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ORIGINAL RESEARCH PAPER

MORINGA OLEIFERA, FUNCTIONAL INGREDIENT: NUTRITIONAL PROPERTIES AND HEALTH BENEFITS

Petronela-Elena Buruiana, Roxana Filip*, Valentina Amaritei, Roxana-Elena Gheorghita

Stefan cel Mare University of Suceava, Faculty of Medicine and Biological Sciences, 720229, Suceava, Romania

*Corresponding author: roxana.filip@usm.ro

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Abstract: *Moringa oleifera* is a tropical plant that provides various nutritional benefits in nutrition and medicine. It is a popular ingredient in fortified staple foods due to its antioxidant, anti-inflammatory, and anti-carcinogenic properties. This study aims to assess the acceptability of the plant among students and its perceived properties. Thus, 44 subjects, divided into two groups (22 in each group) were included in this study. For ten days, each group consumed 5 or 10 grams of moringa per day. Throughout the study, the subjects completed two validated questionnaires: the first one was distributed before the consumption and the second questionnaire after the intended period. The results obtained at the end of the study showed that both groups of consumers noticed beneficial effects on physical well-being and intellectual activity. However, people who consumed 10 g of moringa experienced more noticeable effects due to its powerful effect on concentration, well-being and the elimination of factors that cause fatigue, compared to the consumption of 5 g of moringa, where the majority of respondents stated that they did not feel any effect due to the low dose ingested.

Keywords: *bioactive, food supplement, health, moringa, vegan*

INTRODUCTION

Moringa oleifera is a plant grown in tropical and subtropical countries [1] that belongs to the *Moringaceae* family. It can withstand severe drought conditions, but also frost conditions. Due to its high nutritional value, every part of the plant such as leaves, flowers, roots, seeds, even the rind is used for both nutritional and commercial purposes [2, 3]. It grows on all types of soil, but the most suitable is loamy and sandy soil with a *p*H between 5 and 9 [4].
The *Moringa oleifera* tree is also called the "*Miracle Tree*" because of its extensive practical and nutritional benefits, being involved in disease healing [5]. Due to its high content in essential amino acids, proteins and micronutrients, it is considered a valuable food supplement [6].
Nowadays, moringa leaves are known for their nutritional benefits [7]. In poor rural communities in South America, the leaves are introduced as a supplement in baby porridge and even consumed by nursing mothers [8]. They are one of the main edible parts of the plant and a main source of plant protein [9]. Moringa seed powder is used for water purification and can replace chemicals commonly used for this purpose [10]. The flowers can be used as a source of antioxidants, due to their high levels of phenols and flavonoids [11]. The rind of *Moringa oleifera* has antisecretory potential and antiulcer activity, and some studies state that, in the near future, it could be used as a medicine [5].
In countries such as India and Africa, the young pods of the tree are eaten as vegetables in various dishes, tasting like asparagus, and the mature pods are used in soups and stews [12].

Nutritional composition of Moringa oleifera

Moringa oleifera is rich in nutrients such as protein, fiber, minerals - calcium, potassium, phosphorus, zinc, iron in substantial variations, with an important role in human nutrition [13, 14]. It also contains vitamin A, B, C, E, and essential amino acids [15]. The B-complex vitamins found in *Moringa oleifera* are thiamine, niacin and riboflavin. Their concentration in leaves varies between 0.06 and 0.6 mg/100 g for thiamine, 0.8 mg/100 g for niacin and 0.17 mg/100 g for riboflavin [10]. *Moringa oleifera* provides more vitamin C, vitamin A and calcium than oranges, carrots and milk [2].
The bioavailability of the chemical composition of *Moringa oleifera* is higher compared to other plants because most of the moringa's compounds are found in glycosylated form and are more easily absorbed by epithelial cells [16].
The raw protein level in plant leaves ranges from 23 to 30.3 % [17]. The main amino acids components present include threonine, tyrosine, methionine, valine, phenylalanine, isoleucine, leucine, histidine, lysine and tryptophan [18].
Studies indicated that the fiber content in this food is significant, ranging from 19 to 37 % per 100 grams [15].
Moringa leaves are high in minerals such as calcium, iron, potassium, phosphorus and zinc [9]. In addition to their mineral content, plants also contain phytochemicals. These non-nutritive chemicals have protective and disease-preventing roles [18].
Moringa leaf extract, due to its high phenolic content, exhibits a significant antioxidant capacity [19].

Polyphenols are found in large quantities in *Moringa oleifera* leaves and the main compounds are flavonoids and flavonoid acids. The quantity of polyphenols fluctuates depending on various factors such as the time of harvest, environmental conditions, method of leaf drying, season of harvest, and stage of leaf maturity. The concentration of flavonoids in dried leaves ranges from 5.06 to 12.16 mg/100 g, with myricetin and quercetin being the primary flavonoids found in moringa [20]. Phenolic acids, abundant in fruits, vegetables, moringa leaves, and dried leaves, possess antioxidant, anticarcinogenic, anti-inflammatory, and antimutagenic properties [10, 21].
Quercetin and flavonoids are found in moringa and used in foods, beverages, supplements and has antioxidant and anti-inflammatory properties [22]. The extract of these leaves has been shown to scavenge free radicals and have antioxidant activity [23].

Health benefits of Moringa oleifera consumption
Health benefits of *Moringa oleifera* consumption and its effect in treating various diseases are presented in Figure 1.

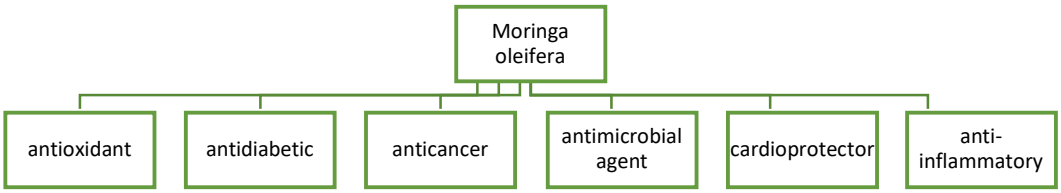


Figure 1. *Health benefits of Moringa oleifera* [24]

Diabetes mellitus is a chronic disease-causing tissue and vascular damage, retinopathy, neuropathy, nephropathy, vascular complications, and ulceration. Type 1 diabetes requires insulin replacement, while type 2 diabetes is more common due to abnormal insulin secretion and resistance. Diabetes mellitus is a chronic disease-causing tissue and vascular damage, retinopathy, neuropathy, nephropathy, complications, ulceration, and requires insulin replacement in type 1 and type 2 patients. Some studies have shown that moringa leaf extract could be used to treat type 1 and type 2 diabetes [6].
Cancer is a prevalent disease with no single cause, influenced by factors like smoking, radiation exposure, and lack of exercise, and treatments like chemotherapy or radiation are costly and can cause side effects. *Moringa oleifera* leaf extracts are antioxidants that inhibit oxidative reactants [2] and may be used as an anti-cancer agent as they are natural and safe in certain concentrations. There are studies that have shown that moringa inhibits the growth of cancer cells, which is why it could be used as an anti-neoplastic agent [25, 26]. The oxidants produced by moringa target only malignant cells, making it an anti-cancer agent [2].
Phenolic compounds in moringa leaves have been associated with antimicrobial and antifungal activity, as the leaves are the part of the plant with the highest amount of compounds [27]. *Moringa oleifera* also acts to control the growth of micro-organisms when added to food, extending the shelf life of the product. Moringa roots have antimicrobial properties and are considered to be rich in antibacterial agents. Studies have found that moringa rind extract is reported to have antifungal effects and rind and

stem extracts are reported to have effects against *Staphylococcus aureus* and *Enterococcus faecalis* [28].
Moringa oleifera also has a role in liver protection, antioxidant and anti-toxic effects due to the concentration of polyphenols found in its leaves and flowers. Moringa oil can restore liver enzyme activity to normal levels by reducing oxidative stress. The flowers and roots of moringa contain a compound called quercetin, which protects the liver [28].
Moringa oleifera is a plant with significant antioxidant activity and can be used to treat neurological disorders. Moringa leaf extract, known for its antioxidant properties, can help improve memory and prevent oxidative stress, which are linked to neurological disorders in the central and peripheral nervous systems [29].
Cardiovascular disease is the leading cause of death worldwide. Herbs have long been used to treat cardiovascular disease due to their ability to act as antioxidants, vasodilators and platelet activating factor antagonists [6]. Studies showed that moringa leaf powder has heart health benefits, intervenes in blood lipid control, prevents atherosclerotic plaque formation and keeps cholesterol levels low [5].

Moringa oleifera and food industry

Research is currently being conducted on the development of functional foods that contain moringa to increase accessibility and consumption. According to expert studies, the addition of moringa to food products such as bread, bakery items, dairy products, beverages, and snacks has the potential to improve their nutritional content, including protein, fiber, minerals, and vitamins [30].
Food fortification aims to enhance the nutritional composition of staple foods in the diet without altering sensory properties, as consumers' initial attraction to food's sensory aspect can affect product acceptability [13, 31]. The food industry has made efforts to develop affordable products that incorporate moringa, such as bread [32 – 34], biscuits [35], yoghurt [36], cheese [13], sweets [37], or smoothies [38].
The quality of bread in many countries is influenced by various factors, including colour, crust texture, volume, and nutritional value, which is dependent on the ingredients used. While taste, color, and flavor are crucial for product acceptability, the food industry aims to improve these parameters. It is worth noting that colour tends to attract attention before taste and aroma [39]. In this regard, *Moringa oleifera* can be added to dough compositions to enhance the nutritional content, making it a functional food (refer to Table 1). Bread that contains moringa is widely recognized for its high nutritional value, and baked snacks made with it are enjoyed globally. It has been attempted to fortify wheat flour biscuits and cookies with moringa leaves or seeds, but it has been found to negatively impact their sensorial quality [13].
The purpose of this study was to evaluate the acceptability of *Moringa oleifera* as a dietary supplement and its potential health benefits, when incorporated into different food products. Participants were administered either 5 or 10 grams of powdered plant and their feedback was collected through questionnaires.
The aim of this article was to identify the current state of research in the field of *Moringa oleifera* consumption. It also aimed to establish the acceptability of *Moringa oleifera* consumption among participants and to identify its beneficial effects. Additionally, the article explored the possibility of using *Moringa oleifera* as a regular

food supplement instead of other commonly consumed products such as coffee, energy drinks or carbonated drinks.

MATERIALS AND METHODS

The study was conducted on a group of 44 students from Suceava University. In this randomized controlled trial, a group of 11 boys and 33 girls participated. The study started with 44 participants and ended with 40 participants. All individuals included in the study have signed the informed consent before participating in the study. The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of Stefan cel Mare University of Suceava, protocol code 100/ 15.12.2022.

Prior to the beginning of the study, all participants were provided with information about *Moringa oleifera*, the study's content, procedures, and their involvement, and were asked to sign an informed consent form. As the study was conducted independently and all participants were consenting adults, it was not necessary to obtain ethics approval from any other institution.

The subjects were separated into two groups and each group was given packages containing either 5 or 10 grams of *Moringa oleifera* powder. The objective was to examine the effects of consumption. After both groups had signed the informed consent, they were asked to complete a questionnaire providing information about *Moringa oleifera*. The questionnaire contains open-ended questions about the effects, the way to prepare, consume and use the product. The questionnaire applied was a validated one, taken from the research article "*Moringa oleifera Lam.: A comparative survey on consumer knowledge, usage, attitude and belief in Africa and India*" [12], being subsequently translated and adapted into Romanian. Following the completion of the questionnaire, each student received 10 sachets of moringa powder, one sachet per day for a period of 10 days. These contained 5 grams and 10 grams of powder respectively. Both groups were advised to drink the powder as tea (infusion).

During the 10-day consumption period, the study participants maintained regular communication with the researchers. This communication occurred through both online messages and physical meetings and covered a range of topics related to the effects of the consumption, the preparation method, and the level of acceptability.

After consumption, the second questionnaire was distributed; including two sections: section A, applied in the research study "*Moringa oleifera Lam. A comparative survey on consumer knowledge, usage, attitude and belief in Africa and India*" [12], with questions regarding the effects observed during consumption, accessibility, administration and preparation, frequency and timing of consumption. Section B was translated and adapted from the article "*Motivations Influencing Caffeine Consumption Behaviors among College Students in Korea: Associations with Sleep Quality*" [40], and included questions on taste, odor, undesirable effects, nutritional composition and preferences in future purchases of *Moringa oleifera* products. For a more effective and simple answering of the respondents during the questionnaire, it has been divided into two sections. Section A had open-ended questions; respondents were able to answer honestly about their knowledge of the preparation, known effects and uses. In section B,

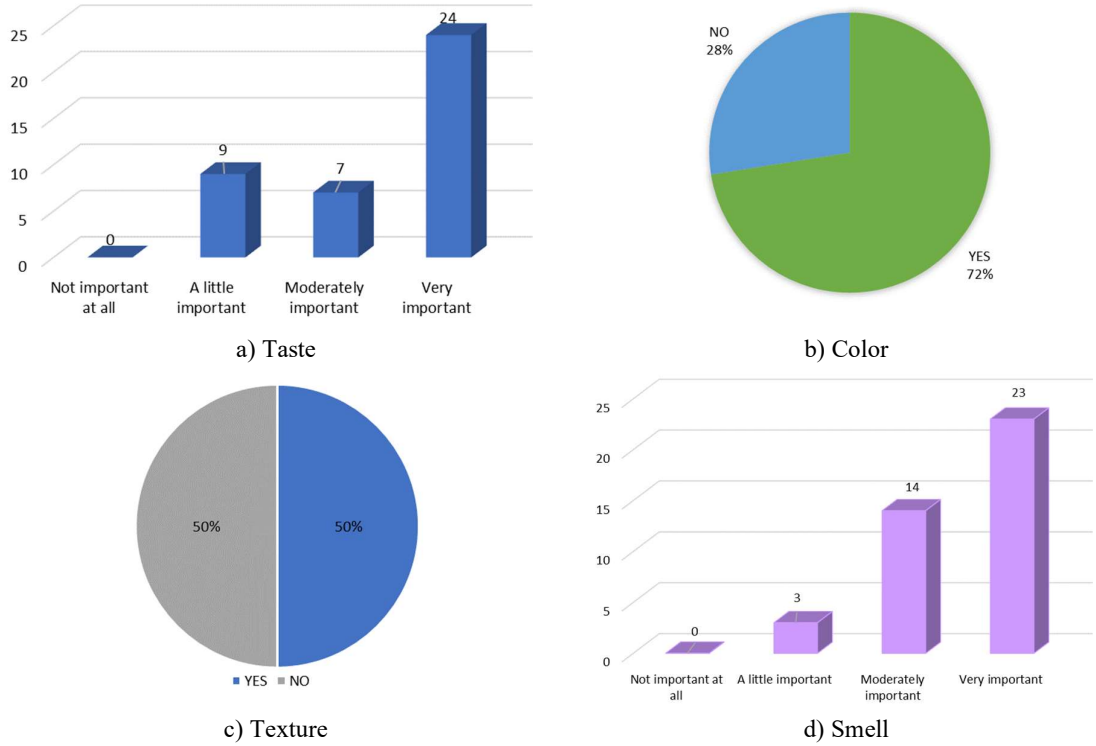
a Likert scale was used, ranging 1-„strongly disagree", 2-„disagree", 3-„neutral" and 4-„agree".
The collected data were interpreted with Data Analysis in Microsoft Excel 2011.

RESULTS AND DISCUSSIONS

Organoleptic characteristics

At the beginning of the study, out of 44 participants, 59 % said they had knowledge about *Moringa oleifera* (Supplementary material - Figure S1), from friends, media, and professionals (Figure S2).
For 46 % of the people participating in the study, moringa is considered to be a food, 40 % consider it to be a medicine, and for 14 % it is a dietary supplement (Figure S3). In our country, due to the poor knowledge about the benefits of the plant, the percentages are quite low, compared to Hedhili Amel's study conducted on the population of Africa and India, where moringa is considered to be a food as well as a medicine by 60 % of the participants [12].
In addition to the possibility of consumption as a food supplement or functional food, 45 % of the participants knew that it is used as animal feed and 15 % knew that it is used for water purification (Figure S4). The results obtained indicate that all participants in the study were interested to know more information about *Moringa oleifera* by searching it in scientific literature. Sagona's study also suggests that the plant is used by the Malawian population both as food, but also as medicine, animal feed, in water purification, and even as a hedge [41].
The mode of consumption by all 44 participants in the study was as tea. Additionally,
7 people also consumed it as an addition to soup and in confectionery, 8 of them chose to consume it as a condiment, and 4 people consumed it in porridge (Figure S5). According to these practices, it may conclude that moringa can be prepared in various ways, according to consumers' preferences. In a recent study, Neergheen-Bhujun reported that most of the respondents consumed *Moringa oleifera* leaves and seedpods as a vegetable, rather than for its medicinal properties [42].
The cooking method was boiling for 63 % of the respondents, infusion and steaming for 19 % and 18 % respectively (Figure S6), compared to Sriwichai's study, which used both boiling and steaming or roasting [43]. Of all consumers, 47 % preferred to consume it at breakfast, 24 % chose lunch and 29 % consumed it as a snack (Figure S7). As heat treatment destroys some of the benefits of consumption, affecting nutritional quality, consumption in smoothie-type drinks or as an addition to cold or already prepared food is recommended.
The difficulty of preparing the product posed no problems for the study participants, 48 % of whom felt it was extremely easy to prepare, 48 % suggested it was easy, and 4 % neither easy nor difficult (Figure S8). This is of interest, especially considering that nowadays it is important that the food is easy to prepare, not requiring elaborate steps and special equipment. For the most part, the students participating in the study are housed in university dormitories and, due to lack of time or experience, usually consume fast food or replace meals with other products satisfying their hunger and cravings at that moment, with no nutritional benefits and no role in maintaining health.

83 % of participants are aware that it is known as a food for other populations (Figure S9), and all consumers stated that they perceive it more as a plant than a vegetable (not fattening).



a) Taste b) Color

c) Texture d) Smell

Figure 2. *Organoleptic acceptability of Moringa oleifera*

Different from conventional supplements, the organoleptic properties of *Moringa oleifera* consumption did not negatively influence consumption (Figure 2). From all the participants, 24 people agreeing with the taste and 9 disagreeing; of the participants included in the study, 65 % said they liked the taste (Figure 2a), and 68 % claimed that it did not taste like cabbage or spinach (Figure S10). 32 % of those who disliked the taste of moringa were those who did not consume dietary supplements and were not used to the taste. Color was accepted by 72 % of consumers (Figure 2b) and texture by 50 % (Figure 2c). In terms of smell, 23 of the respondents agree with it, 3 disagreed, and 14 of them do not influence it in any way (Figure 2d).

Nutritional composition

In terms of nutritional content, 34 respondents agree that is very important that moringa is low in calories (Figure 3a) and high in fiber (Figure 3b); 33 agree that it is low in fat (Figure 3c) and 29 participants agree that it is high in protein (Figure 3d). All participants in the study agreed that *Moringa oleifera* contains no additives, has only natural ingredients, is safe for consumption and contains both minerals and vitamins. Zohar Kerem's study also suggests that products with moringa provide good quality vegetable protein, minerals and fiber for organism. Thus, research shows that the

addition of *Moringa oleifera* into the human diet enhances the nutritional density [45]. Similarly, Ndlovu's study shows that *Moringa oleifera* is a plant rich in protein, fiber and lower fat content [21].

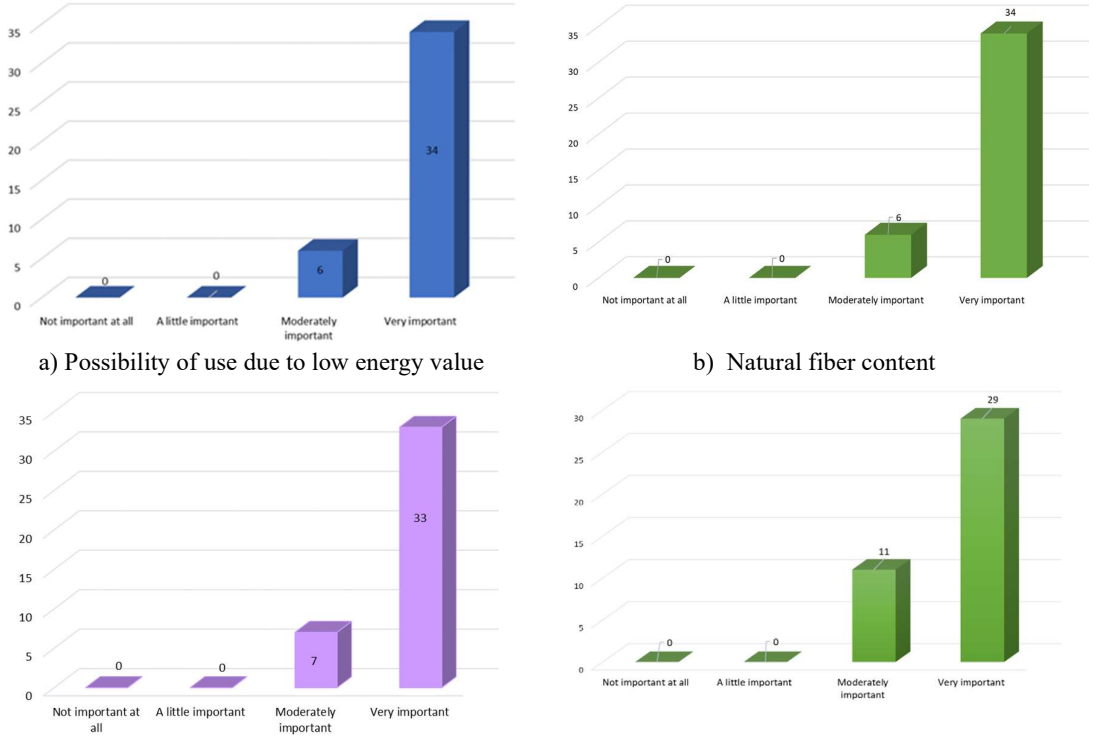
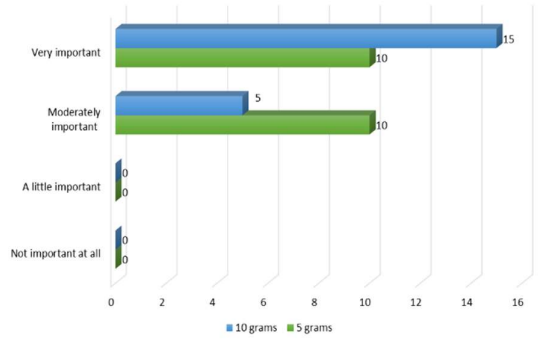


Figure 3. *Consumption acceptability due to Moringa oleifera composition*

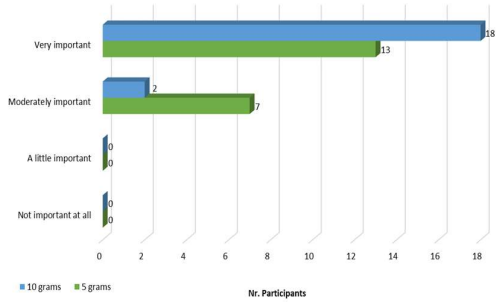
Moringa can be beneficial not only because of its nutritional quality, but also because it can be consumed as a snack during breaks from work or other meetings, with the side effect of facilitating the development of social contacts, as Choi Kinkyung showed in his study in which he demonstrated that caffeine-containing beverages are a positive factor in maintaining and creating new social contacts [33]. When asked about this aspect, the students who agreed to be included in the study largely consider that an indirect effect of *Moringa oleifera* consumption could be the social connections.

Benefits of consumption

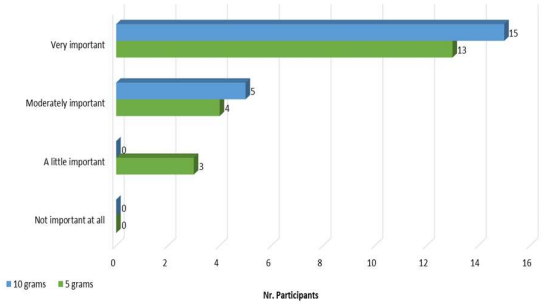
During consumption, 57 % of the participants said that moringa is nutritious (Figure S12) and 75 % considered that it can also be consumed by children (Figure S13). Walia *et al.* also reported that adding *Moringa oleifera* powder in children's diet helps to treat malnutrition [44].
The main benefits observed by the subjects after consuming *Moringa oleifera* powder are presented in Figures 4 (a-h) and 5 (a-d).



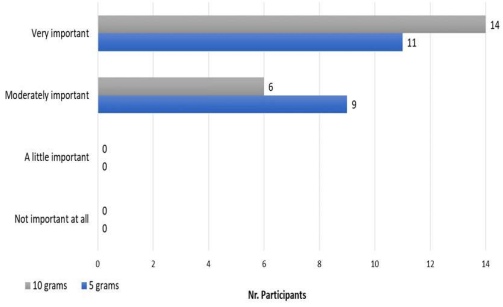
a) Concentration level increasing



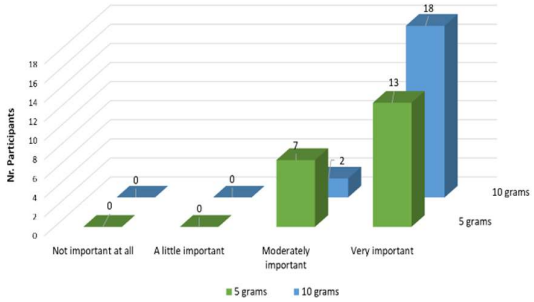
b) Well-being state increasing



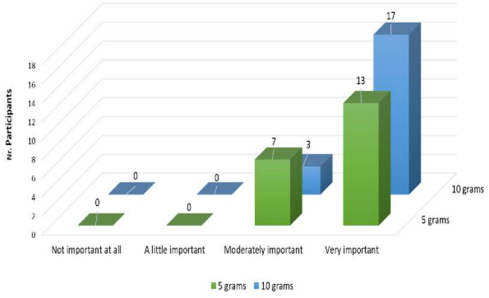
c) Maintaining attention efficiency



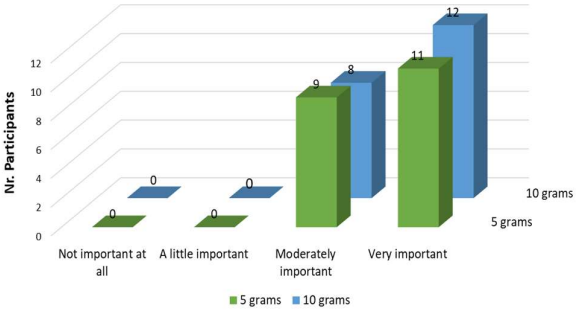
d) Lowering fatigue capacity



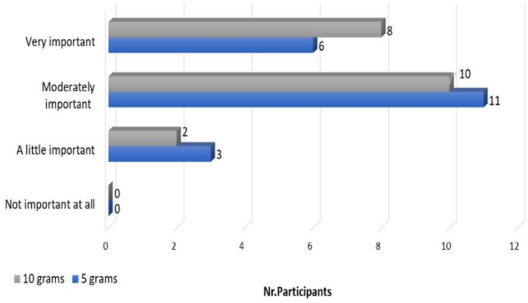
e) General mood improvement



f) Stimulant effect

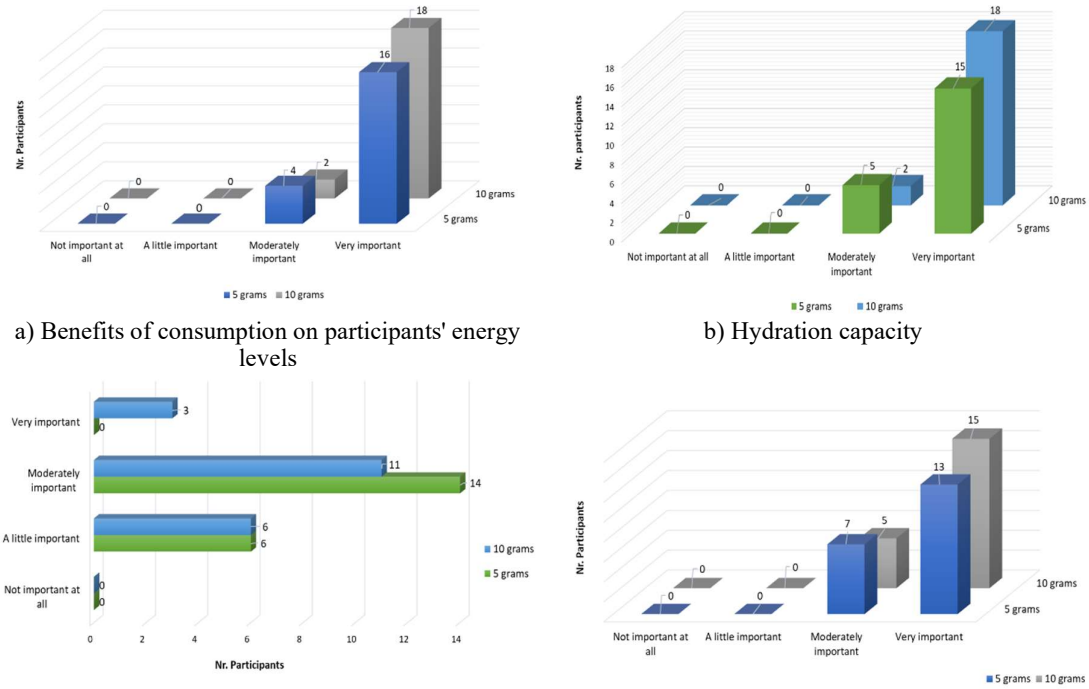


g) Maintaining physical and mental fitness



h) The invigorating effect

Figure 4. *The main benefits observed by the subjects after consuming Moringa oleifera powder*



a) Benefits of consumption on participants' energy levels

b) Hydration capacity

c) Eliminating migraines

d) Sustaining attention for an extended period of time

Figure 5. *The main benefits observed by the subjects after consuming Moringa oleifera powder*

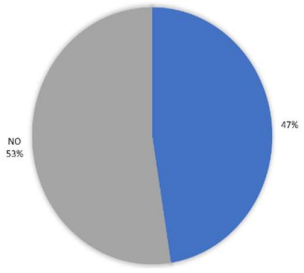
In this study, more than 50 % of the people who received the 10-gram dose agreed that consuming *Moringa oleifera* helped them to carry out their daily activities, even if they were tired (Figure 4d), while maintaining their energy levels and productivity (Figure 4c). Respondents who usually consumed dietary supplements felt that replacing them with *Moringa oleifera* was a good choice, experiencing improved effects compared to when they consumed other dietary supplements. Mood was also improved in people who consumed a higher amount of moringa, *i.e.* 10 grams (Figure 4e), with more of them (n = 18) mentioning that it improves mood, as opposed to those who consumed 5 grams each and identified no noticeable effects (Figure 4b). Triab *et al.* presented the same effects after energy drink consumption among students: good mood, all-day energy and productivity [46].

The beneficial effect of consumption on the maintenance of blood pressure in normal parameters was not felt by the participants who consumed 5 grams and 10 grams of the product respectively (Figure S15). It is true that blood pressure was not monitored using equipment designed for this purpose, but only took into account any changes that the participants might have felt. The study group did not have blood pressure-related conditions, unlike Seriki's study which focused on blood pressure and lipid profile effects, which found *Moringa oleifera* to lower blood pressure and improve lipid profile [47]. However, 3 of the subjects who consumed 10 grams of powder felt that their headaches were reduced (Figure 5c). A study found that 21 people did not improve digestion (Figure S11), unlike Choi Jinkyung's study where students reported benefits in digestion, blood pressure, and headache elimination [40]. Moringa did, however, have an effect on maintaining attention, with a large proportion of those in the study who

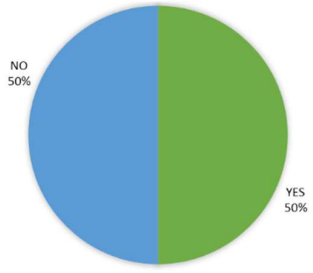
received 10 grams each agreeing that they noticed benefits in this regard following consumption (Figure 5d), and 14 of those who received 10 grams agreeing that they were more motivated to work, compared with 11 who received only 5 grams (Figure 4g).

Consumers' perception

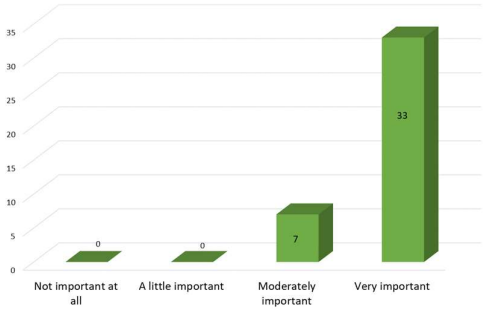
Although the affordability of purchasing *Moringa oleifera* is not exactly within reach, being considered as an expensive product by 50 % of consumers (Figure 6a), 47 % of them stated that they do not reject the product because of the price and will consume it because of the high benefits (Figure 6c). Also, the orientation of the industry towards the development of products with moringa added could stimulate the production of this plant and the import from already known areas, making the price affordable for all consumers. The authorities in the field should be aware of the high quality of health-promoting products and there could be regulations to this effect.
All participants in the study consumed moringa once a day, and following consumption, regardless of quantity, all observed benefits in well-being and increased energy levels throughout the day.
Already knowing the benefits that *Moringa oleifera* has on the body, respondents had a high willingness to consume it at first. However, following the survey, only 45% of participants indicated that they would consume it again (Figure S9), mainly due to the predominantly cabbage or spinach colour, aroma and taste (Figure S10). On the other hand, people consuming such natural supplements (spirulina, creatine, caffeine) want to direct their preferences towards moringa because of the observed effects, superior to those identified after consumption of other stimulant foods.



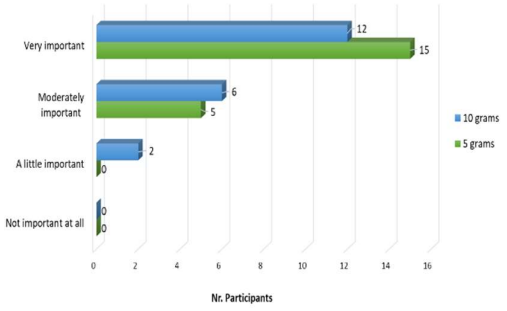
a) Availability of purchase of gorse, from in terms of current price



b) Product affordability



c) Willingness to consume, knowing its benefits



d) The habit of consuming moringa

Figure 6. *Consumers' perception regarding Moringa oleifera*

All respondents mentioned that *Moringa oleifera* is found in herbal pharmacies, compared to Hedhili Amel's study in which Indians and Africans bought it from the market or from their own moringa tree [12]. However, the increasing openness to eating such foods could persuade large retail chains to distribute such products in supermarkets as well, so that they are within consumer reach.
Affordability in purchasing *Moringa oleifera* is not exactly within reach, being considered as an expensive product by 50 % of consumers (Figure 6b), 47 % of them said that they do not reject the product because of the price and will consume it because of the high benefits (Figure 6a).
It was observed that the habit of consumption was more easily identifiable among those who consumed a smaller amount, i.e. 5 grams (n = 15), compared to those who received 10 grams (Figure 6d). The effect can also be attributed to sensory attributes, which may influence product rejection in this respect (cabbage or spinach taste, smell or texture). To increase acceptability and consumption, the industry could promote this product by including it in food products because of the benefits it has. The positive response of people who have consumed the product can be useful in identifying the level of acceptability. The study found that only 33 participants agreed to consume caffeinated energy drinks (Figure 6d), similar to Reid's study on youth and adolescents, where a portion consumed them for taste [48]. Also, Nowak's study of Polish teenagers showed that more than half of them consumed caffeinated energy drinks due to a good taste [49].
Following the discussions, there is openness arose on their part to consume products that could contain moringa, such as chocolate, cakes, bars, muffins, biscuits.
The present study started with 44 participants and ended with 40. The dropouts gave reasons for unpleasant sensory attributes such as taste or smell, but also lack of time.

CONCLUSIONS

According to the obtained results, a quantity of 10 grams of the product is sufficient to alter the consumer's state of well-being, increase the level of attention and eliminate some undesirable effects that occur due to fatigue. The effects obtained were more intense among those who consumed 10 grams, as opposed to those who consumed half the amount (5 grams), thus confirming that the beneficial effects depend on the dose ingested.
The strongest intention to continue consumption was observed among students who were already using other dietary supplements and found *Moringa oleifera* to have superior effects. These students expressed a desire to replace conventional products with *Moringa oleifera*.
Although some of the subjects do not consider that the taste and smell of the powder can negatively influence consumption, the possibility to lead the industry towards the development of such products could be an important aspect in the consumption of healthy food by the entire population.
While the affordability of the product was not mentioned as a negative aspect, it should be noted that the participants in the study received quantities of *Moringa oleifera* for free. Therefore, it is not possible at this stage to determine whether their choice would

be influenced by the price of the product, as the results are based solely on their responses.

Our study is limited with the unequal gender distribution in the sample, which may cause bias and limit the generalizability of the results. To enhance the external validity of the findings, the future research should aim to balance the gender distribution.

To increase the clarity and reliability of the results, the study will be conducted over a longer period of time and with a cohort with more than one hundred subjects involved.

Additionally, it would be needed to investigate the effects of moringa powder, capsules or tablets on cardiovascular pathologies. From a nutritional perspective, moringa fortification can be explored in various products, including muffins, energy drinks, chocolate, biscuits, and cakes.

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SUPPLIMENTARY MATERIAL

QUESTIONNAIRE 1

Name/Age/Sex:

Questionnaire on the consumption of *Moringa oleifera*

1. Have you heard of moringa?

2.Where did you hear about moringa for the first time? (family, media, friends, health professionals, other)
---
3. For you, what is moringa? (a medicine, a food, etc)
---
4. What other uses of moringa do you know? (water purification, household cleaning agent, fence, animal feed, I don't know, other)
---
5. Where do you most frequently find your moringa? (I buy it from the herbal shops, I buy it from the local market, I buy it from the supermarket, from my own morigna tree, other)

6*. Would you consume moringa after the benefits you already know?
---
7. How do you eat moringa? (as vegetable in soups, as spice, as tea, raw, in porridge, as vegetable in salad, in confectionary, as vegetable in sauce, other)
---
8. Which cooking method do you use the most often to prepare moringa? (boiling, steaming, frying, baking, other)
---
9. At what time during the day do you eat dishes containing moringa? (for breakfast, for lunch, as a snack, for dinner)
---
10. How hard do you think it would be to prepare meals with *Moringa oleifera*?

QUESTIONNAIRE 2

Name/Age/Sex:

Questionnaire on the consumption of *Moringa oleifera*

A.

1*. Have you noticed any benefits from taking *Moringa oleifera*?

2*. Will you continue to consume moringa, already knowing the benefits?

3*. How often do you use moringa as an ingredient in your cooking? (more than once daily, once daily, more than once weekly, once weekly,1-2 times a month, less than 1-2 times a month)

---

4. Which cooking method do you use the most often toprepare moringa? (boiling, steaming, frying, baking, other)

---

5. At what time during the day do you eat dishes containing moringa? (for breakfast, for lunch, as a snack, for dinner)

6*. How difficult was it to prepare *Moringa oleifera*? (extremely easy, easy, neither easy nor difficult, difficult, extremely difficult)

---

7. Do you agree with the following statements:

- I like the taste of moringa
- It is like cabbage or spinach
- It is an herb more than a vegetable
- It is nutritious
- It is good for health
- It is only consumed with local foods
- It can be given to children
- It makes me gain weight
- It is safe to consume
- I like it's aroma
- It is very expensive
- I like the texture
- It is easily accessible
- I like its color

This questionnaire was translated and adapted into English from the study *Moringa oleifera Lam.: A comparative survey on consumer knowledge, usage, attitude and belief in Africa and India, South African Journal of Botany, Volume 147, July 2022.*

B.

Moringa oleifera	Strongly disagreed	Disagreed	Neutral	Agreed
1. I like the taste				
2. It is a pleasant ritual				
3. I love the smell				
4. Contains no additives				
5. Is low in calories				
6. Contains natural ingredients				
7. Is low in fat				
8. Is high in fiber				
9*. Contains vitamins and minerals				
10. Is high in protein				
11. Keeps healthy				
12*. Facilitates social contacts				
13. It helps me to concentrate				
14. It improves my mood				
15. It helps me when I am tired				
16. It helps me to stay awake				
17. My mood becomes better				
18. It stimulates me				
19. It invigorates me				
20. Is good for my skin/teeth/hair/nails				
21. I feel physically and mentally fitter				
22. It makes me more motivated to work				
23. It has a soothing effect and instills a sense of well-being				
24. It hydrates me				
25. It makes me feel that I am full of energy				
26. It reduces headaches				
27. It is good for my blood pressure				
28. It helps me digest				
29*. It helps me keep my attention for longer				
30*. I got used to consuming				
31*. I would buy the product because of the observed effects				

This questionnaire was translated and adapted into Romanian after 2 studies: 1. *Motivations Influencing Caffeine Consumption Behaviors among College Students in Korea: Associations with Sleep Quality Jinkyung Choi, Department of Foodservice Management, Woosong University, Daejeon 34606, Korea; Received: 18 January 2020; Accepted: 24 March 2020; Published: 30 March 2020* and 2. *Food Choice Questionnaire Scoring Key- Adaptation of the Food Choice Questionnaire: the case of Hungary, Zoltán Szakály and Enikő Kontor, Sándor Kovács and József Popp, Károly Pető, Zsolt Polereczki, British Food Journal, 2018*

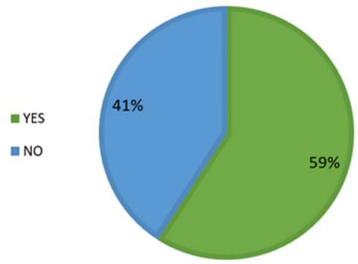

Figure S1. *Percentage of knowledge of information on Moringa oleifera among participants*

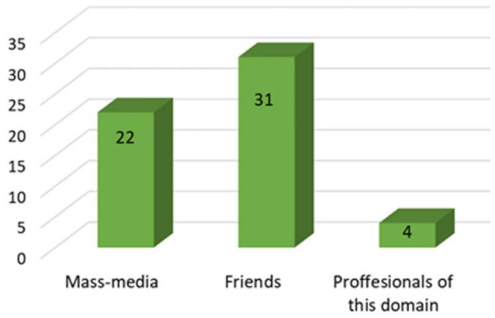

Figure S2*. Information sources about Moringa oleifera*

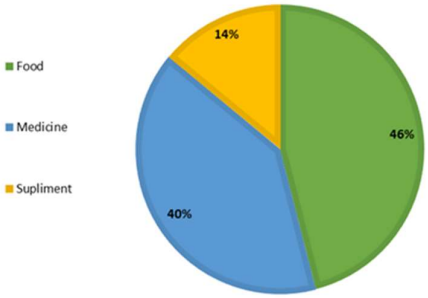

Figure S3*. The role of the plant in everyday life*

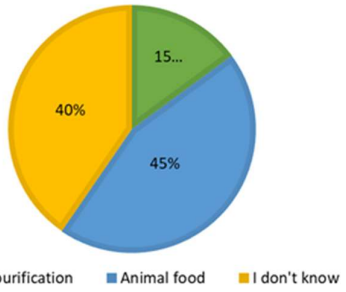

Figure S4*. Information on other uses of the plant*

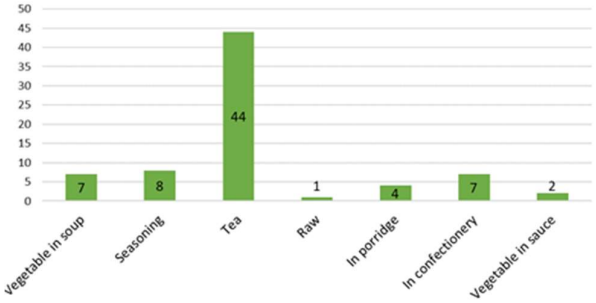

Figure S5. *How would you consume moringa?*

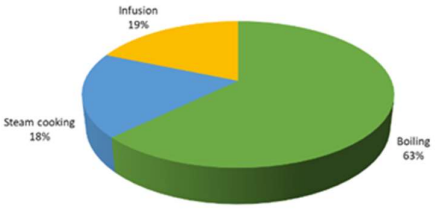

Figure S6. *How to prepare moringa?*

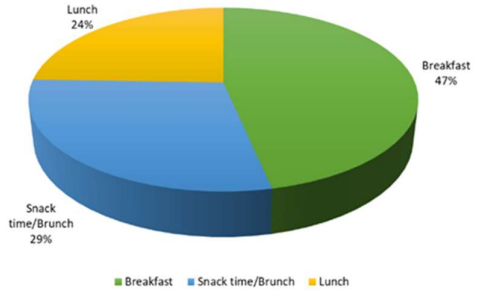

Figure S7*. Favourite time of day to eat Moringa oleifera*

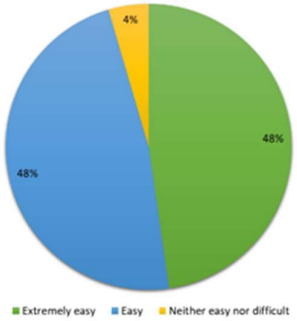

Figure S8. *Difficulty in preparing moringa*

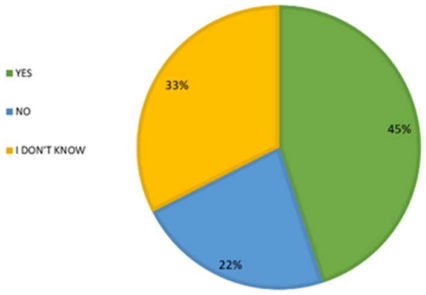

Figure S9. *Openness to the consumption of moringa, given its known benefits*

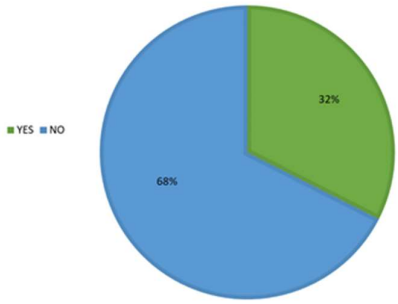

Figure S10. *Participants' responses on the similarity of taste to cabbage or spinach*

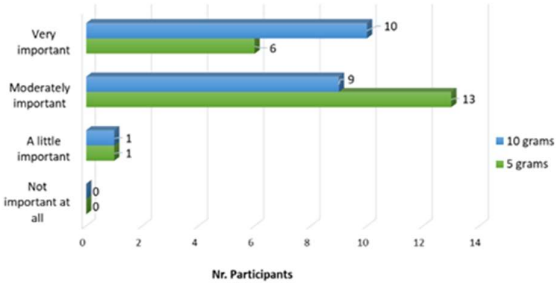

Figure S11. *Benefits of consumption on the digestion process*

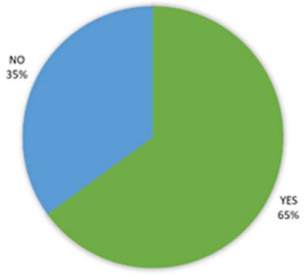

Figure S12. *Level of acceptability of consumption by flavour*

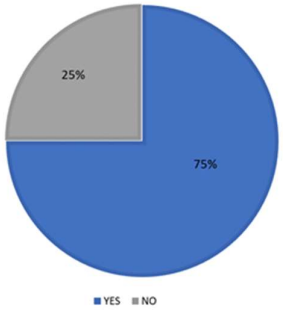

Figure S13. *Survey participants' confidence in children's consumption*

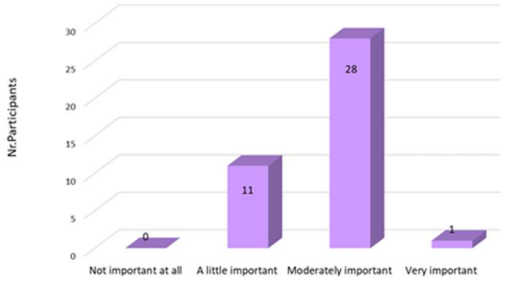

Figure S14. *Facilitating consumption by making social contacts*

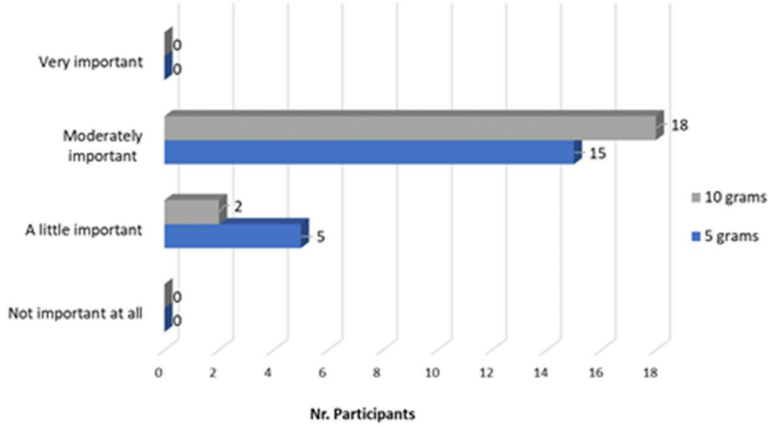

Figure S15. *Benefits of consumption in maintaining blood pressure within normal parameters*