

# Formulation, Nutritional Assessment and Sensory Evaluation of *Moringa Oleifera* Infused Herbal Tea Formulation and its Effect on Obesity and Hemoglobin Levels

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## ABSTRACT

Anemia in post pubertal women and obesity in both genders is one of the biggest health problems in many countries, including India. It was reported that 51% of Indian women are anemic. In terms of obesity, India contributes up to 3.7% (men) and 5.3% (women) to the global obese population and ranks fifth globally in obesity. Reports have suggested that drinking more amounts of tea is toxic to health and also contributes to obesity. But this habit cannot be avoided since tea is the preferred starter drink of a day for most people. Therefore, a less toxic and a highly nutrient herbal tea formulation would fix this issue. The aim of the present study is to prepare a refreshing herbal tea formulation with *Moringa oleifera* leaf extract as a base substance, which can improve the hemoglobin (Hb) content in blood and can also contribute for weight loss. *Moringa* tea (M-tea) was formulated and screened by 50 panelists through sensory evaluation. The nutritional analysis of M- tea revealed that the iron and calcium levels were high compared to the standard commercial tea formulations. To determine its effect on body weight and Hb, a sachet of M-tea diffused in 100-125 ml of hot water without sugar was given twice a day to selected individuals for 15 days. The initial (day 0) and final (day 15) bodyweights and hemoglobin levels were recorded in all individuals. The results showed an increase in Hb levels and decrease in body weights in most of the individuals compared to the initial data. From our data, we can consider that if the tea servings were taken regularly it might help to reduce anemia by increasing the Hb levels and also could control obesity in both genders without side effects. Based on this, we recommend the nutrient rich M-Tea for regular use as an alternative for commercial tea to energize the body, to reduce anemia and to control obesity. The cost of M-tea will also be relatively less compared to the commercial teas.

**Keywords:** Obesity, Herbal tea, Anemia, M-Tea, *Moringa*

*oleifera*, *Carica papaya*

## INTRODUCTION

A good nutrition is the crucial part to achieve a suitable level of human growth [1]. High risk of micronutrient deficiency especially anemia is seen in girls in the adolescence stage. The most significant cause of anemia is believed to be deficiency in Iron [2]. On an average, anemia affects 27% of the total world population. Developing countries like India accounts for more than 89% of the anemia burden. The most affected ones are preschool children and women at reproductive age (age: 18-50). The prevalence of anemia is 30.2% in non-pregnant women and 41.8% in pregnant woman around the world. 57% of women (15-49) have anemia as per the National Family Health Survey 2019–2021 report. World health organization (WHO) defines anemia as a condition in which the number of red blood cells or their capacity to carry oxygen is not sufficient to meet the physiologic needs [3-6]. The main reason for anemia is the shortage of hemoglobin, as its primary function is delivering oxygen and taking back carbon dioxide to the lungs for elimination from the body [7].

Worldwide, overweight and obesity seen in young population is a preventable common health problem [8]. It is also the most ignored health problem which can cause diabetes and cardiovascular diseases (CVDs). Developing countries like India, is in a transitional state of obesity due to the industrialization and rapid urbanization. In India, more than 135 million people are affected by obesity. The high proportion of obesity in India varies due to age, gender, geographical environment, socio-economic status, etc. In India, abdominal obesity is one of the main threats for CVDs. Studies have revealed that the dominance of obesity amongst women were considerably higher as compared to men. Obesity is also one of the chief medical and economic burdens for the government [9,10].

The common methods to fight against anemia involve supplementation of iron and food-based approaches. Iron supplementation is quick but a short term solution for highly affected individuals [11]. So, the food-based approaches are a better choice. Health conscious individuals prefer refreshing drink that is nutritious as well as feel them relaxing and reliving[12]. Tea, an important refresher drink around the world is also considered as one

of the reasons for anemia and obesity when taken in more amounts [13]. It is the most ancient aromatic beverage which is consumed by most of the world's population, averaging consumption of 120ml/day [14]. Pouring hot water over the leaves of plant is the most common method for tea preparation. Studies suggest that Tea possess various affirmative health benefits like help in the reduction of various chronic diseases [15]. Herbal Tea is a natural plant based drink which has become a fundamental part of the modern population at the present time [14].

*Moringa oleifera*, also called a Horseradish tree or miracle tree, is one of the 13 species of *Moringa* genus with wide usage in ethnobotany. All parts of *Moringa* plant are edible, with most frequent usage of leaves and pods. It contains 7 times more vitamin C than orange, 10 times more vitamin A than carrots, 17 times more calcium than milk, 9 times more protein than yoghurt, 15 times more potassium than bananas and 25 times more iron than spinach. Packed with high amounts of vitamins and nutrients, it can be used to treat chronic diseases [16,17]. Based on preclinical studies, the dietary iron of *Moringa* is well-thought-out as having more potential to ferric citrate [18]. This plant is having various medicinal properties like analgesic, anti-inflammatory, anticancer, antipyretic, antioxidant, nootropic, hepatoprotective, gastroprotective, cardiovascular, anti-ulcer, anti-obesity [19], antiepileptic, antidiabetic, anti-urolithiatic, antiasthmatic, diuretic, local anesthetic, anthelmintic, anti-allergic, wound healing, immunomodulatory, antimicrobial, and antidiarrheal properties [20]. A number of food products and supplements are prepared from *Moringa* and sold in markets. Due to high range of nutritional value, dry *Moringa* leaves were also marketed. *Moringa* seed oil is used as a novel food supplement for its high antioxidant capacity in various regions.

Unlike *Moringa*, most of the parts of *Carica papaya*, belonging to Caricaceae family, are useful as medicine. *Carica papaya* L. leaf tea or extract has a potential as a tumor destroying agent. It is also used as a medicine for an upset stomach and associated illnesses. The seed is used for colonic worms when chewed. The root juice is used for cough, bronchitis, and other respiratory diseases. The unripe fruit is used as a medication for ulcer and impotence. Chewing the seeds of ripe fruit also helps to clear nasal congestion. The green unripe papaya has a therapeutic value due to its antiseptic quality whereas ripe fruit has an

anti-anemic effect [21]. The tea prepared with the green papaya leaf, promotes digestion and aids in the treatment of ailments such as chronic indigestion, overweight and obesity [22], arteriosclerosis, high blood pressure and weakening of the heart [23].

Based on the above literature, the present study was designed to prepare a natural herbal tea derived from *Moringa oleifera*, which can be used as a food supplement in an easily supplemented mode and also to combat the problems of anemia and obesity in India. With this aim, a *Moringa oleifera* tea (M-Tea) is formulated, evaluated for its sensory and nutritional parameters and checked for its anti-anemic and anti-obesity effects.

## MATERIALS AND METHODS

### Collection of Plant Materials

Fresh leaves of *Moringa oleifera* and *Carica papaya* (papaya) were collected from the local farm of Bardoli. The samples were further authenticated by taxonomists from the C G Bhakta Institute of Biotechnology, Uka Tarsadia University, Bardoli.

### M-Tea Formulation

The collected cleaned leaf samples were shade dried for 1-2 weeks, crushed, sieved to a fine powder separately and used for further product preparation. Five different tea formulations (A, B, C, D and E) were prepared with different gradient proportions of *Moringa oleifera* and *Carica papaya* leaf powders. The *Moringa oleifera* tea (M-Tea) was then prepared by conventional diffusion method.

### Sensory Evaluation

The final M-Tea formulation was prepared based on the sensory evaluation data. Totally fifty panelists were employed for sensory evaluation. A pilot scale sensory evaluation was performed to shortlist 3 samples (A, B, C) from the five samples (A, B, C, D and E) on the basis of taste, color and smell. The shortlisted 3 samples (A, B, C) were evaluated by a five-point hedonic scale with 1-5 grade ranking based on the criteria of taste, smell, color, flavor and feeling after consumption. The five point (1-5) hedonic scale represents 5- as very good, 4- as good, 3- as average, 2- as dislike moderately and 1- as dislike extremely.

## Nutritional Evaluation

Assessment of total protein was done by Bradford method [24]. Briefly, 1 gram of homogenized samples were mixed with Phosphate buffer (pH 7) and centrifuged at 12000rpm for 5 min. The supernatant was collected in a fresh tube. BSA was taken as standard. To this, Bradford reagent was added, mixed well and incubated at room temperature for at least 5 min. The absorbance was measured at 595nm.

Assessment of total carbohydrates was done by Anthrone method with slight modification [25]. Briefly, 1gm of the sample was taken and kept in boiling water bath for 10min. After it was cooled down, anthrone reagent and HCl were added. The absorbance was measured at 625nm with glucose as the standard.

The fat, calcium and iron contents were analyzed at Lilaba Laboratory, Surat, Gujarat, India.

### Anti-anemic Effect (Estimation of hemoglobin)

30 target individuals with low hemoglobin levels were selected for anti-anemic effect. The recommended dosage of M-Tea was 3 sachets (morning, noon and evening with minimum 4 hours interval) per day taken for consecutive 30 days. For anti-anemic effect, the amount of hemoglobin was measured by Sahli's method before and after the experimental period. In this study, 30 individuals with normal hemoglobin levels (12-14) served as control.

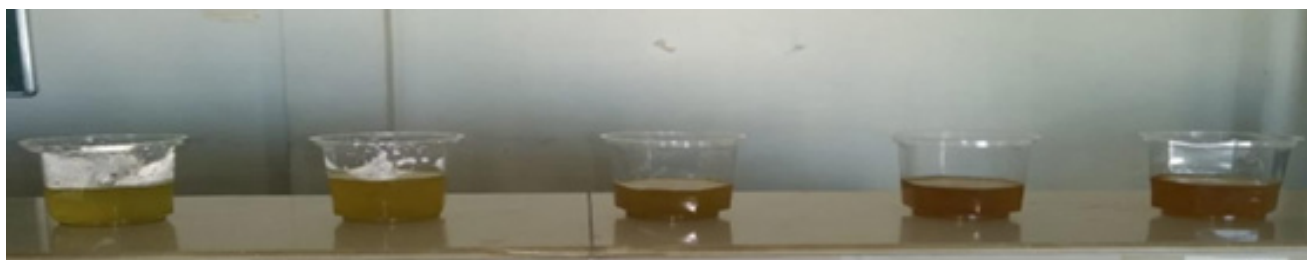
### Anti-obesity Effect (Measurement of weight parameter)

30 obese individuals were selected for anti-obesity effect. For anti-obesity effect, the weights were recorded initially and after using M-Tea for 30 days.

### Statistical Analysis

Values are represented as mean  $\pm$  standard deviation (SD) calculated from SPSS commercial software version 20. All the individuals involved in anti-anemic and anti-obesity studies were informed clearly about the experiments and accepted in volunteer in the studies by signing the informed consent form as per the standard guidelines.

**RESULTS**



**Figure 1:** Five different samples (A, B, C, D and E) M-Tea formulation in the order of display.

Figure 1 represents the tea prepared with the five different samples of M-Tea namely sample A, B, C, D and E. The changes in the colours can be noted in the samples which were in correspondence to the different proportions of *Moringa oleifera* and *Carica papaya*.

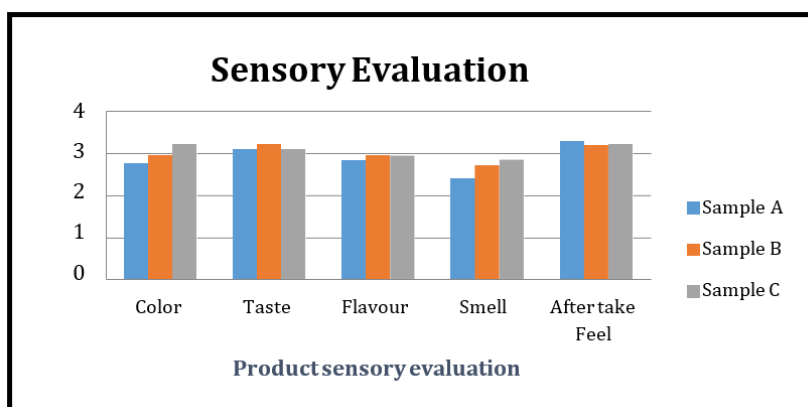
Table 1 represents the sensory characteristics of five different *Moringa* Tea samples.

**Table 1:** Sensory characteristics of M-Tea.

Samples	Colour	Smell	Taste
A	Pale green	Herbal	Not bitter
B	Greenish orange	Green tea	Not bitter
C	Slight orange	Green tea	Slightly bitter
D	Honey colour	Herbal	Bitter
E	Honey green	Herbal	Bitter

The results of the sensory evaluation of the three shortlisted samples (A, B, C) based on color, taste, flavor, smell and feeling after consumption were presented in figure 2. Of the 3 samples (A, B, C), the sample B was preferred by most

of the panelists based on the above mentioned parameters. Sample B was selected as the final formulation of M-Tea for further nutritional analysis and to determine anti-anemic and anti-obesity effects in target individuals.



**Figure 2:** Sensory analysis/evaluation of M-Tea samples: Average /mean rating of shortlisted M-Tea samples. X-axis: criteria of M-Tea sensory evaluation and Y-axis: mean score of panelists Where, n=50.

**Table 2:** Nutritional assessment of formulated *Moringa* tea.

Nutrients	Composition (Per gram of sample)
Carbohydrates	4.0 mg
Proteins	0.042 mg
Total fat	0.062 mg
Calcium	3.24 mg
Iron	0.168 mg

The nutritional assessment of M-Tea sample is presented in Table 2. Whereas Table 3 and 4 shows the result of anti-obesity and anti-anemic effect of *Moringa* Tea. The results showed a positive effect in terms of decrease in weight in obesity and an increase in the amount of hemoglobin in anemic individuals.

**Table 3:** Anti-obesity effect of *Moringa* tea supplementation.

Duration (Days)	Normal weight *	Underweight *	Overweight *	Obese *
0	21.14 ± 2.80	16.95 ± 0.27	28.91 ± 1.01	34.36 ± 4.76
5	20.73 ± 2.11	17.04 ± 2.43	28.24 ± 1.73	33.60 ± 2.54
10	21.25 ± 1.94	17.66 ± 1.75	27.61 ± 2.50	32.99 ± 3.18
15	21.98 ± 2.63	18.85 ± 2.03	27.12 ± 0.96	31.41 ± 2.82
20	22.36 ± 3.06	18.74 ± 1.06	26.95 ± 1.74	30.58 ± 2.59
25	23.47 ± 2.75	19.62 ± 2.13	26.13 ± 2.35	30.04 ± 1.60
30	23.12 ± 1.54	19.17 ± 1.03	25.48 ± 1.42	29.97 ± 1.53

30 individuals were categorized according to their BMI into 4 groups as 10 per group. \*Normal weight, BMI 18-25 kg/m<sup>2</sup>; Underweight, BMI < 18 kg/m<sup>2</sup>; Overweight, BMI 25-30 kg/m<sup>2</sup>; Obese, BMI 25-30 kg/m<sup>2</sup>. Values are represented as mean ± SD; n=30.

**Table 4:** Hemoglobin level (in percentage) by *Moringa* Tea drinking group (n=30).

Days	Percentage of hemoglobin in control individuals	Percentage of hemoglobin in anemic individuals taking <i>Moringa</i> Tea
0	12.30 ± 0.11	9.71 ± 0.03
10	13.77 ± 0.06	10.15 ± 0.07
15	13.05 ± 0.92	11.96 ± 0.18
20	12.74 ± 0.13	13.47 ± 1.03
25	13.31 ± 0.10	13.21 ± 0.08
30	13.82 ± 0.08	14.05 ± 1.02

Values are represented as mean ± SD; n=30 on each group of control and anemic individuals treated with M-tea for a period of 30 days.

## DISCUSSION

Dry *Moringa* leaf extract is rich in essential nutrients and is suitable in food supplementation. *Moringa* plant is drought resistant and grows all the year round. Hence, it can serve

as an economically nutrient rich option in the fight against micronutrient deficiencies and malnutrition. Dry *Moringa oleifera* leaf extract can serve as an alternative to morning tea. The extract of *Moringa oleifera* contains iron and calcium. Iron is an essential nutritional element and its functions include

its involvement in energy metabolism, gene regulation, cell growth and differentiation, oxygen binding and transport, muscle oxygen use and storage, enzyme reactions, neurotransmitter synthesis, and protein synthesis [26]. Deficiency of iron could result in lowered endurance, decreased work capacity, impaired temperature regulation, depressed immune function, increased rates of infection, impaired cognitive functioning and memory, decreased school performance, compromised growth and development, increased lead and cadmium absorption, increased risk of pregnancy complications, including prematurity and fetal growth retardation. Calcium is essential in the body for blood clotting, stabilizes blood pressure, contributes to normal brain function and bone health. The level of carbohydrates of the extract indicates that it can be ranked as a carbohydrate rich in food. However the moderate levels of protein and carbohydrate shows that it can form a part of human diet. Also the level of fat shows that the vegetable is not a source of lipid accumulation which can cause atherosclerosis; hence, the extract will be suitable for individuals suffering from or who are prone to diseases of the cardiovascular system [27].

The panelists preferred the flavour of *Moringa* Tea. In sensory evaluation, it appeared to be appealing since the feel experienced after taking it was graded good.

The sample B was preferred by most of the individuals and hence it was selected to be the preferred formulation for preparing *Moringa* Tea.

The subjects agreed to take this *Moringa* Tea in dosage of 1 sachet per serving morning and evening (twice a day) for 30 days. The bodyweights and the hemoglobin levels were recorded initially and at the end of the day 30. The levels of hemoglobin at day 15 and 30, was found to be increased in most of the individuals which showed that *Moringa* Tea increased the level of hemoglobin which may be due to the increase in the iron content in the blood. Also the body weight changes at the end of the 15 and 30 day showed a reduction when compared to the day 1 in most of the subjects. Hence, the intake of *Moringa* Tea proved to reduce the bodyweight thus exhibiting an anti-obesity effect.

In a study by Shija AE, et al. [9] 2019, *Moringa* leaf powder was used as food supplements to check the reducing effect of anemia on children below 2 years of age. The studies showed 31.3% of effectiveness in increasing hemoglobin levels

compared to 20.3% in the control group by using *Moringa* leaf powder for a short term usage (2-3 month duration). But the level of hemoglobin is sharply increased in third month of use of *Moringa* as supplements. Therefore, use of *Moringa* leaf powder for a longer time can be effective against anemia [9].

Based on the results of the present study, we conclude that the formulated *Moringa* Tea is effective in increasing the hemoglobin levels and also in turn it will reduce obesity without any side effects if taken on a regular basis.

## CONCLUSION

Dry *Moringa* leaf extract is rich in essential nutrients and is suitable in food supplementation. *Moringa* plant is drought resistant and grows all the year round. Hence it can serve as an economically nutrient rich option to fight against micronutrient deficiencies and malnutrition. Dry *Moringa oleifera* Tea extract can serve as an alternative to Morning Tea. Its nutritional value surpasses traditional morning tea and this makes it suitable for hyperlipidemic and anemic individuals. *Moringa oleifera* Tea should be advocated for supplementation in households' diets especially in rural communities.

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