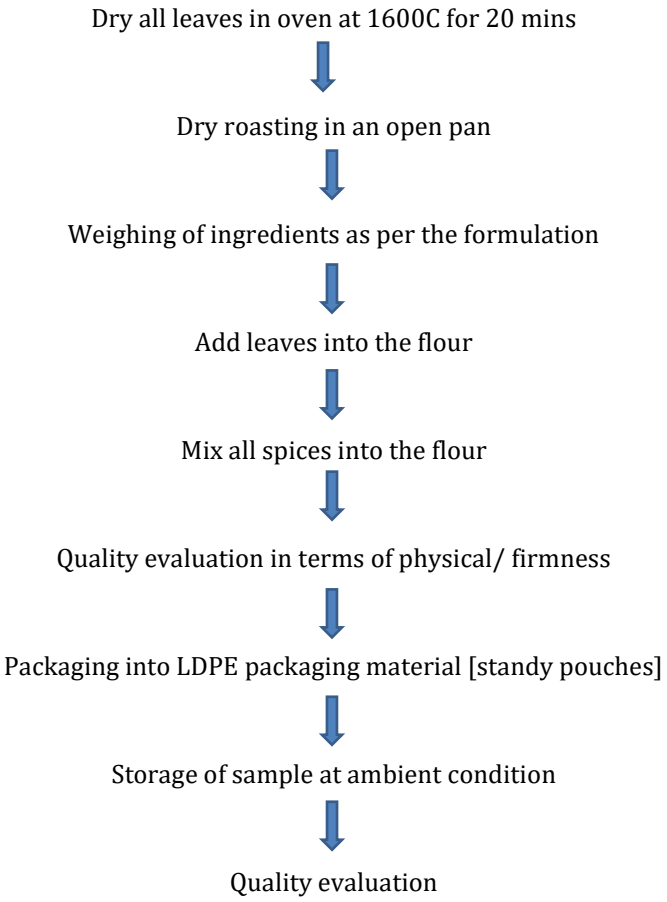
2.2. The Flow Chart Provides a Visual Representation of the Preparation Method

Collection of raw materials



Clean moringa and Colocasia leaves [wash underwater]





2.3. Proximate Analysis, Sensory Analysis and Shelf-Life Study

The proximate analysis included parameters such as ash content, moisture content, acidity, carbohydrate, protein, and energy. Standard methods were used for the analytical tests. For the sensory analysis, 14 untrained panel members evaluated the samples using a 5-point Hedonic Rating scale for taste, odor, texture, appearance, and overall acceptability. The scoring key ranged from 1 (poor) to 5 (excellent). The scoring key used was: 5- Excellent, 4- Very good, 3- Good, 2- Fair, 1- Poor To determine the shelf life of the moringa premix, the sample was stored for 30 days. Moisture content, TPC (total plate count), and sensory analysis were conducted on the 0th, 7th, 14th, 21st, and 28th days.

2.4. Statistical Analysis

The data obtained from the experiment was subjected to an analysis of variance (ANOVA) to assess the statistical significance of the results. The statistical software used for this analysis was SPSS version 22, and a significance level of $p \leq 0.05$ was considered for determining the significance of the findings.

3. RESULTS AND DISCUSSION

The study aimed to investigate the consumption patterns of traditional food, with a specific focus on the consumption of uncommon or lesser-known traditional food. It also examined consumer preferences for value-added products and the development of such products. A total of 308 respondents participated in the survey. The data obtained from the organoleptic evaluation of two trials showed that there was a highly significant difference in taste ($p=0.4$) and odor ($p=0.8$) between the trials. There was a significant difference in texture ($p=0.001$), but no significant difference in appearance and overall acceptability characteristics ($p \leq 0.05$).

Table 1. Organoleptic Evaluation of Multipurpose Premix for Taste, Odour, Texture, Appearance and Overall Acceptable

Characteristics	Mean ± SD		F-Test	P
	T1	T2		
Taste	3.57±0.51	3.42±0.51	47.73	0.46
Odour	3.00±0.78	2.92±0.73	7.85	0.80
Texture	4.35±0.74	3.35±0.74	6.48	0.001
Appearance	4.42±0.51	2.92±0.47	0.00	0.000
Overall-acceptable	4.21±0.69	3.14±0.66	0.00	0.000

Table 2. Result of Proximate Analysis of Colocasia and Moringa Multipurpose Premix

Sr. no	Parameter	Test method	Result
1	Ash	AOAC 942.05	4.94%
2	Moisture	AOAC 930.15	6.30%
3	Carbohydrate	Using formula	117/ 100g
4	Protein	Using formula	33/ 100g
5	Energy	Using formula	680kcal/ 100g

Table 3. Result of Shelf-Life Study of Colocasia and Moringa Leaves Multipurpose Premix

Para- meters	Day 0th	Day 7th	Day 14th	Day 21st	Day 28th
Ash	5.01%	6.012%	5.749%	5.042%	4.941%
Moisture	4.23%	4.553%	5.968%	6.086%	6.307%
TPC	NIL	NIL	NIL	NIL	NIL
Sensory Evaluation	Bitter and Spicy flavor	No changes	No changes	No changes	No changes

Moisture content is a critical parameter in assessing the shelf life of food products. It serves as an indicator of both sensory attributes and product stability, regardless of the sample's initial moisture state. Additionally, the determination of ash content is essential for evaluating the nutritional composition and longevity of food items. By employing Arizona Instrument LLC's Computrac® Moisture/Solids/Ash Analyzers, the process of analyzing moisture and ash content becomes effortless and expeditious, thereby optimizing production efficiency and enhancing quality control measures [23].

4. CONCLUSION

This research study aimed to assess the knowledge, attitude, and practices related to traditional food intake methods. The study involved 308 participants from various age groups and backgrounds, who completed an online survey. The bioactive components identified in Moringa Oleifera and Colocasia leaves have demonstrated their versatility and significance in Indian multipurpose cuisine. These leaves, with their rich nutritional profile, contribute unique flavors and potential health benefits to a variety of dishes. The findings revealed that the extracts of moringa and Colocasia leaves exhibited significant growth inhibition effects on multiple myeloma and pancreatic carcinoma cells, respectively. Furthermore, this review emphasizes the nutritional importance of these plants, including cultivation, post-harvest management, and processing techniques to extend the shelf life of fresh corms. The integration of Moringa Oleifera and Colocasia leaves in traditional Indian cooking highlights the cultural appreciation for their bioactive properties and their potential role in promoting well-being through diet. Further research is warranted to explore the specific bioactive compounds and their mechanisms of action to fully comprehend their potential health impacts.

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Author Contributions Statement

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Ruchika More	✓	✓	✓	✓		✓		✓	✓	✓	✓			✓
Nalini Khatwani		✓	✓		✓		✓		✓	✓	✓		✓	

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

Conflict of Interest Statement

The authors declare that there are no conflicts of interest regarding the publication of this paper.

Informed Consent

All participants were informed about the purpose of the study, and their voluntary consent was obtained prior to data collection.

Ethical Approval

The study was conducted in compliance with the ethical principles outlined in the Declaration of Helsinki and approved by the relevant institutional authorities.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

REFERNCES

[1] N. Mungofa, J. J. Sibanyoni, M. E. Mashau, and D. Beswa, 'Prospective Role of Indigenous Leafy Vegetables as Functional Food Ingredients - PubMed', vol. 27, Nov. 2022. doi.org/10.3390/molecules27227995

[2] U. Sarker and S. Oba, 'Phenolic profiles and antioxidant activities in selected drought-tolerant leafy vegetable amaranth', Sci. Rep., vol. 10, no. 1, p. 18287, Oct. 2020. doi.org/10.1038/s41598-020-71727-y

[3] A. F. Abdull Razis, M. D. Ibrahim, and S. B. Kntayya, 'Health benefits of Moringa oleifera', Asian Pac. J. Cancer Prev., vol. 15, no. 20, pp. 8571-8576, 2014. doi.org/10.7314/APJCP.2014.15.20.8571

[4] A. F. Abdull Razis, M. D. Ibrahim, and S. B. Kntayya, 'Health benefits of Moringa oleifera', Asian Pac. J. Cancer Prev., vol. 15, no. 20, pp. 8571-8576, 2014. doi.org/10.7314/APJCP.2014.15.20.8571

[5] S. Ghimire, L. Subedi, N. Acharya, and B. P. Gaire, 'Moringa oleifera: A tree of life as a promising medicinal plant for neurodegenerative diseases', J. Agric. Food Chem., vol. 69, no. 48, pp. 14358-14371, Dec. 2021. doi.org/10.1021/acs.jafc.1c04581

[6] X. Kou, B. Li, J. B. Olayanju, J. M. Drake, and N. Chen, 'Nutraceutical or Pharmacological Potential of Moringa oleifera Lam', Nutrients, vol. 10, no. 3, p. E343, Mar. 2018. doi.org/10.3390/nu10030343

[7] S. J. Stohs and M. J. Hartman, 'Review of the safety and efficacy of Moringa oleifera', Phytother. Res., vol. 29, no. 6, pp. 796-804, June 2015. doi.org/10.1002/ptr.5325

[8] M. A. Hassan et al., 'Health benefits and phenolic compounds of Moringa oleifera leaves: A comprehensive review', Phytomedicine, vol. 93, no. 153771, p. 153771, Dec. 2021. doi.org/10.1016/j.phymed.2021.153771

[9] F. Anwar, S. Latif, M. Ashraf, and A. H. Gilani, 'Moringa oleifera: a food plant with multiple medicinal uses', Phytother. Res., vol. 21, no. 1, pp. 17-25, Jan. 2007. doi.org/10.1002/ptr.2023

[10] S. Gómez-Martínez et al., 'Moringa oleifera leaf supplementation as a glycemic control strategy in subjects with prediabetes', Nutrients, vol. 14, no. 1, p. 57, Dec. 2021. doi.org/10.3390/nu14010057

[11] S. Ghimire, L. Subedi, N. Acharya, and B. P. Gaire, 'Moringa oleifera: A tree of life as a promising medicinal plant for neurodegenerative diseases', J. Agric. Food Chem., vol. 69, no. 48, pp. 14358-14371, Dec. 2021. doi.org/10.1021/acs.jafc.1c04581

[12] A. K. Al-Asmari, S. M. Albalawi, M. T. Athar, A. Q. Khan, H. Al-Shahrani, and M. Islam, 'Moringa oleifera as an anti-cancer agent against breast and colorectal cancer cell lines', PLoS One, vol. 10, no. 8, p. e0135814, Aug. 2015.doi.org/10.1371/journal.pone.0135814

[13] L. Berkovich, G. Earon, I. Ron, A. Rimmon, A. Vexler, and S. Lev-Ari, 'Moringa Oleifera aqueous leaf extract down-regulates nuclear factor-kappaB and increases cytotoxic effect of chemotherapy in pancreatic cancer cells', BMC Complement. Altern. Med., vol. 13, no. 1, p. 212, Aug. 2013. doi.org/10.1186/1472-6882-13-212

[14] R. K. Saini, I. Sivanesan, and Y.-S. Keum, 'Phytochemicals of Moringa oleifera: a review of their nutritional, therapeutic and industrial significance', 3 Biotech, vol. 6, no. 2, p. 203, Dec. 2016. doi.org/10.1007/s13205-016-0526-3

[15] M. W. Zubair et al., 'Functional profile and encapsulating properties of Colocasia esculenta (Taro)', Food Sci. Nutr., vol. 11, no. 6, pp. 2440-2449, June 2023. doi.org/10.1002/fsn3.3357

[16] A. Kumar, K. Gupta, M. A. Islam Apu, G. S. Abrol, and V. Tomer, 'Effect of household processing on nutritional and antinutritional composition, mineral-mineral ratios, and functional properties of Colocasia leaves', Heliyon, vol. 9, no. 6, p. e17137, June 2023. doi.org/10.1016/j.heliyon.2023.e17137

[17] K. Gupta, A. Kumar, V. Tomer, V. Kumar, and M. Saini, 'Potential of Colocasia leaves in human nutrition: Review on nutritional and phytochemical properties', J. Food Biochem., vol. 43, no. 7, p. e12878, July 2019. doi.org/10.1111/jfbc.12878

[18] Rashmi DR, Raghu N, Gopenath TS, Pradeep Palanisamy, Pugazhandhi Bakthavatchalam, Murugesan Karthikeyan, Ashok Gnanasekaran, Ranjith MS, Chandrashekrappa GK and Kanthesh M Basalingappa Taro (Colocasia esculenta)

[19] N. Muinat, Lewu 1, Patrick O. Adebola 2 and Anthony J. Afolayan 1* Effect of cooking on the proximate composition of seven accessions of Colocasia esculenta (L.) Schott tubers growing in South Africa - PubMed

[20] Melese Temesgen1* Negussie Retta2 Nutritional Potential, Health and Food Security Benefits of Taro Colocasia Esculenta. L.): A Review.

[21] Zikri Noer, Nasrudin MN, Nurdin Bukit, Juwairish, Susilawati Susilawati, Jkhwanuddin Characterisation of low-density polyethylene (LDPE)/ Carbon black (CB) nanocomposite- based packaging material November 2018. Journal of physics conference series 1120(1):012066Doi:10.1088/17426596/1120/1/012066https://www.researchgate.Net/publication/329882488_characterisation_of_lowdensity_polethylene_LDPECarbon_black_CB_nanocomposite-based_packaging_material. doi.org/10.1088/1742-6596/1120/1/012066

[22] B. M. Kyaw, R. Champakalakshmi, M. K. Sakharkar, C. S. Lim, and K. R. Sakharkar, 'Biodegradation of low density polythene (LDPE) by Pseudomonas species', Indian J. Microbiol., vol. 52, no. 3, pp. 411-419, Sept. 2012. doi.org/10.1007/s12088-012-0250-6

[23] https://www.foodonline.com/doc/moisture-and-ash-testing-in-food-processing 0002#:~:text=Moisture%20content%20has%20been%20established,a%20food's%20nutrition%20and%20longevity.

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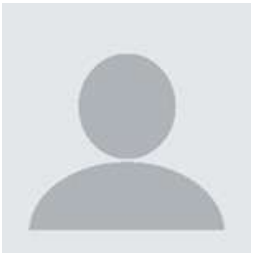
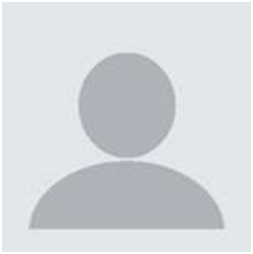
	**Ruchika More,** is a qualified Dietician currently practicing at Cancer Centers of America (CCA) in Nashik, Maharashtra, India a NABH-accredited oncology hospital known for advanced cancer care supported by US Board Certified Oncologists. With a focus on oncology nutrition, she is dedicated to supporting cancer patients through evidence-based dietary guidance. She has contributed to academic research, including a published study on the bioactive components and nutritional properties of Moringa Oleifera and Colocasia leaves, exploring their anticancer and health-promoting potential. Email: ruchikamore299@gmail.com
	**Nalini Khatwani,** is an Assistant Professor at the School of Beauty and Wellness, Symbiosis Skills and Professional University, Pune, India the first skill-building and development university in the state of Maharashtra. The School of Beauty and Wellness upholds the ethos and values of the National Skill Development sector, training students for careers in one of India's fastest-growing industries. She has contributed to academic research in nutrition and food science, co-authoring a published study on the bioactive and health-promoting properties of Moringa Oleifera and Colocasia leaves in Indian cuisine.