Agriculture Association of Textile Chemical and Critical Reviews Journal (2022) 36-40

AATCC Review

28 August 2022: Received
30 October 2022: Revised
08 December 2022: Accepted
25 December 2022: Available Online

http://aatcc.peerjournals.net/

Research Article Open Access

Influence of Blanching and Drying Methods on the Retention of Nutritional Quality of Dried Moringa Leaves

R. Neelavathi*[1], C. Indu Rani**, M. Durgadevi, M. Durgadevi, S. Ezhilmathi, K. Gnanasundari, R. Gokila and M. Prabhu

Horticultural College and Research Institute for Women, Tamil Nadu Agricultural University, Tiruchirappalli, Tamil Nadu, India

Abstract

The research work on "Influence of blanching and drying methods on the retention of quality of dried Moringa (Moringa oleifera Lam.) leaves" was conducted at Horticultural College and Research Institute for Women, Tiruchirappalli, Tamil Nadu. Moringa leaves need to be used on the same day of harvesting due to shorter shelf life and leaf yellowing and suitable processing technique is essential to extend the shelf life. Water blanching of leaves was done at 50o, 60o, 70o and 80oC for 1, 2 and 3 minutes. Among twelve blanching methods, water blanching at 50oC for 3 minutes was found to be the best in retention of total carotenoids, vitamin C, iron and calcium and less non-enzymatic browning in dehydrated moringa leaves. Sensory quality was recorded highest in water-blanched, dehydrated moringa leaves stored in HDPE and LDPE bags. After water blanching at 50oC for 3 minutes, the moringa leaves were dried in sun drying, shade drying and cabinet drying. Among drying methods, the drying ratio was found to be highest in cabinet-dried moringa leaves in water blanching as pre-treatment. Cabinet-dried moringa leaves after water blanching at 50oC for 3 minutes retained the highest total carotenoids (124.65 mg/100g), vitamin C (467.25 mg/100g), iron (21.50 mg/100g) and calcium (1413.10 mg/100g) content. Cabinet drying of moringa leaves after water blanching recorded the least non-enzymatic browning (1.03 O.D.). The sensory quality was found to be highest in cabinet-dried moringa leaves (8.8).

Keywords: *Moringa, Moringa oleifera Lam., blanching, cabinet drying, moisture content, total carotenoids, calcium, iron, non-enzymatic browning*

Introduction

Moringa, *Moringa oleifera* Lam. belongs to the family, Moringaceae. It is also known as "Drumstick tree" and "Horse radish tree". In India, it is cultivated in an area of 38,000 ha. Andhra Pradesh ranks first in cultivation in an area of 15, 655 hectares followed by Karnataka with 10,280 hectares and Tamil Nadu with 7,408 hectares. In Tamil Nadu, Theni, Madurai, Dindigul, Toothukudi, Ariyalur, Tiruppur and Karur districts have been declared as "Export zones of Moringa". It is an important perennial leafy vegetables cultivated mainly for leaves, pods and seeds. Moringa leaves, pods, seeds and flowers are used in various food preparations as moringa leaves contain high nutritional and medicinal values [1]. Moringa leaves are advocated as an outstanding indigenous source of good digestible protein, Vitamin A (378 µg/100g), calcium (440 mg/100g), iron (4 mg /100g), protein (6.7 g/100g) and folic acid. Iron is also present in high value, which can be a great dietary supplement for anaemic patients [2].

Moringa leaves are highly perishable posses very short shelf life due to leaf yellowing and senescence. Saponin content present in moringa leaves gives an unpleasant aroma and bitter taste which reduces the consumer acceptability. Extension of shelf life is need of the hour through the development of value added products of leaves with enhanced nutritional quality. Blanching prevents the enzyme activity and destroys microorganisms present on the vegetable surface reducing risk of food poisoning and reducing the saponin content in the moringa leaves [3] . Blanching

*CorrespondingAuthor: R.Neelavathi.
E-mail Address: - neelapht@gmail.com
DOI:https://doi.org/10.58321/AATCCReview.2022.10.04.36

influences the quality [4], nutritional content and digestibility [5]. Moringa has enormous potential uses but is very less explored. There is a great scope for moringa leaf based products such as soup, cookies, biscuits, bread, moringa panner, moringa chocolates, idli powder, dhal powder and halwa to make them available throughout the year. With increasing malnutrition, the need for nutrient rich value-added products is ever increasing. Ready-to-use moringa leaf powder has the potential of becoming an important product with changing lifestyles. Keeping these in view, the present study was conducted on the influence of blanching and drying methods on the retention of nutritional quality of dried Moringa leaves.

Materials And Methods

The research work on "Studies on blanching and drying methods for the better retention of nutritional quality of dried Moringa (*Moringa oleifera* Lam.) leaves" was conducted at Horticultural College and Research Institute for Women, Tiruchirapalli, Tamil Nadu during 2018-19. The freshly harvested PKM 1 moringa leaves were procured from Thanjavur, Tamil Nadu. The cleaned, washed leaves were subjected to water blanching at 50°, 60°, 70° and 80°C for one, two and three minutes and then dried under a cabinet drier at 50°C for standardizing the blanching treatment. The details are as follows.

T_0 : Without blanching
T_1 : Water blanching at 50°C for one minute
T_2 : Water blanching at 50°C for two minutes
T_3 : Water blanching at 50°C for three minutes
T_4 : Water blanching at 60°C for one minute
T_5 : Water blanching at 60°C for two minutes
T_6 : Water blanching at 60°C for three minutes
T_7 : Water blanching at 70°C for one minute
T_8 : Water blanching at 70°C for two minutes
T_9 : Water blanching at 70°C for three minutes
T_{10} : Water blanching at 80°C for one minute
T_{11} : Water blanching at 80°C for two minutes
T_{12}: Water blanching at 80°C for three minutes.

The drying ratio and rehydration ratio were calculated. Moisture content, total carotenoids, vitamin C, iron, calcium and non-enzymatic browning [6] were estimated to standardize the blanching method for better retention of nutritional quality in dehydrated leaves. Total carotenoids were measured at 452 nm using a spectrophotometer. Ascorbic acid was determined by titrating a known weight of the sample with 2, 6, dichloro phenol indo phenol dye using metaphosphoric acid as stabilizing agent [6]. The sensory evaluation for assessing the colour, flavour and texture of dried moringa leaves was conducted by a panel of seven judges and scoring was done using the nine-point hedonic scale [7] . A score of 5.5 and above were rated as acceptable. Based on biochemical analysis and sensory evaluation, the best blanching method was selected.

The unblanched and water-blanched (best blanching method 50°C for three minutes) leaves were dried using different drying methods *viz*., sun drying, shade drying and cabinet drying.

D_1: Control (Without blanching) + Sun drying
D_2: Control (Without blanching) + Shade drying
D_3: Control (Without blanching) + Cabinet drying
D_4: Water blanching (50°C for three minutes) + Sun drying
D_5: Water blanching (50°C for three minutes) + Shade drying
D_6: Water blanching (50°C for three minutes) + Cabinet drying.

The leaves were spread in the food grade trays and dried under sunlight for drying with frequent turning. Shade drying was carried out in the insect, rodent, dust proof and well ventilated room. In cabinet drying, the leaves were spread in thin layer and dried at a temperature of 50°C for eight hours. In all the drying methods, leaves were turned over frequently for uniform drying. The experiment was laid out in Completely Randomized Design and subjected statistical analysis [8].

Results And Discussion

Moringa leaves were primarily processed and the loss during primary processing was recorded as 58 per cent, edible to non-edible ratio is 0.92:1. The fresh leaves contain 70 per cent moisture, 440 mg/100g calcium, 7 mg/100mg iron, 220 mg /100g vitamin C and 4mg / 100g total carotenoids.

Among twelve treatments, T_9 (Water blanching 70°C for three minutes) recorded better drying ratio (9.00) than other treatments (Table 1). The rehydration ratio was slightly higher (1.94) in T_3 (Water blanching 50°C for three minutes). This might be due to better water absorption, the increased porousness of the cell wall in dehydrated leaves and difference in the number of imbibing materials. Similar report of enhanced

rehydration due to blanching was observed in cabbage [9]. The blanched moringa leaves recorded higher moisture content compared to unblanched dried moringa leaves (4.95%) due to the gel formation on pectin substances of cell membrane which hindered the water removal from the cell. Similar findings were reported [10].

Water blanching at 50°C for three minutes retained a higher amount of total carotenoids (124.65 mg/100 g) and vitamin C (467.25 mg/100 g) followed by water blanching at 60°C for one minute (Fig.1).

There was a noticeable difference in the retention of total carotenoids in the dried moringa leaves might be due to the concentration of total carotenoids during blanching. Though thermal degradation of ascorbic acid occurs, the remarkable stability could be probably due to the inactivation of the ascorbic acid oxidase enzyme during blanching. Water blanching increased cell damage and membrane permeability.

The leaching loss of ascorbic acid increased rapidly as the cells die and cell membrane turned permeable. Loss of vitamin C occurs during the blanching of vegetables was reported [4]. The highest iron (21.50 mg/100g) and calcium content (1413.10 mg/100g) in T_3 (Water blanching at 50°C for three minutes) recorded was due to the concentration of nutrients during blanching. Water blanching might have heavily ruptured the cells and high permeability of the membrane through which nutrients might have leached out.

Non-enzymatic browning was found to be least (1.00) in T_3 (Water blanching at 50°C for three minutes) compared to other treatments. It is due to the fact that inversion of sugar and degradation of ascorbic acid might be the two reasons for the enhanced browning. Moisture in the dried moringa leaves would also have played a crucial role in the formation of browning compounds.

Sensory evaluation showed that the treatments influenced the sensory quality of moringa leaves (Table 3). The overall sensory score is higher (8.7) in T_3 (Water blanching at 50°C for three minutes) followed by T_2 (Water blanching at 50°C for two minutes) due to the reduction in saponin content during blanching [3]. At 50°C, the rate of biochemical reaction is slower and helped in maintaining better colour and texture of dried moringa leaves.

Table1: Effect of blanching methods on moisture content, drying ratio and rehydration ratio of dried moringa leaves

Treatments	Moisture content (%)	Drying ratio	Rehydration ratio
T_0	4.95	11.50	1.91
T_1	5.10	11.33	1.93
T_2	5.14	11.33	1.93
T_3	5.17	12.00	1.94
T_4	5.20	10.67	1.92
T_5	5.37	11.00	1.92
T_6	5.47	10.67	1.92
T_7	5.50	10.17	1.91
T_8	5.52	10.33	1.91
T_9	5.56	09.00	1.91
T_{10}	5.56	09.83	1.91
T_{11}	5.59	09.83	1.91
T_{12}	5.60	09.83	1.90
Mean	**5.36**	**10.58**	**1.92**
CD(0.05)	**0.65**	**0.44**	**0.03**
SEd	**0.32**	**0.22**	**0.01**

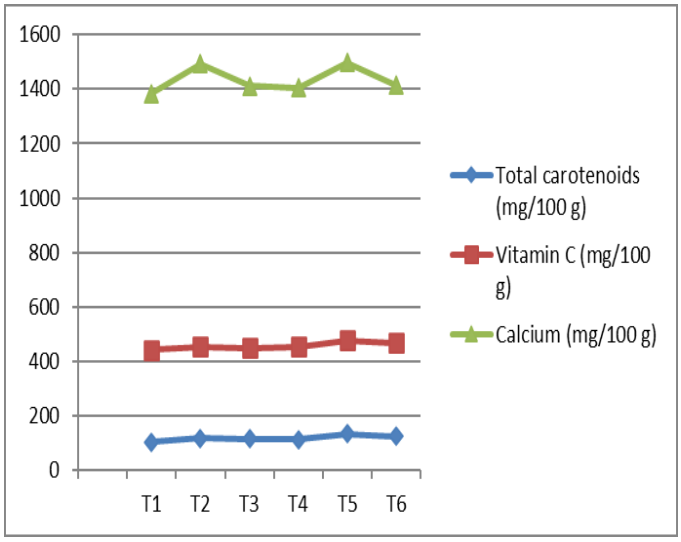

Figure 1. Effect of drying methods on the retention of total carotenoids, vitamin C and calcium content of dried moringa leaves

Water blanching at 50°C for three minutes (T_3) was adjudged as the best blanching treatment. The water blanched (50°C for 3 minutes) and unblanched

moringa leaves were dried under different conditions *viz*. cabinet drying, shade drying and sun drying. Treatment, T_1 recorded the lowest drying ratio (10.50) compared to other treatments (Table 4). The highest drying ratio in blanched, dried moringa leaves might be due to the leakage of water from cells during blanching and removal of water directly to the atmosphere which resulted in better drying. Rehydration ratio was found to be higher in T_3 (1.93) as compared to other treatments and moisture content was found to be lower in T_1 (4.52) as compared to blanching treatments (Table 4).

Table 4 : Sensory evaluation moringa soup made from dried moringa leaves

Treatments	Colour	Flavour	Taste	Overall Sensory score
T_0	7.3	6.9	7.5	7.2
T_1	7.0	7.5	7.0	7.2
T_2	8.0	8.0	8.5	8.2
T_3	8.5	8.5	9.0	8.7
T_4	7.0	7.5	7.1	7.2
T_5	7.3	7.5	7.4	7.4
T_6	7.3	7.6	7.5	7.5
T_7	7.5	7.6	6.0	7.0
T_8	7.7	7.7	6.3	7.2
T_9	7.8	7.7	6.5	7.3
T_{10}	7.8	7.8	6.3	7.3
T_{11}	7.8	7.8	6.6	7.4
T_{12}	7.8	7.8	6.7	7.4
Mean	**7.6**	**7.7**	**7.1**	**7.5**

There was significant difference among the drying methods in the retention of total carotenoids. Total carotenoids content was found to be significantly higher in T_5 (133.61 mg/100g) followed by T_2 (124.65 mg/100g). High retention of total carotenoids observed in blanched, cabinet dried moringa leaves. This might be due to the concentration of total carotenoids during blanching and uniform temperature during drying. Sulphiting in addition to blanching was also more effective in the retention of beta-carotene in the dehydrated moringa leaves [11]. The retention of vitamin C was found to be significantly higher in T_5 (477.50 mg/100g) followed by T_6 (467.25 mg/100g). Thermal degradation is the main reason for decrease in ascorbic acid content. The loss of vitamin C varies with the drying technique employed [12]. Cabinet tray drying was found to be superior in respect of retention of vitamin C, total iron in selected vegetables as compared to sun drying and shade drying [13].

Table 4: Effect of drying methods on moisture content, drying ratio and rehydration ratio of dried moringa leaves

Treatments	Moisture content	Drying ratio	Rehydration ratio
D_1	4.52	10.50	1.89
D_2	4.62	11.12	1.92
D_3	4.75	11.50	1.93
D_4	4.65	11.37	1.88
D_5	4.75	11.25	1.90
D_6	5.12	12.00	1.92
Mean	**4.74**	**11.29**	**1.91**
CD (0.05)	**0.59**	**0.23**	**0.04**
Sed	**0.24**	**0.11**	**0.002**

Table 5. Sensory evaluation of moringa soup made from dried moringa leaves

Treatments	Colour	Flavour	Taste	Consistency	Overall Sensory score
S_1	7.0	7.0	7.0	7.0	7.0
S_2	8.0	7.5	7.5	7.5	7.6
S_3	8.0	8.0	8.0	8.0	8.2
S_4	8.0	7.0	8.0	8.0	7.7
S_5	8.5	8.1	8.5	8.5	8.4
S_6	9.0	8.5	9.0	9.0	8.8
Mean	**8.1**	**7.7**	**8.0**	**8.0**	**8.0**

There was no significant difference on the retention of iron content in the dried moringa leaves dried under different drying methods**.** Studies conducted by various scientists from different parts of the world showed that different drying conditions did not bring significant change in the mineral content of vegetables [14]. Iron content was found to be higher in T_6 (21.50 mg/100g) followed by T_3 (21.08 mg/100g). Blanched, cabinet dried moringa leaves showed high iron content due to the concentration of iron during blanching. The retention of calcium content was found to be higher in T_5 (1498.08 mg/100g) followed by T_6 (1413.10 mg/100g). Higher calcium content was observed in blanched, cabinet dried moringa leaves due to concentration of nutrients during blanching. Blanched and shade-dried moringa leaves recorded higher nutrients content and were used

for standardizing moringa leaf versatile food mix [15]. The dehydrated green leafy vegetable powder retained a good amount of calcium and iron [16].

Non-enzymatic browning was found to be significantly lower in T_6 (1.03 O.D.) followed by T_5 (1.72 O.D.).Sensory evaluation showed that the treatments influenced the sensory quality of moringa leaves (Table 5). The sensory score was higher in T_6 (8.8) followed by T_3 (8.3).

Conclusion

The present study shows that water blanching at 50°C for three minutes retained more nutrients and colour in dehydrated moringa leaves and recorded the highest rehydration ratio and other parameters and concluded that the nutrient contents of the dried moringa leaves were not significantly affected by the blanching and drying methods. Blanching before drying improved the water absorption efficiency of the dried moringa leaves. Among the treatments, total carotenoid content in the dried moringa leaves ranged from 90.30 to 133.61 mg/100g. Moringa leaves dried in cabinet drier after water blanching (50°C for three minutes) retained the higher amount of total carotenoids, vitamin C, iron and calcium. The drying temperature caused decrease in colour parameter. Cabinet drying of moringa leaves after water blanching showed least non enzymatic browning. The sensory quality was found to be higher in cabinet dried moringa leaves.

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