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Sakshi Maurya
 Research Scholar,
 Department of Horticulture,
 Naini Agricultural Institute,
 Sam Higginbottom University
 of Agriculture, Technology and
 Sciences, Prayagraj, Uttar
 Pradesh, India

Saket Mishra
 Assistant Professor,
 Department of Horticulture,
 Naini Agricultural Institute,
 Sam Higginbottom University
 of Agriculture, Technology and
 Sciences, Prayagraj, Uttar
 Pradesh, India

Corresponding Author:
Sakshi Maurya
 Research Scholar,
 Department of Horticulture,
 Naini Agricultural Institute,
 Sam Higginbottom University
 of Agriculture, Technology and
 Sciences, Prayagraj, Uttar
 Pradesh, India

Evaluation of physico-chemical and organoleptic properties of value added moringa green tea

Sakshi Maurya and Saket Mishra

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Abstract

The study was carried out to prepare the value added moringa green tea blended with herbs and spices with the objective to assess the physico-chemical and organoleptic properties of the green tea. The experiment was conducted in Post-harvest Technology Laboratory, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India. The experiment was conducted in Completely Randomized Design (CRD), with nine treatments and three replications. Based on the results of assessment, it was concluded that the treatment T₇ (Moringa Leaves 90% + Cardamom 10%) has performed best in terms of physico-chemical properties viz., moisture (5.10%), ash (9.87%), fat (3.05%), protein (22.35%), carbohydrate (59.63%), energy (355.57kcal), vitamin C (24.05mg/100g). On the basis of sensory evaluation, treatment T₇ (Moringa Leaves 90% + Cardamom 10%) was found most acceptable in terms of organoleptic properties viz., colour (8.7), taste (8.7), flavour (9.0), aroma (8.7), overall acceptability (8.7).

Keywords: Herbs, moringa, organoleptic properties, physico-chemical properties, spices, tea

Introduction

Drumstick (*Moringa oleifera*) is one of the vegetables of the Brassica order and belongs to the family Moringaceae. The Moringaceae is a single genus family with 13 known species (Khawaja *et al.*, 2010) [9]. *Moringa oleifera* is a small native tree of the sub-Himalayan regions of North West India, which is now indigenous to many regions in Africa, Arabia, South East Asia, the Pacific and Carabbean Islands and South America. Traditionally, besides being a daily used vegetable among people of these regions, the Moringa is also widely known and used for its health benefits. Among commoners, it has earned its name as 'the miracle tree' due to its amazing healing abilities for various ailments and even some chronic diseases. For centuries and in many cultures around the world, the medicinal usage of the Moringa has been used to treat problems such as skin infections, anaemia, anxiety, asthma, blackheads, blood impurities, bronchitis, catarrh, chest congestion, cholera and many other illnesses (Khawaja *et al.*, 2010; Hamza, 2010; Singh *et al.*, 2012) [9, 5, 25].

Moringa is a sole genus in the flowering plant family, Moringaceae. All its parts are not only edible but also healthy, nutritious and with numerous potential uses (Fahey, 2006) [4]. It has medicinal and antioxidant properties and contains a variety of proteins, vitamins and minerals (Kamal, 2008) [7]. Research has also shown that Moringa is extremely low in fats and contains no harmful cholesterol (Bernett *et al.*, 2003) [2]. In addition, *Moringa oleifera* leaves also have various biological activities including the prevention of anemia in both children and adults (Singh *et al.*, 2018) [26].

Every part of *M. oleifera* is a storehouse of important nutrients and anti-nutrients. The leaves of *M. oleifera* are rich in minerals like calcium, potassium, zinc, magnesium, iron and copper (Kasolo *et al.*, 2010) [8]. Vitamins like beta-carotene of vitamin A, vitamin B such as folic acid, pyridoxine and nicotinic acid, vitamin C, D and E also present in *M. oleifera* (Mbikay, 2012) [14]. Phytochemicals such as tannins, sterols, terpenoids, flavonoids, saponins, anthraquinones, alkaloids and reducing sugar present along with anti-cancerous agents like glucosinolates, isothiocyanates, glycoside compounds and glycerol-1-9-octadecanoate (Berkovich *et al.*, 2013) [1]. Moringa leaves also have a low calorific value and can be used in the diet of the obese. The pods are fibrous and are valuable to treat digestive problems and

thwart colon cancer (Oduro *et al.*, 2008) [15]. Pods have 30% of amino acid content, the leaves have 44% and flowers have 31%. The immature pods and flowers showed similar amounts of palmitic, linolenic, linoleic and oleic acids.

Moringa has lot of minerals that are essential for growth and development among which, calcium is considered as one of the important minerals for human growth. *Moringa oleifera* also consists of anti-inflammatory, anti-spasmodic, anti-hypertensive, anti-tumour, anti-oxidant, anti-pyretic, anti-ulcer, anti-epileptic, diuretic, cholesterol lowering, renal, anti-diabetic, (Paliwal *et al.*, 2011; Sharma *et al.*, 2012) [17, 24] and hepatoprotective activities (Lai *et al.*, 2010; Huang *et al.*, 2012) [12, 6]. The Moringa was claimed to be 'the most nutrient-rich plant yet discovered' by Khawaja *et al.* (2010) [9].

Tea is ranked as one of the important world foods and is one of the most widely consumed beverages in the world next to water (Schmidt *et al.*, 2005) [21]. The utilization of plants and plant extracts in tea production has led to tea variants generally called "herbal tea" which are not produced from *Camellia sinensis* leaves. Herbal tea is produced from brewing mixtures of herbs, fruits, seeds, leaves or plant extracts of various plants. Herbal teas are actually mixtures of several ingredients, and are more accurately known as 'tisanes'. Tisanes are made from combinations of dried leaves, seeds, grasses, nuts, barks, fruits, flowers, or other botanical elements that give them their taste and provide the benefits of herbal teas (Ravikumar, 2014; Kumar *et al.*, 2005) [18, 10].

The development of moringa tea presents an exceptional opportunity to harness the potential of moringa leaves, known for their rich nutritional content, while simultaneously addressing the challenge of perishable raw materials. By incorporating complementary ingredients such as basil, lemongrass, rosemary, mint, ginger, cinnamon, cardamom and cumin, this tea not only enhances its flavour profile but also capitalizes on the medicinal properties associated with these ingredients. The present investigation aims to develop a value-added moringa green tea and evaluate its physico-chemical and organoleptic properties.

Materials and Methods

The experiment was conducted in the Post-harvest Technology Laboratory, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India during the year 2022-2024. The experiment was laid out in Completely Randomized Design (CRD) having 09 treatments and 03 replications. The treatments were T₀ (Control), T₁ (Moringa Leaves 75% + Basil 25%), T₂ (Moringa Leaves 75% + Lemon grass 25%), T₃ (Moringa Leaves 75% + Rosemary 25%), T₄ (Moringa Leaves 75% + Mint 25%), T₅ (Moringa Leaves 90% + Ginger 10%), T₆ (Moringa Leaves 90% + Cinnamon 10%), T₇ (Moringa Leaves 90% + Cardamom 10%), T₈ (Moringa Leaves 90% + Cumin 10%).

Preparation and Storage of Moringa Green Tea

Fresh moringa leaves were washed and carefully dried in a hot air oven at 60°C until their moisture content dropped below 6%. Each batch of Moringa green tea was then uniquely flavoured by adding basil, lemongrass, rosemary, mint, ginger, cinnamon, cardamom and cumin. Subsequently, the mixture was thoroughly crushed to ensure

proper mixing and optimal flavour infusion. Finally, the blended green tea was carefully packed into tea bags and sealed using a traditional method involving thread, preserving its freshness and flavour. Small tea bags were filled with moringa green tea and stored at ambient room temperature.

Evaluation of Physico-chemical Properties of Moringa Green Tea

The prepared moringa green tea was evaluated for various physico-chemical properties *viz.*, moisture, ash, fat, protein, carbohydrate, energy and vitamin C. The moisture content was analyzed by oven dry method. The ash content was analyzed by muffle furnace method. The fat content was analyzed by soxhlet extraction method. The protein content was analyzed by kjeldahl method. The carbohydrate content was calculated by difference method. The energy content was calculated by calorific value determination method. The vitamin C content was analyzed by 2, 6-dichlorophenol-indophenol visual titration method. The recorded data of all samples for different parameters were tabulated and statistically analyzed to find out the most suitable treatment combination in terms of physico-chemical properties.

Evaluation of Organoleptic Properties of Moringa Green Tea

The prepared moringa green tea was evaluated for various organoleptic properties *viz.*, colour, taste, flavour, aroma and overall acceptability. The samples were analyzed using the 9-point hedonic scale rating method by a panel of five judges. Each sample was assessed and given a score by the panelists on a scale of 1-9 for each parameter. The mean scores of all samples from all five panelists were tabulated and statistically analyzed to find out which treatment combination is the most acceptable in terms of organoleptic properties.

Results and Discussion

Physico-chemical Properties of Moringa Green Tea

The nutritional value of moringa green tea was evaluated by analyzing its physico-chemical properties *viz.*, moisture, ash, fat, protein, carbohydrate, energy and vitamin C. The data recorded on effect of different treatments on physico-chemical properties of moringa green tea have been presented in Table 1.

Effect of different treatments on Moisture content of Moringa Green Tea

Statistical analysis revealed that moisture content differed significantly across all treatments. The mean values of moisture content ranged from 5.10 to 5.83%. The minimum moisture content 5.10% was recorded in T₇ (Moringa Leaves 90% + Cardamom 10%), while the maximum moisture content 5.83% was recorded in T₀ (Control). Similar results were reported by, Ubbor *et al.* (2022) [28] in herbal tea from moringa leaves and lemon peel powder; Chorage *et al.* (2021) [3] in herbal tea from moringa fortified with ginger and tea leaf powder. Optimum moisture content in moringa green tea ensures flavor retention and microbial stability, enhancing its overall quality and health benefits.

Effect of different treatments on Ash content of Moringa Green Tea: Statistical analysis revealed that ash content differed significantly across all treatments. The mean values

of ash content ranged from 9.87 to 10.51%. The minimum ash content 9.87% was recorded in T₇ (Moringa Leaves 90% + Cardamom 10%), while the maximum ash content 10.51% was recorded in T₈ (Moringa Leaves 90% + Cumin 10%). Similar results were reported by, Wickramasinghe *et al.* (2020) ^[29] in herbal tea developed from moringa leaves; Okafor and Ogbobe (2015) ^[16] in green and black herbal tea from moringa. The ash content in Moringa green tea serves as an indicator of mineral concentration, reflecting its nutritional value and potential health benefits.

Effect of different treatments on Fat content of Moringa Green Tea

Statistical analysis revealed that fat content differed significantly across all treatments. The mean values of fat content ranged from 3.05 to 3.50%. The minimum fat content 3.05% was recorded in T₇ (Moringa Leaves 90% + Cardamom 10%), while the maximum fat content 3.50% was recorded in T₈ (Moringa Leaves 90% + Cumin 10%). Similar results were reported by, Chorage *et al.* (2021) ^[3] in herbal tea from moringa fortified with ginger and tea leaf powder; Shaizad *et al.* (2020) ^[23] in herbal tea from moringa. Low fat content in moringa green tea ensures a lighter mouthfeel, facilitates better extraction of water-soluble bioactive compounds and promotes optimal absorption of phytochemicals, enhancing its health-promoting properties.

Effect of different treatments on Protein content of Moringa Green Tea

Statistical analysis revealed that protein content differed significantly across all treatments. The mean values of protein content ranged from 20.98 to 22.35%. The minimum protein content 20.98% was recorded in T₀ (Control), while the maximum protein content 22.35% was recorded in T₇ (Moringa Leaves 90% + Cardamom 10%). Similar results were reported by, Chorage *et al.* (2021) ^[3] in herbal tea from moringa fortified with ginger and tea leaf powder. Okafor and Ogbobe (2015) ^[16] in green and black herbal tea from moringa. Moringa green tea with high protein content offers enhanced nutritional value, supporting overall health and well-being.

Effect of different treatments on Carbohydrate content of Moringa Green Tea

Statistical analysis revealed that carbohydrate content differed significantly across all treatments. The mean values of carbohydrate content ranged from 58.50 to 60.16%. The minimum carbohydrate content 58.50% was recorded in T₈ (Moringa Leaves 90% + Cumin 10%), while the maximum carbohydrate content 60.16% was recorded in T₄ (Moringa Leaves 75% + Mint 25%). Similar results were reported by, Chorage *et al.* (2021) ^[3] in herbal tea from moringa fortified with ginger and tea leaf powder; Okafor and Ogbobe (2015) ^[16] in green and black herbal tea from moringa. The carbohydrate content in moringa green tea provides energy and enhances taste, making it a satisfying and nourishing beverage option.

Effect of different treatments on Energy content of Moringa Green Tea

Statistical analysis revealed that energy content differed significantly across all treatments. The mean values of energy content ranged from 353.02 to 355.37kcal. The minimum energy content 353.02kcal was recorded in T₈

(Moringa Leaves 90% + Cumin 10%), while the maximum energy content 355.37kcal was recorded in T₇ (Moringa Leaves 90% + Cardamom 10%). Similar results were reported by, Wickramasinghe *et al.* (2020) ^[29] in herbal tea developed from moringa leaves. The energy content in Moringa green tea provides a natural source of vitality, promoting alertness and sustained focus without the crash associated with high-sugar beverages.

Effect of different treatments on Vitamin C content of Moringa Green Tea

Statistical analysis revealed that vitamin C content differed significantly across all treatments. The mean values of vitamin C content ranged from 22.20 to 24.05mg/100g. The minimum vitamin C content 22.20mg/100g was recorded in T₀ (Control), while the maximum vitamin C content 24.05mg/100g was recorded in T₇ (Moringa Leaves 90% + Cardamom 10%). Similar results were reported by, Ubbor *et al.* (2022) ^[28] in herbal tea from moringa leaves and lemon peel powder. Moringa green tea with high vitamin C content offers potent antioxidant benefits, supporting immune health and overall well-being.

Organoleptic Properties of Moringa Green Tea

The sensory acceptability of moringa green tea was evaluated by analyzing its organoleptic properties *viz.*, colour, taste, flavour, aroma and overall acceptability. The data recorded on effect of different treatments on organoleptic properties of moringa green tea have been presented in Table 2.

Effect of different treatments on Colour of Moringa Green Tea

Statistical analysis revealed that organoleptic score for colour differed significantly across all treatments. The mean values of organoleptic score for colour ranged from 7.0 to 8.7. The minimum organoleptic score 7.0 for colour was recorded in T₀ (Control), while the maximum organoleptic score 8.7 for colour was recorded in T₇ (Moringa Leaves 90% + Cardamom 10%).

Effect of different treatments on Taste of Moringa Green Tea

Statistical analysis revealed that organoleptic score for taste differed significantly across all treatments. The mean values of organoleptic score for taste ranged from 6.3 to 8.7. The minimum organoleptic score 6.3 for taste was recorded in T₀ (Control), while the maximum organoleptic score 8.7 for taste was recorded in T₇ (Moringa Leaves 90% + Cardamom 10%).

Effect of different treatments on Flavour of Moringa Green Tea

Statistical analysis revealed that organoleptic score for flavour differed significantly across all treatments. The mean values of organoleptic score for flavour ranged from 6.0 to 9.0. The minimum organoleptic score 6.0 for flavour was recorded in T₀ (Control), while the maximum organoleptic score 9.0 for flavour was recorded in T₇ (Moringa Leaves 90% + Cardamom 10%).

Effect of different treatments on Aroma of Moringa Green Tea: Statistical analysis revealed that organoleptic score for aroma differed significantly across all treatments.

The mean values of organoleptic score for aroma ranged from 5.3 to 8.7. The minimum organoleptic score 5.3 for aroma was recorded in T₀ (Control), while the maximum organoleptic score 8.7 for aroma was recorded in T₇ (Moringa Leaves 90% + Cardamom 10%).

Effect of different treatments on Overall acceptability of Moringa Green Tea: Statistical analysis revealed that

Table 1: Effect of different treatments on Physico-chemical properties of Moringa Green Tea

Treatment	Moisture (%)	Ash (%)	Fat (%)	Protein (%)	Carbohydrate (%)	Energy (kcal)	Vitamin C (mg/100g)
T ₀	5.83	10.09	3.47	20.98	59.63	353.71	23.32
T ₁	5.60	10.40	3.49	21.12	59.40	353.46	22.65
T ₂	5.50	10.35	3.36	21.31	59.48	353.40	22.83
T ₃	5.41	10.26	3.27	21.46	59.59	353.66	23.16
T ₄	5.27	10.12	3.20	21.25	60.16	354.42	23.07
T ₅	5.28	10.07	3.19	21.62	59.84	354.58	23.91
T ₆	5.17	9.91	3.12	22.24	59.55	355.27	23.87
T ₇	5.10	9.87	3.05	22.35	59.63	355.37	24.05
T ₈	5.62	10.51	3.50	21.87	58.50	353.02	22.20
F-test	S	S	S	S	S	S	S
SE(d)	0.03	0.03	0.03	0.04	0.07	0.26	0.35
CV	0.726	0.411	1.097	0.202	0.136	0.090	1.838
CD at 5%	0.067	0.072	0.062	0.075	0.139	0.546	0.732

Table 2: Effect of different treatments on Organoleptic properties of Moringa Green Tea

Treatment	Colour	Taste	Flavour	Aroma	Overall acceptability
T ₀	7.0	6.3	6.0	5.3	6.7
T ₁	7.3	7.7	7.7	7.3	7.7
T ₂	8.0	7.3	8.0	8.0	8.0
T ₃	7.7	7.7	7.7	7.7	7.3
T ₄	8.0	8.0	8.3	8.0	7.7
T ₅	8.3	8.3	8.0	8.0	8.0
T ₆	8.3	8.3	8.3	8.3	8.3
T ₇	8.7	8.7	9.0	8.3	8.7
T ₈	7.3	7.0	8.0	7.3	7.7
F-test	S	S	S	S	S
S.Ed	0.38	0.42	0.42	0.38	0.42
CV	6.004	6.609	6.454	6.209	6.547
CD at 5%	0.809	0.873	0.873	0.809	0.873

Conclusion

Based on the results of assessment, it is concluded that treatment T₇ (Moringa Leaves 90% + Cardamom 10%) has performed best in terms of physico-chemical properties *viz.*, moisture (5.10%), ash (9.87%), fat (3.05%), protein (22.35%), carbohydrate (59.63%), energy (355.57kcal), vitamin C (24.05mg/100g). On the basis of sensory evaluation treatment T₇ (Moringa Leaves 90% + Cardamom 10%) was found most acceptable in terms of organoleptic properties *viz.*, colour (8.7), taste (8.7), flavour (9.0), aroma (8.7), overall acceptability (8.7).

The development of value added moringa green tea represented a promising avenue for harnessing the nutritional potential of moringa leaves and addressing the challenge of perishable raw materials. Through the incorporation of complementary ingredients such as basil, lemongrass, rosemary, mint, ginger, cinnamon, cardamom and cumin, this tea not only offered an enhanced flavour profile but also capitalized on the medicinal properties associated with these ingredients.

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organoleptic score for overall acceptability differed significantly across all treatments. The mean values of organoleptic score for overall acceptability ranged from 6.7 to 8.7. The minimum organoleptic score 6.7 for overall acceptability was recorded in T₀ (Control), while the maximum organoleptic score 8.7 for overall acceptability was recorded in T₇ (Moringa Leaves 90% + Cardamom 10%).

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