

ORIGINAL ARTICLE

Use of *Moringa oleifera* in culinary preparations at the “La Barraca” restaurant from the Hotel Nacional de Cuba

Empleo de *Moringa oleifera* en preparaciones culinarias del restaurante “La Barraca” del Hotel Nacional de Cuba

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Abstract In recent years, interest in multipurpose plants has increased, with *Moringa oleifera*, a member of the Mor-ingaceae family, standing out. Native to the Himalayas, this plant has been widely cultivated in Africa, Central and South America, India, Mexico, Malaysia, Indonesia, and the Phil-ippines. It grows year-round, withstands adverse conditions such as poor soils and extreme climates, and is easy to cul-tivate. This study aimed to evaluate the use of moringa in culinary preparations at the “La Barraca” restaurant from the Hotel Nacional. The level of knowledge about moringa and its culinary use among internal and external customers was analyzed. The chemical composition of fresh moringa leaves and culinary preparations was determined to assess their nutritional contribution. Surveys were conducted to gauge customer satisfaction with these preparations. The results showed a high level of knowledge among customers about moringa and its culinary applications. Moringa leaves and culinary preparations exhibited signi- cantly higher protein, dietary iber, and zinc content compared to values reported in the literature. The preparations were predominantly rated as “like very much” and “like”.

Keywords *Moringa oleifera*, nutritional composition, culi- nary preparations, customer perception, sensory evaluation.

Resumen En los últimos años aumentó el interés por las plantas multiuso, entre las cuales destaca la *Moringa oleife- ra*, perteneciente a la familia Moringaceae. Originaria del Himalaya, esta planta se cultivó ampliamente en África, Centro y Sudamérica, India, México, Malasia, Indonesia y Filipinas. Crece en cualquier época del año, resiste condi- ciones adversas como suelos pobres o climas extremos y su cultivo es sencillo. El objetivo de este trabajo fue evaluar el uso de la moringa en preparaciones culinarias del restaurante “La Barraca” del Hotel Nacional. Se analizó el nivel de co- nocimiento de clientes internos y externos sobre la moringa y su uso culinario. Se determinó la composición química de las hojas frescas de moringa y de las preparaciones culinarias para evaluar su aporte de nutrientes. Se aplicaron encuestas para determinar el nivel de agrado de los clientes hacia estas preparaciones. Los resultados demostraron un alto nivel de conocimiento por parte de los clientes sobre la moringa y su aplicación culinaria. Las hojas de moringa y las preparacio- nes culinarias presentaron un contenido significativamente superior de proteínas, fibra dietética y zinc en comparación con los valores reportados en la bibliografía. Las preparacio- nes recibieron una valoración de agrado mayoritariamente clasificada como “me gusta mucho” y “me gusta”.

Palabras clave *Moringa oleifera*, composición nutricional, preparaciones culinarias, percepción del cliente, evaluación sensorial.

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Introduction

Since ancient times, plants have been fundamental to human and animal nutrition, becoming essential resources in various cultures worldwide. *Moringa oleifera*, known as the tree of life, has stood out for its multiple applications and benefits. Originating from the Himalayas, this species, belonging to the Moringaceae family, is currently cultivated in regions of Africa, Latin America, Asia, and the Caribbean due to its adaptability, resistance to adverse conditions, and ease of cultivation (Pareek et al., 2023).

In recent years, interest in multi-use plants has grown significantly, and *Moringa oleifera* has been the subject of numerous studies due to its nutritional and therapeutic properties. Recent research has highlighted its use as an accessible and low-cost resource to combat malnutrition and prevent various pathologies, thanks to its high content of proteins, vitamins, minerals, and antioxidants found in its leaves, seeds, and flowers (Kashyap et al., 2022; Hodas et al., 2021). Furthermore, various studies have demonstrated its anti-inflammatory, antitumor, and circulatory system-stimulating properties, positioning it as one of the most versatile and valuable species in the scientific and food sectors (Kou et al., 2018).

The trend toward healthier and more nutritious preparations has motivated establishments to incorporate functional ingredients into their culinary offerings in the tourism and gastronomy sectors. This strategy seeks to meet the demands of an increasingly discerning and quality-conscious customer and contributes to the sustainable development of the food industry (Horn et al., 2022). This study aimed to evaluate the use of *Moringa oleifera* in the culinary preparations at the “La Barraca” restaurant, located on the terrace of the Hotel Nacional de Cuba, considering its nutritional contributions and the customers’ perception of these innovative gastro-nomic proposals.

Materials and methods

The level of knowledge about moringa and its culinary use was evaluated through surveys based on the procedure of Espinosa (2015) and designed and validated by the authors. The sample consisted of 80 respondents, and the results were expressed as a percentage of concordant responses.

The selection of culinary preparations with moringa was based on the responses to the previous survey. Culinary specialists from the hotel analyzed the recipes for each dish and evaluated the availability of ingredients and the feasibility of their preparation. The preparations included starters, main dishes, and side dishes. The selected dishes were moringa pasta, fresh moringa salad, moringa lasagna, puff pastry with moringa, stuffed pasta rosettes with moringa, moringa cannelloni, moringa croquettes, cocktails, moringa cream, and fresh moringa bread.

Chemical analyses of moringa leaves and the culinary preparations were performed in duplicate. Moisture, fat, ash by gravimetry, dietary fiber, proteins, and minerals (calcium, iron, and zinc) were determined by the AOAC (2000) methodology. The energy contribution was calculated based on the macronutrients, and the results were compared with the values of similar dishes obtained using the Ceres Plus software.

The level of liking for the moringa preparations was evaluated through a survey designed and validated by the authors. The questionnaires were applied to workers of the Hotel Nacional and external clients who consumed moringa dishes at the “La Barraca” restaurant between February and April 2015. The sample consisted of 66 respondents, and the results of the level of liking were expressed as a percentage of concordant responses. Descriptive statistics were used, calculating position and dispersion statistics (mean and standard deviation), and for statistical analysis, a significance level of $p \leq 0.05$ was used (Castro, 2019).

Results and discussion

The level of knowledge of internal and external clients about moringa and its culinary use was evaluated through a survey applied to 80 adult clients of both sexes. The sociodemographic variables of the study population are shown in Table 1. The majority (58.75%) of the respondents were male. The highest proportion (71.25%) was between the ages of 31 and 60, followed by 20% of respondents between the ages of 61 and 80.

The sample was represented by 22 countries from all continents. The most represented country was Cuba, with 39 respondents (48.75%), while the rest of the nations did not exceed 10%. Canada, Venezuela, Brazil, and England represented 5%. At the same time, Bangladesh, New Zealand, Argentina, Belize, Chile, El Salvador, Colombia, Russia, China, Spain, and Costa Rica only reached 2.5%, and the rest of the countries accounted for less than 1%.

The survey of 40 hotel workers related job characteristics that influence their level of knowledge, including the department each worker belongs to, their role, and years of experience. The application of new trends in the restaurant industry was related to using moringa in various culinary preparations.

It observes that 23 of the respondents belonged to the kitchen and food service area, 8 to accommodation, 5 to the commercial department, and 4 to general services. The distribution highlighted the heterogeneity of the staff. Ninety percent of the staff had between 3 and 30 years of experience, with the majority (35%) working between 11 and 20

years. Work experience provides security to the establishment and contributes to a positive work environment that can ensure stability and service quality.

Table 1. Sociodemographic characteristics of the surveyed population

Sociodemographic characteristic	Frequency	Percentage
Sex		
Male	47	58.75
Female	33	41.2
Age (years)		
20-30	7	8.75
31-60	57	71.25
61-80	16	20
Work area		
Kitchen and gastronomic service	23	57.5
Accommodation	8	20
Commercial department	5	6.25
General services	4	5

Figure 1 shows the responses related to knowledge of moringa and its health benefits. Most respondents were familiar with moringa (87.5%) and its health benefits (80%). These results reflect the growing globalization of moringa as food, medicine, and remedy (Olson & Fahey, 2011).

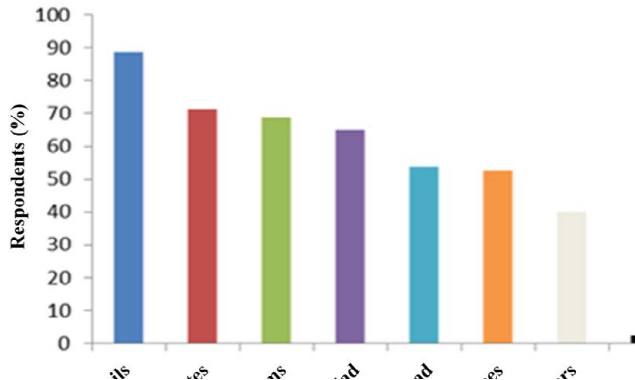


Figure 1. Knowledge and benefits of moringa for health.

The responses indicated a lack of knowledge about moringa in 12.5% of the respondents, and 20% were unaware of its health benefits. Eighty-two percent of the respondents expressed interest in consuming dishes made with moringa, 13% indicated they might be interested, and 5% said they would not consume it; none chose not to consume it for now. These results suggest that culinary preparations with moringa could be incorporated into the menus of various gastronomic establishments. Including these dishes could have a high weekly frequency in the diet of the studied age group.

The survey asked about the culinary preparations the respondents would prefer moringa to be used. The responses are shown in Figure 2. The questionnaire offered six types of

culinary preparations, and the respondents could select more than one alternative in each case. The highest number of responses was for cocktails, with 71 clients (88.75%); this response should be considered when creating new offerings in the bar area. Preparations such as croquettes, creams, broths and soups, salads, breads, and accompanying sauces showed response percentages above 50%. These dishes could be prepared and then subjected to an evaluation of acceptance and preference by customers.

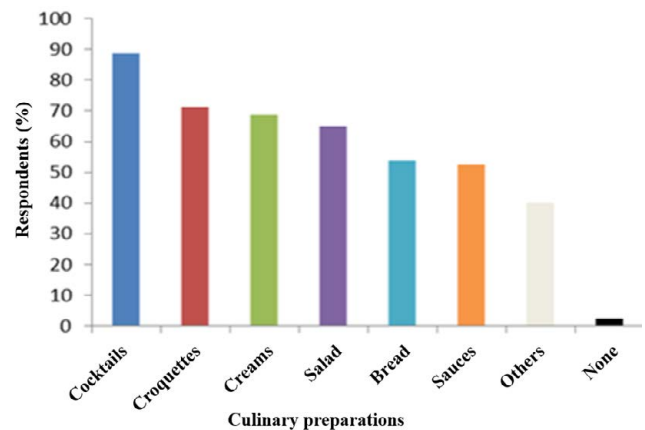


Figure 2. Percentage of respondents according to the types of culinary preparations selected.

The respondents expressed their willingness to accept and try other culinary preparations with moringa, which would open the possibility of expanding the range of products with this plant. The inclusion of these dishes on the menu of any restaurant reflects a shift towards applying new trends in gastronomy, offering a healthier product that meets all the qualities needed to provide a pleasant culinary experience

(Romani-Bendeg et al., 2021). The chemical determinations of the moringa leaves are shown in Table 2.

Table 2. Chemical composition of the leaves of *Moringa oleifera*

Componente	Masa (en base 100 g moringa fresca)
Energy (kcal)	52.59
Moisture (g)	77.29
Protein (g)	8.8
Fat (g)	1.31
Carbohydrates (g)	10.36
Dietary Fiber (g)	8.96
Ash (g)	2.24
Iron (mg)	2.91
Calcium (mg)	368
Zinc (mg)	2.43

The energy value of 100 g of fresh moringa did not match the value reported by Martín et al. (2013); however, its caloric contribution was higher than 50 kcal/100 g, a result that aligns with the available literature (72 kcal). The protein content exceeded the 6.7 g reported by Alvarado-Ramírez et al. (2018), confirming the high protein level in moringa and its essential amino acids contribution. The moisture content

was also above the reference value (James, 1987). The fat and carbohydrate contents were slightly lower than those reported in the literature (Alvarado-Ramírez et al., 2018).

The ash, iron, and calcium values were lower than those of Carbajal (2013). Consuming this vegetable provides important micronutrients that positively contribute to maintaining human health. The dietary fiber value of 8.86 g/100 g of fresh leaves positions the plant as a source with high nutritional value. Moringa is an inexpensive and available year-round source of this element, offering benefits for preventing coronary diseases (Chin-Chan et al., 2021).

Zinc is found in the moringa leaves, and this compound is beneficial for the immune system and wound healing. It also plays a role in protein metabolism and the transport of vitamin A to the retina (Maywald & Rink, 2022). The variability in the chemical composition results may be attributed to factors such as cultivation conditions, soil type, environmental conditions, harvesting time, and the plant's age (Patil et al., 2022).

Table 3 presents the chemical composition of the culinary preparations with moringa. These values reflect the combined contribution of all the ingredients, including moringa. An increase in energy values was observed in nine of the preparations, possibly related to adding fats such as pastry lard, butter, and flour; this could also explain the variations in carbohydrate and fat content.

Table 3. Chemical composition of culinary preparations with moringa

Component (100 g fresh moringa)	Moringa	Pasta	Salad	Lasagna	Cake	Rosette	Cannelloni	Croquettes	Fresh pasta	Cream	Bread
Energy (kcal)	52.59	59.52	38.05	243.73	342.61	256.87	263.3	282.78	192	77.16	267.66
Moisture (g)	77.29	83.55	91.51	56.66	37.96	52.96	53.63	49.61	57.11	84.21	34.07
Protein (g)	8.8	9.11	1.33	8.26	8.46	9.53	8.24	4.7	6.45	0.99	11.17
Fat (g)	1.31	1.32	1.37	15.69	20.37	15.59	17.22	17.22	5.52	4	2.06
Carbohydrates (g)	10.36	4.8	5.1	17.37	31.36	19.61	18.84	27.25	29.13	9.3	51.11
Dietary Fiber (g)	8.96	2.5	0	0	0	0	0	0	0	0	0
Ash (g)	2.24	1.22	0.69	2.02	1.85	2.31	2.07	1.22	1.79	1.5	1.59
Iron (mg)	2.91	2.51	0.44	1.6	2.45	1.87	1.52	2.62	3.92	.	6.04
Calcium (mg)	368	343	16.57	38.5	31.43	79.21	75.43	11.8	6.9	0	14.2
Zinc (mg)	2.43	2.58	3.08	3.06	2.32	0.79	0.7	0.6	2.44	0	0.85

In the culinary preparations that required cooking after the addition of moringa (lasagna, pastry, rosetta, cannelloni, croquettes, and bread), a decrease in moisture content was observed due to the cooking methods used. The reduction in protein content in the fresh vegetable salad, croquettes, fresh pasta, and cream was mainly attributed to the quantity and ingredients contributing to this nutrient. A variable chemical composition was observed in each preparation, which was

related to the type of preparation, the nature and quantity of the ingredients, and the cooking method used.

The incorporation of moringa into culinary preparations to increase their nutritional value was evaluated by comparing some of these preparations with others of similar type in the Ceres Plus program. Table 4 presents the composition and comparison of both types of preparations.

Table 4. Comparison of moringa preparations and similar dishes

Component (100 g fresh moringa)	Vegetable salad	Fresh salad	Fresh pasta	Moringa lasagna	Cake	Moringa cake	Cream	Moringa cream	Soft crust bread	Moringa bread
Energy (kcal)	19	38.05	192	243.73	450	342.61	17	77.16	287	267.66
Moisture (g)	94	91.51	57.11	56.66	25	37.96	96.5	84.21	33.4	34.07
Protein (g)	1.30	1.33	6.45	8.26	3.5	8.46	1.5	0.99	6.7	11.17
Fat (g)	0.2	1.37	5.52	15.69	27	20.37	0.6	4	2.7	2.06
Carbohydrates (g)	3.9	5.1	29.13	17.37	44	31.36	1.4	9.3	57.2	51.11
Iron (mg)	1.3	0.44	3.92	1.6	0.69	2.45	1	0	0.54	6.04
Zinc (mg)	0.4	3.08	2.44	3.06	0.1	2.32	0.3	0	0.54	0.85
Calcium (mg)	84	16.57	6.9	38.5	13	31.43	8	0	11	14.2

The values of energy, protein, fat, carbohydrates, and zinc in the moringa vegetable salad were higher than those of the regular vegetable salad, demonstrating the nutrient contribution of the moringa plant. The other nutrients in the moringa preparation were lower than in the vegetable salad. The moringa lasagna had a higher protein, fat, zinc, and calcium content, providing more energy. A similar behavior was observed for the pastry.

The moringa cream had a lower nutrient content than the traditional cream, which could be related to its dilution and the amount of moringa used in this preparation. The moringa cream did not contain calcium, iron, or zinc, while these nutrients were present in the traditional cream; from a nutritional perspective, this preparation is not recommended.

Soft moringa bread had a better nutrient contribution than traditional soft bread, confirming the nutritional properties of this plant and positioning it for use in restaurants to offer healthier products, which is in line with new trends. The products with the best nutritional characteristics were the fresh salad and the soft bread with moringa, which are more nutritious alternatives that are always part of a good table.

When evaluating the level of enjoyment of internal and external clients for the culinary preparations, it was found that of the 66 respondents, 40.9% were women, and 59% were men; 33.3% were in the 41 to 50 age range, followed by those between 31 and 40 years (24.24%). The majority were of Cuban, Chilean, and Argentine nationality (71.21%), followed by the United States with 16.66%.

Clients' most consumed culinary preparations with moringa were croquettes (92.4%), vegetable salad (71.2%), and bread (62.1%). The high acceptance of these products allows their inclusion in the restaurant menu, considering that more than 60% of the respondents agreed to request these offerings.

Clients expressed their enjoyment of the culinary preparations regardless of the type of preparation. The most selected

category concerning the enjoyment of culinary preparations was "I like it a lot" (33%), followed by "I like it" (19%). The responses for "I like it extremely" and "I neither like nor dislike" were 4% and 6%, respectively. The lowest level of enjoyment corresponded to the categories "I dislike it" (2%) and "I dislike it a lot" (1%). Although the results were acceptable, further work should be done to improve the sensory quality of moringa-based preparations to increase client satisfaction.

The consumption frequency of culinary preparations with moringa showed that 39% preferred to consume these preparations two or three times a week, 23% on specific occasions, and 15% daily. The lowest frequency was recorded for "rarely" (12%) and "weekends" (11%).

Overall, the consumption frequency results indicate an interest among the respondents in moringa-based preparations, which is favorable for the restaurant. This justifies the inclusion of these preparations in the menu and drives it toward a modern, natural, and highly competitive restaurant scene.

Conclusions

The knowledge of internal and external clients about moringa and its culinary use was high. The chemical composition of moringa leaves and culinary preparations stood out for their higher protein, dietary fiber, and zinc content than the values reported in the literature, supporting their nutritional potential. Culinary preparations with moringa received a positive evaluation, with the categories "I like it a lot" and "I like it" predominating. The highest willingness to consume was associated with a frequency of "two or three times per week".

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Conflicts of interest

The authors declare that they have no conflicts of interest.

Author contributions

Conceptualization: Yudenis Reyes. **Data curation:** Maylin L. Fernández, Yudenis Reyes. **Formal analysis:** Maylin L. Fernández, Yudenis Reyes. **Research:** Maylin L. Fernández, Yudenis Reyes. **Methodology:** Yudenis Reyes. **Software:** Maylin L. Fernández. **Supervision:** Yudenis Reyes. **Validation:** Yudenis Reyes. **Visualization:** Maylin L. Fernández. **Writing the original draft:** Maylin L. Fernández, Yudenis Reyes. **Writing, review and editing:** Maylin L. Fernández, Yudenis Reyes.

Data availability statement

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Statement on the use of AI

The authors acknowledge the use of generative AI and AI-assisted technologies to improve the readability and clarity of the article.

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