International Journal of Advanced Biochemistry Research

ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2025): 5.29
IJABR 2025; SP-9(10): 285-289
www.biochemjournal.com
Received: 08-07-2025
Accepted: 11-08-2025

AR Mevada
M.Tech Scholar, Department of Processing and Food Engineering, Junagadh Agricultural University, Junagadh, Gujarat, India

SP Cholera
Professor (CAS), Department of Renewable Energy Engineering, Junagadh Agricultural University, Junagadh, Gujarat, India

PJ Rathod
Associate Professor, College of Agriculture, Khapat, Junagadh Agricultural University, Junagadh, Gujarat, India

Darshal Vithalani
M.Tech Scholar, Department of Processing and Food Engineering, Junagadh Agricultural University, Junagadh, Gujarat, India

Ashish Kumar
M.Tech Scholar, Department of Processing and Food Engineering, Junagadh Agricultural University, Junagadh, Gujarat, India

Corresponding Author:
AR Mevada
M.Tech Scholar, Department of Processing and Food Engineering, Junagadh Agricultural University, Junagadh, Gujarat, India

Effect of blanching time on quality parameter of moringa leaves dried using solar tunnel dryer

AR Mevada, SP Cholera, PJ Rathod, Darshal Vithalani and Ashish Kumar

DOI: https://www.doi.org/10.33545/26174693.2025.v9.i10Sd.5838

Abstract
Moringa (*Moringa oleifera*) is widely recognized for its exceptional nutritional and medicinal properties, being rich in protein, vitamins, minerals, antioxidants and bioactive compounds. Maintaining its quality over time is difficult due to its perishable characteristics. The present investigation was undertaken to study the effect of pre-treatment and drying on the quality of moringa leaves powder using solar tunnel dryer. Moringa leaves were processed using hot water with 0.5% KMS for three durations (1, 3 and 5 minutes) and unblanched moringa leaves, followed by solar tunnel drying techniques. The experiment was designed using a three-factor completely randomized design (FCRD) with two replications. Among all Treatments hot water blanching for 1-minute treatment was found to be best, yielding 223.33 mg/g total phenol,71.59% antioxidant activity, 1.51 mg/g chlorophyll a,0.39 mg/g chlorophyll b and 1.90 mg/g total chlorophyll content. All results were statistically analysed using ANOVA and significant differences were determined at the 5% level.

Keywords: Moringa leaves, pre-treatment, blanching time, drying techniques, solar tunnel drying, antioxidant activity

Introduction
Green leafy vegetables (GLVs), particularly *Moringa oleifera*, are vital to human nutrition due to their rich content of vitamins (A, C), minerals (calcium, iron), proteins, antioxidants, and dietary fiber (Anwar *et al*., 2007) [1]. These nutrients are associated with reduced risks of diabetes, cardiovascular diseases, malnutrition, and more (Gupta and Wagle, 1988) [2]. However, the high moisture content of GLVs such as moringa leaves makes them highly perishable, leading to substantial post-harvest losses especially in regions that lack proper storage and processing infrastructure.

To mitigate spoilage and retain nutritional quality, preservation techniques like blanching and drying are commonly employed. Blanching methods help inactivate enzymes that cause browning and nutrient loss, and the addition of potassium metabisulfite (KMS) may further preserve antioxidants (Bamidele *et al*., 2017) [3]. Likewise, solar drying methods especially solar tunnel dryers offer controlled drying environments that outperform traditional sun-drying in both efficiency and product quality. Despite these advancements, there remains insufficient evaluation of how combinations of blanching techniques (with KMS) coupled with solar tunnel drying affect the nutritional, phytochemical, and sensory quality of moringa leaves (Steinteld and Segal, 1986) [4].

This study aims to address this gap by systematically comparing the effects of different blanching pre-treatments (hot water blanching with KMS) followed by solar tunnel drying, on the nutrient retention, antioxidant activity, drying efficiency, and overall qualitative attributes of moringa leaves. The outcomes are expected to inform scalable, low-cost post-harvest protocols for rural and small-scale processors, enhancing the shelf life and nutritional value of moringa-based products.

Martials and Methods
1. Collection and preparation of moringa leaves
The moringa leaves of PKM-1 variety was procured from the forest of Junagadh, Gujarat and then Damaged and discolored leaves were manually removed by hand picking to maintain

the quality of the raw material. The selected moringa leaves were then cleaned properly before further processing.

2. Pre-treatment of moringa leaves

The freshly harvested moringa leaves were subjected to pre-treatment prior to solar tunnel. one moringa leaves sample was kept as unblanched (control), while the remaining moringa leaves underwent a blanching process using hot water blanching with 0.5% KMS, moringa leaves were wrapped in a muslin cloth to blanched by immersing them hot water with 0.5% KMS at 80 °C temperature for 1 min, 3 min, and 5 min.

3. Drying of Moringa Leaves

The fresh unblanched and blanched leaves were weighed and spread in a SS-tray and loaded in solar tunnel dryer. Weighed the leaves every hour and continued drying until constant weight was achieved.

4. Determination of Quality parameters

4.1 WAI (Water absorption index)

The WAI and WSI was determined using the method described by Anderson (1982) [5]. The method involves adding 2.5 g of moringa powder in 25 g of distilled water at 30 °C. A glass rod was used to break up any lumps. After stirring for 30 minutes, the dispersion was rinsed into tarred centrifuge tubes. The solution was then centrifuged at 3000 rpm for 10 minutes. The sediment obtained in the estimation of WAI and calculated using the following equation).

$$\text{WAI,\%} = \frac{\text{Weight of sediments}}{\text{Weight of dry solid powder}} \times 100$$

4.2 Water solubility index

The supernatant liquid was poured carefully into a tarred evaporating dish and dry the supernant The sediment obtained in the estimation of water solubility index and calculated using the following equation).

$$\text{WSI,\%} = \frac{\text{Weight of dissolved solid in supernatant}}{\text{Weight of dry solid powder}} \times 100$$

4.3 Total phenol content

Total phenol content was estimated by the method of Malick and Singh (1980). About 0.1 g of sample was extracted with 10 ml of 80% ethanol and centrifuged. From the supernatant, 0.1 ml was taken and the volume was made up to 3 ml with distilled water. To this, 0.5 ml Folin-Ciocalteu reagent was added, followed by 2 ml of 20% Na_2CO_3 solution after 3 min. The mixture was heated in a boiling water bath for 1 min, cooled, and absorbance was measured at 650 nm using a UV-Visible spectrophotometer. Total phenol content was calculated from a standard curve prepared with catechol and expressed as% of catechol equivalent.

$$\text{Total phenol (mg/g)} = \frac{\text{Graph fcator(µg)} \times \text{Optical density} \times \text{Total vol.(ml)}}{\text{Sample aliquots(ml)} \times \text{Weight of sample (g)} \times 1000}$$

4.4 Antioxidant activity

Antioxidant activity was determined by the DPPH free radical scavenging method (Chandra Shekhar and Anju, 2014) [7]. About 0.1 g of sample was extracted with 10 ml of 90% methanol. DPPH solution was prepared by dissolving 0.012 g DPPH in 100 ml distilled water. One milliliter of extract was mixed with 2 ml of DPPH solution, while the control contained only DPPH solution.

$$\text{DPPH scavenging effect (\%)} = \frac{\text{A control} - \text{A test}}{\text{A control}} \times 100$$

4.5 Chlorophyll content

Chlorophyll content was determined following the method of Kamble *et al*. (2015) [8]. One gram of dry moringa leaf powder was extracted with 20 ml of 80% acetone using a mortar and pestle. The extract was centrifuged at 2500 rpm for 5 min, and the supernatant was transferred into a 50 ml volumetric flask. The volume was made up to 50 ml with 80% acetone, which was also used as blank. Absorbance of the extract was recorded at 645 nm and 663 nm using a UV-Visible spectrophotometer. Chlorophyll a, chlorophyll b, and total chlorophyll contents were calculated using standard equations.

$$\text{Chlorophyll 'a'} \left(\frac{\text{mg}}{\text{g}}\right) = 12.7(A_{663}) - 2.69(A_{645}) \times \frac{V}{1000} \times W \quad \text{Chlorophyll 'b'} \left(\frac{\text{mg}}{\text{g}}\right) = 22.9 \times (A_{645}) - 4.68(A_{663}) \times \frac{V}{1000} \times W$$

$$\text{Total chlorophyll} \left(\frac{\text{mg}}{\text{g}}\right) = 20.2 \times (A_{645}) - 8.02(A_{663}) \times \frac{V}{1000} \times W$$

Results and Discussions

The results obtained for various analytical parameters are outlined in the form of tables for better visibility. The results are also divided into two parts namely: functional analysis and biochemical analysis.

Functional composition

WAI (Water absorption index)

The WAI (Water absorption index) content of the dried moringa leaves ranged from 4.16 to 4.93% WAI (Table.1). As expected, The WAI increased with longer blanching durations. The lowest value (4.16%) was recorded in unblanched sample, while the highest (4.93%) was seen at 5 minutes (M_3) and for blanching time lowest found in 1 min blanching 4.46%. This gradual rise in WAI with blanching duration may be attributed to enhanced gelatinization of starch and breakdown of cell walls, which improves water absorption capacity Paramita *et al*. (2024) [9].

WSI (Water soluability index)

The WSI (Water Solubility index) content ranged for 13.96 to 20.23% showed in Table 1. Highest WSI value found in 5 minute blancing time and lowest in unblanched leaves powder. The 5-minute blanching have caused moderate softening may of tissues and partial breakdown of complex molecules, improving solubility and in unblanched leaves tissues and partial breakdown of complex molecules is less than blanching because of hot water. These result earliest reports by Waseem *et al*. (2022) [10] as well as Bhardwaj *et al*. (2023) [11].

Table 1: Functional parameters of dry moringa leaves powder

Sr. No.	Treatment	WAI	WSI
1	S1M0D1	4.16	13.96
2	S1M1D1	4.46	15.21
3	S1M2D1	4.85	15.60
4	S1M3D1	4.93	15.68

S1=Hot water blanching D1=Solar tunnel drying
M0= Unblanched M1 = 1 min M2= 3 min M3= 5 min

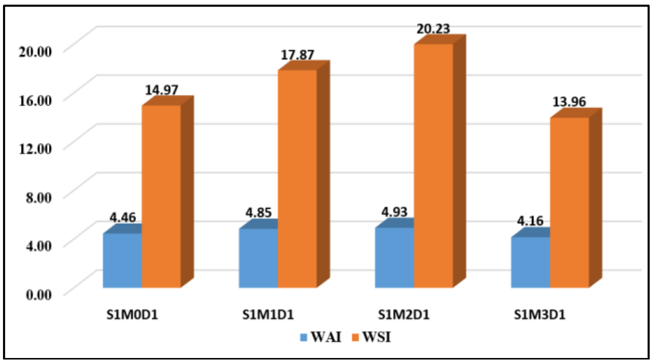

Fig 1: Effect of Blanching time on functional properties of moringa leaves powder

Biochemical analysis

Total Phenol

Total phenol content reflects the antioxidant potential and overall nutraceutical value of dried moringa leaves. These anching time also significantly influenced the phenol content. The highest value (223.33 mg/100 g) was observed at 1-minute blanching (M_1), followed by 202.50 mg/100g at compounds contribute significantly to health promoting properties by combating oxidative damage. Bl 3 minutes (M_2), and the lowest value of 168.33 mg/100g at unblanched sample. This decreasing trend because of prolonged exposure to heat leads to thermal degradation of phenolic compounds, while shorter times are more favorable for their retention (Razzak, 2021) [12].

Antioxidant activity

Antioxidant content indicates the ability of dried moringa leaves to neutralize free radicals and reduce oxidative stress, which contributes to its health-promoting properties. Blanching time had a considerable effect. The highest antioxidant content (71.59%) was observed at 1-minute blanching (M_1), while 3-minute blanching (M_2) followed closely at 68.09%, and a further decline was observed at 5 minutes (M_3) with 65.56% and unblanched sample was observed lowest antioxidant 62.96%. This trend indicates that blanching with short-duration time helped in preserving antioxidant compounds. Longer blanching times tend to reduce antioxidant levels due to heat and oxidation-related losses Kim *et al*. (2013) [13].

Table 2: Biochemical parameters of dry moringa leaves powder

SR. No.	Treatment	Total Phenol (mg/100 g)	Antioxidant activity (%)	Chlorophyll a (%)	Chlorophyll b (%)	Total chlorophyll (%)
1	S1M0D1	168.33	62.96	1.40	0.30	1.70
2	S1M1D1	223.33	71.59	1.51	0.39	1.90
3	S1M2D1	202.50	68.09	1.43	0.34	1.77
4	S1M3D1	178.17	65.56	1.38	0.28	1.67

S1=Hot water blanching D1=Solar tunnel drying
M0= Unblanched M1 = 1 min M2= 3 min M3= 5 min

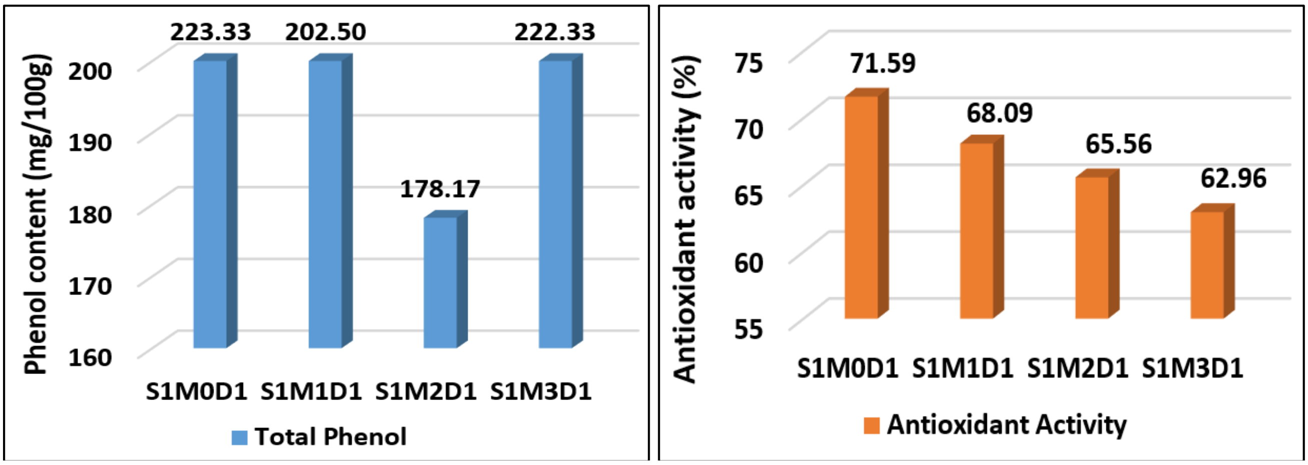

Fig 1: Effect of Blanching time on Phenol and antioxidant activity of moringa leaves powder

Chlorophyll 'a'

Chlorophyll 'a' is one of the primary pigments responsible for the green coloration and photosynthetic activity in moringa leaves. Its retention during processing is crucial for maintaining nutritional and visual quality. Blanching time showed a more visible effect. The highest chlorophyll 'a' content (1.47 mg/g) was found at 1-minute blanching (M_1), while longer times such as 5 minutes (M_3) led to a decline (1.43 mg/g). This trend may be due to prolonged heat exposure leading to breakdown of chlorophyll pigments. Thus, short blanching time appears more favorable for retaining chlorophyll 'a'.

Chlorophyll 'b'

Chlorophyll 'b' is another key pigment in moringa leave that supports photosynthesis and enhances visual apprance. It is more heat-sensitive than chlorophyll 'a', making it a useful indicator of processing impact. Blanching time had a greater influence on chlorophyll 'b'. A 3-minute blanching time (M_2) gave the highest value (0.35 mg/g), while both shorter (M_1-0.34 mg/g) and longer times (M3-0.31 mg/g) were slightly lower because chlorophyll is heat sensitive so longer time in hot water blanching cause of nutritional loss but show in fig unblanched leaves is less chlorophyll content than blanching reasons of KMS solution Because KMS has a behaviour or capacity to retain chlorophyll. This suggests that a moderate blanching duration may be optimal for protecting chlorophyll 'b' from degradation.

Total Chlorophyll

Blanching time had a more noticeable effect. The highest total chlorophyll content was observed at 3-minute blanching (M_2) with 1.83 mg/g, while the 5-minute treatment (M_3) recorded a lower value (1.74 mg/g). This suggests that moderate blanching may help inactivating enzymes effectively without causing excessive degradation of chlorophyll pigments. The results were close agreement with Amin and Lee (2005) [14]. Chlorophyll content also related to sensory properties if chlorophyll directly contact with color is chlorophyll content is more than color retention is more than other treatment. As per the data high chlorophyll value found 1 min.

Solar tunnel drying is better drying method for retention of nutrition as well as blanching time also affect the nutrient Cholera *et al*. (2025) [15] said that Better retention of quality parameter in solar tunnel dried sample on natural air convection mode as compared to sun drying and Use of solar tunnel dryer could reduce the post-harvest loss of 14.71% as compared to traditional sun drying method.

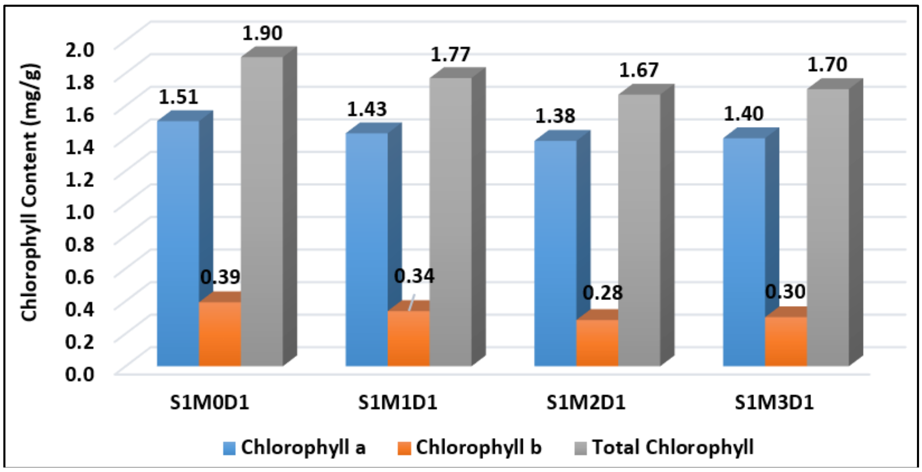

Fig 1: Effect of Blanching time on Phenol and antioxidant activity of moringa leaves powder

Conclusion

Blanching time has a significant effect on the functional parameter and biochemical parameter of moringa leaves powder. Solar tunnel dryer is the better retention of quality parameter and its reduse the post-harvest loss. Overall best treatment was found for blanching is 1 min hot water blanching with KMS solution for quality parameter. Suggestion for further research needs to be carried out regarding the use of variations in blanching time, KMS solution percentage and different types of blanching treatment as well as carrying out sensory propartie of moringa leaves powder.

Acknowledgement

The authors are gratefully acknowledged her major and minor guides for their guidance and support, and her classmates, friends, and family for their constant encouragement throughout this work and their invaluable assistance during this research.

References

1. Anwar F, Latif S, Ashraf M, Gilani AH. *Moringa oleifera*: a food plant with multiple medicinal uses. Phytother Res. 2007;21(1):17-25.
2. Gupta K, Wagle DS. Nutritional and antinutritional factors of green leafy vegetables. J Agric Food Chem. 1988;36(3):472-474.
3. Bamidele OP, Fasogbon BM, Adebowale OJ, Adeyanju A. Effect of blanching time on total phenolic, antioxidant activities and mineral content of selected green leafy vegetables. Curr J Appl Sci Technol. 2017;24(4):1-8.
4. Steinteld A, Segal I. A simulation model for solar thin-layer drying process. Dry Technol. 1986;4(4):535-554.
5. Anderson RA. Water absorption and solubility and amylograph characteristics of roll-cooked small grain products. Cereal Chem. 1982;59(4):265-269.
6. Malick CP, Singh MB. Plant Enzymology and Histo Enzymology. New Delhi: Kalyani Publishers; 1980. p. 286.
7. Chandra Shekhar T, Anju G. Antioxidant activity by DPPH radical scavenging method of *Ageratum conyzoides* Linn. leaves. Am J Ethnomed. 2014;1(4):244-249.
8. Kamble PN, Giri SP, Mane RS, Tiwana A. Estimation of chlorophyll content in young and adult leaves of some selected plants. Univ J Environ Res Technol. 2015;5(6):306-310.
9. Paramita VD, Yuliani HR, Rosalin R, Irawati L. Physiochemical and functional properties of *Moringa oleifera* protein obtained by isoelectric precipitation. Food Res. 2024;8(1):1-8.
10. Waseem M, Akhtar S, Qamar M, Saeed W, Ismail T, Esatbeyoglu T. Effect of thermal and non-thermal processing on nutritional, functional, safety characteristics and sensory quality of white cabbage powder. Foods. 2022;11(23):3802.
11. Bhardwaj S. Development of process protocol for the drying of moringa leaves [MSc thesis]. Himachal Pradesh: Dr. Yashwant Singh Parmar University of

Horticulture and Forestry; 2023. Available from: https://krishikosh.egranth.ac.in/handle/1/5810207127
12. Razzak A. Effect of drying condition on physicochemical and antioxidant properties of dried moringa leaf powder. Food Res. 2021;8:308-318.
13. Kim MH, Kim JM, Yoon KY. Effects of blanching on antioxidant activity and total phenolic content according to type of medicinal plants. Food Sci Biotechnol. 2013;22(3):817-823.
14. Amin I, Lee WY. Effect of different blanching times on antioxidant properties in selected cruciferous vegetables. J Sci Food Agric. 2005;85(13):2314-2320.
15. Cholera SP, Prajapati GV, Chauhan PM, Dulavat MS, Kelaiya SV. Solar tunnel drying for spices: a novel alternative to traditional sun drying. Plant Arch. 2025;25(35):547-554.