RESEARCH PAPER | International Journal of Agricultural Engineering | Volume 10 | Issue 1 | April, 2017 | 10-15
e ISSN–0976–7223 ■ Visit us : *www.researchjournal.co.in* ■ **DOI: 10.15740/HAS/IJAE/10.1/10-15**

Effect of blanching and drying treatment on the proximate composition of *Moringa oleifera* leaves

■ **R.B. KSHIRSAGAR, A.R. SAWATE, S.K. SADAWATE, B.M. PATIL AND M.A. ZAKER**

Received : 24.10.2016; **Revised :** 03.02.2017; **Accepted :** 17.02.2017

See end of the Paper for authors' affiliation

Correspondence to :

R.B. KSHIRSAGAR
Department of Food Engineering, College of Food Technology, Vasantrao Naik Marathwada Krishi Vidyapeeth, PARBHANI (M.S.) INDIA

■ **ABSTRACT :** This research was carried out to investigate the influence of different blanching and drying methods on the proximate composition of *Moringa oleifera* L. Fresh sample of *Moringa* leaves were collected, sorted, blanched (boil blanched, steam and boil blanched with Na_2CO_3) and dried using different methods. The blanched and dried plant samples were analysed separately for proximate composition using appropriate methods. The protein content in the blanched *Moringa oleifera* leaves powder decreased from the unblanched *Moringa oleifera* leaves powder sample. The highest fat content in the boil blanched + sodium bicarbonate blanched sample was recorded (2.1 %) and lowest fat contained in the sample of boil blanched (1.5 %) was recorded. Steam blanching method observed superior among all blanching treatments. It retained maximum amount of crude protein, carbohydrate and crude fibre while crude fat was much more when steam blanching used. Cabinet tray dried leaves powder retained higher protein and fat content as compared to other dried powders.

■ **KEY WORDS :** *Moringa oleifera* leaves, Blanching, Drying, Proximate composition

■ **HOW TO CITE THIS PAPER :** Kshirsagar, R.B., Sawate, A.R., Sadawate, S.K., Patil, B.M. and Zaker, M.A. (2017). Effect of blanching and drying treatment on the proximate composition of *Moringa oleifera* leaves. *Internat. J. Agric. Engg.*, **10**(1) : 10-15, **DOI: 10.15740/HAS/IJAE/10.1/10-15.**

The leaves of *Moringa oleifera* L. had good nutritional and therapeutic values used to prevent or treat protein-energy malnutrition and other nutritional related diseases (Tete-Benissan *et al.*, 2012). *Moringa oleifera* leaves are low in fat and carbohydrate but are excellent sources of amino acids (Rajangam *et al.*, 2001).

Associated with high nutritional value of its edible portions pave a way in making this plant more popular as an important food source in order to combat protein energy malnutrition problem prevailed in most of the under developed and developing countries of the world. Presence of various types of antioxidant compounds make this plant leaves a valuable source of natural antioxidants (Anwar *et al.*, 2007) and a good source of nutraceuticals and functional components as well (Makkar and Becker, 1996). *Moringa* leaves have been reported to contain more vitamin A than carrots, more calcium than milk, more iron than spinach, more vitamin C than oranges, and more potassium than bananas, and that the protein quality of *Moringa* leaves rivals that of milk and eggs. *Moringa* leaves are more potent in nutritional values. Its vitamin C content is seven times more than that of oranges, it has thirteen times more vitamin than spinach and is on a lead on its own when it comes to amino acid 2,000 times more than green tea and 242 times more than apples.

The different methods of processing *viz.*, blanching

and drying could have an effect on the sensorial properties of *Moringa* leaves and the overall acceptability by consumers. The quality and storage life of powder prepared with *Moringa oleifera* parts (leaves, flowers and pods) was improved by the use of primary processing techniques like blanching and dehydration. Blanching which is an important pre-processing heat treatment of vegetable destined for freezing, canning or dehydration inevitably causes separation and loss of water soluble nutrients such as minerals, water soluble vitamins. Sun-dried vegetables have inferior colour, texture and acceptability compared with vegetables dried in the cabinet drier. For *Moringa* leaves with very high moisture contents, dehydration results in considerable reduction in weight and bulk and consequent savings in storage and distribution costs. These leaves could retain 50 per cent of their β-carotene on shade dehydration and the dehydrated leaves could be easily rehydrated and incorporated into traditional Western Indian recipes without altering their acceptability characteristics (Nambiar *et al*., 2003).

Many food preparation and processing techniques have been shown to reduce the antinutrients in many vegetables (Mosha *et al*., 1995 and Gidamis *et al.,* 2003), the process, however, causes significant nutrient losses (Morris *et al.,* 2004). Blanching is a popular vegetable cooking method in Nigeria and involves exposure of vegetables to steam or hot water to tenderise the edible portion.

This study was undertaken to asses the effect of blanching and drying on the nutrient composition of *Moringa oleifera* leaves.

METHODOLOGY

Collection of drumstick varieties:

The prominent variety of drumstick (Koimtoor -1) majorly grown in Marathwada region was selected with concern of horticulturist.

Morphological and physical characteristics of leaves were determined with the help of Vernier Calliper and Electronic Digital Weighing Balance.

Pre-treatments:

Blanching:

Three blanching treatments were selected namely boil blanched water, steam blanching, and boil blanched water with Na_2CO_3. The *Moringa oleifera* leaves were sorted, washed with distilled water and sprayed on muslin cloth then placed in above blanching medias for 3 minutes. Further these blanched leaves of *Moringa oleifera* were dried in a cabinet drier at a temperature of 60º C for 4 hours in a single layer. The dried materials were further milled in a powder with mixer cum grinder, sieved through a 0.4 mm wire mesh and stored in airtight container at room temperature prior to formulations and chemical analysis (Stevel and Babatunde, 2013).

Drying:

Weigh accurately 200g of the drumstick leaves for sun, shadow and cabinet tray drying process (Satwase *et al.,* 2013).

Sun drying:

In this method the fresh drumstick leaves of 200 grams were washed and air dried for few minutes then put on the filter paper. Filter paper with tray placed at a place where adequate amount of sunlight was for 4 days.

Shade drying:

In shade drying the air dried leaves were spread on filter papers and kept in the room which was well ventilated for 6 days. Natural current of air was used for shadow drying the leaves.

Cabinet tray drying:

In cabinet tray drying method, the fresh samples of leaves were washed with sufficient amount of water till it was free from dust, rodents. The drumstick samples spread on to tray and placed into the cabinet tray drier at 60°C for 4 hours. In cabinet tray method, retention of nutrient values was more as compared to other drying methods.

Drumstick powder (Leaf, flower and pod):

After drying, the dried leaves were further grinded in a mixer cum grinder, sieved through a 0.4 mm wire mesh and stored in airtight container at room temperature prior to formulations and chemical analysis (Ukey *et al.,* 2014).

Proximate composition :

Moisture, fat, protein, carbohydrates, crude fibre and ash content were determined by using AOAC methods (AOAC, 2005).

■ RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Morphological characteristics of *Moringa oleifera* leaves (Variety: Koimtoor-1) :

The morphological characteristics of *Moringa oleifera* leaves were observed and pertained as in Table 1.

The leaves are pale green to deep green in colour, compound, and 30-60 cm in length. The leaves are bipinnate or more commonly tripinnate, upto 45 cm long, and are alternate and spirally arranged on the twigs. Pinnae and pinnules are opposite. It has many small leaflets which are 1.0 to 2.0 cm long and 0.6 to 1.0 cm wide. The leaflets are finely hairy, green and almost hairless on the upper surface, paler and hairless beneath, with red-tinged mid veins, with entire (not toothed) margins, and are rounded or blunt-pointed at the apex and short-pointed at the base.

Per cent yield of *Moringa oleifera* leaves powder (Variety: Koimtoor-1) :

The per cent yield of *Moringa oleifera* leaves powder (Variety : Koimtoor-1) was observed and pertained as in Table 2.

The per cent yield of leaves powder prepared depends upon the influence of pretreatment of blanched and the moisture content. The highest value obtained in unblanched leaves was (22 % while lowest yield of leaves was obtained in case of boil blanched + sodium bicarbonate treatment (14 %).

The reduction of per cent yield in treatment of blanching may be due to split upto tissues in the leaves during blanching which had rapid evaporation of water as compared to unblanched sample .

Effect of blanching treatments on proximate composition of *Moringa oleifera* leaves powder :

The effect of blanching treatments on proximate composition of the *Moringa oleifera* leaves powder were studied and given in Table 3.

The obtained values of proximate composition of differently treated *Moringa* leaf powder are summarized in Table 3. The analyzed chemical attributes were moisture, crude protein, crude fibre, crude fat, carbohydrate, ash.

The drying of drumstick leaf reduces the moisture content. The lowest moisture content was observed in steam blanched sample (5.0 %) while highest moisture content was observed in unblanched sample of (5.6 %) which may reduce the shelf-life of prepared powder. Moreover, the boil blanched and sodium bicarbonate treated leaves powder were having low moisture content (5.4 %). However, there was slight difference in moisture content was observed in between blanching and blanching with chemical treatment in drying method. This result is consistent with the findings of Greve *et al.* (1994) and Waldron *et al.* (2003) who showed that cells loose their wall integrity when blanched with steam and thus, bound water is lost faster than in un-blanched samples.

Table 1: Morphological characteristics of *Moringa oleifera* leaves (Variety: Koimtoor-1)

Sr. No.	Parameters	Observation
		Leaves
1.	Colour	Pale green to deep green in colour
2.	Length (cm)	30-60
3.	Leaflets length (cm)	1-2
4.	Width of leaflets (cm)	0.6-1.0

*Each value is average of three determinations

Table 2 : Per cent yield of leaves powder of *Moringa oleifera* (Variety: Koimtoor-1)

Sr. No.	Treatments	*Moringa oleifera* parts (%)
		Leaves
1.	Unblanched (control)	22
2.	Boil blanched	15
3.	Steam blanched	17
4.	Boil blanched + Sodium bicarbonate treatment	14

*Each value is average of three determinations

The fat content in three samples of blanched *Moringa oleifera* leaves powder was in the range of 1.5-2.1 per cent. The highest fat content in the boil blanched + sodium bicarbonate blanched sample was recorded (2.1 %) and lowest fat contained in the sample of boil blanched (1.5 %) was recorded. Unblanched sample contained (3.2 %) fat this indicates that blanching has very limited effect on the fat content of *Moringa oleifera* leaves powder. This result is consistent with the findings of Nkafamiya *et al.* (2010).

The protein content in three samples of blanched *Moringa oleifera* leaves powder was in the range of 16.31-20 per cent. Maximum protein content (20 %) was recorded in the unblanched sample and the minimum one was in boil blanching + sodium bicarbonate sample (16.31 %). The protein content in the blanched *Moringa oleifera* leaves powder decreased from the unblanched *Moringa oleifera* leaves powder sample. The unblanched *Moringa oleifera* leaves contain (20 %). The protein content of the 3 blanching treatment of the *Moringa* leaves compared to the unblanched leaves was significant. Their values are in agreement with the protein content (27.1 %) as Fuglie (2001) reported for *M. oleifera*. This result is consistent with the findings of Nkafamiya *et al.* (2010). Blanching reduced the protein content probably due to leaching (Osum *et al.*, 2013). There was a slight loss in protein amounts in all processed *Moringa oleifera* leaves powder and this slight loss in crude protein was probably due to loss of water soluble nitrogen containing compounds such as free amino acid and nucleotides during blanching (Njoroge *et al.*, 2015).

The carbohydrates are important from nutritional point of view as it provides energy to body. Highest value was obtained in case of boil blanched + sodium bicarbonate sample of 34.70 per cent which was followed by steam blanched 34.26 per cent. The lowest value was observed for unblanched sample which was followed by boil blanched (31.41 % and 33.71 %, respectively). It is observed from Table 3 that among all the samples pretreatment of blanching increased carbohydrates content of *Moringa* leaf powder. Nkafamiya *et al.* (2010) observed that carbohydrate composition declined as a result of blanching. This could be attributed to the breakdown of ketogenic amino acids to glucose thereby increasing the carbohydrate content of the vegetable.

Changes in crude fibre content of the leaves panel listed to different processes were not consistent. Fibre in all processed leaves ranged from 12.26 per cent to 19.03 per cent (Table 3). The blanched sample contained low crude fibre compared with unblanched sample. The lowest fibre content was observed in boil blanched + sodium bicarbonate blanched (12.26 %) and highest in steam blanched (19.03 %). There were no considerable differences in the fibre contents. Blanching treatment affected fibre content of drumstick leaves powder and blanching reduced the crude fibre content this is similar to findings of Nkafamiya *et al.* (2010).

The ash content in three samples of blanched *Moringa oleifera* leaves powder was in the range of 5.0 – 6.7 per cent. Maximum ash content (6.7 %) was recorded in the boil blanched + sodium bicarbonate sample and the minimum one was in boil blanched sample (5.0 %). The ash content in the blanched *Moringa oleifera* leaves powder decreased from the unblanched

Table 3 : Effect of blanching treatments on proximate composition of *Moringa oleifera* leaves powder

Blanching treatment	Proximate composition					
	Moisture content	Crude fat	Crude protein	Carbohydrates	Crude fibre	Ash
Unblanched (control)	5.6	3.2	20	31.41	28.02	8.7
Boil blanched	5.2	1.5	17.01	33.71	14.33	5.0
Steam blanched	5.0	1.9	18.67	34.26	19.03	5.9
Boil blanched + Sodium bicarbonate	5.4	2.1	16.31	34.70	12.26	6.7

*Each value is average of three determinations

Table 4 : Effect of drying methods on proximate composition of *Moringa oleifera* leaves powder

Drying methods	Proximate composition					
	Moisture content	Crude fat	Crude protein	Carbohydrates	Crude fibre	Ash
Fresh leaves	70.1	1.5	6.2	11.7	0.8	1.3
Cabinet tray dried	5.1	9.7	31.9	37.5	11.5	8.3
Shadow dried	5.9	8.7	29.7	42.7	10.9	8.5
Sun dried	5.7	8.9	26.2	43.3	11.3	8.3

*Each value is average of three determinations

Moringa oleifera leaves powder sample. The unblanched *Moringa oleifera* leaves powder was recorded (8.7 %) ash content. This could be attributed to the reduction in moisture contents during drying that resulted in corresponding increases in dry matter contents due to concentration of soluble solids (Fellows, 1990). This result is consistent with the findings of Nkafamiya *et al.* (2010).

Effect of drying methods on proximate composition of *Moringa oleifera* leaves powder :

The effect of drying methods on proximate composition of the *Moringa oleifera* leaves powder were studied and given in Table 4.

The moisture content in the three samples of the dehydrated *Moringa oleifera* leaves powder was in the range of 5.1-5.7 per cent. Maximum moisture content was in shadow dried sample (5.9 %) and minimum was in the cabinet dried sample (5.1 %). Whilst shadow-dried leaves had the highest moisture and relatively dried leaves obtained from cabinet tray drying method might be due to the extremely high temperature (60°C for 4 hrs) applied at a moderately short time. This was because, according to Yousif *et al*. (1999), during the long hours of drying, the heat was conducted from the surface to the interior of the leaves and the rate of evaporation of water on the surface of the leaves was faster than the rate of diffusion to the surface. This result was consistent with the findings of Greve and Waldron (Greve *et al.,* 1994 and Waldron *et al.,* 2003).

Carbohydrate content of the dried *Moringa oleifera* leaves powder was in the range of 37.5-43.3 per cent. The carbohydrate content in the dehydrated powder of sun dried sample was maximum (43.3 %) and minimum was recorded in the cabinet tray dried sample (37.5 %). All heating methods, except cabinet tray drying did appear to affect the carbohydrate content in the moringa leaves. Only the carbohydrate level in cabinet tray dried leaves was found to be different from the raw leaves. Sun dried leaves preserved most of the carbohydrates in the leaves compared with that in the fresh leaves. Cabinet tray dried leaves relatively lost more carbohydrates than all the other drying methods. Generally, during the heating, the starch was turned to dextrin which drove off the water, whilst the sugar caramelised quickly and then burnt. The amount lost due to heating may be the low molecular weight carbohydrates, which are usually lost during heating (FAO, 1980).

The protein content in the three samples of the dehydrated leaves was in the range of 26.2-31.9 per cent. Maximum protein content was in the cabinet tray - dried sample (31.9 %) and minimum protein contained was recorded in the sun dried sample (26.2 %). The fresh drumstick leaves contain 6.2 per cent protein. The difference in the protein content of the three samples of the leaves compared to the fresh leaves was significant. The drying process increased the protein content due to moisture loss (Osum *et al.,* 2013).

The fat content of three dried leaves samples was in the range of 8.7- 9.7 per cent. The fat content was highest in the cabinet dried samples (9.7 %) and lowest in the shadow dried sample (8.7 %). In dehydrated leaves has higher amount of fat content as compared to the fresh one was reported by Vimala (2000).

The fibre content of the cabinet tray dried sample was highest yield (11.5 %) followed by sun dried sample was recorded (11.3 %) and the lowest was recorded in shadow dried sample (10.9 %). The leaf sample was a rich source of fibre.

The results showed that ash contents in shadow-dried leaves sample was significantly higher than in those leaves dried in sun and cabinet tray. Ash content of dehydrated leaves was in the range of 8.3-8.5 per cent. This result was consistent with the findings of Gernah and Sengev (2011).

The result shows that dry leaves are better source of fat, fibre, protein and carbohydrate than the fresh leaves. The trend in change in the proximate composition of the *M. oleifera* leaves at different drying conditions agrees with the work of Adeyemi *et al.* (2014).

Conclusion :

In this study, variation in the proximate composition of *Moringa oleifera* as influenced by the different blanching and drying techniques employed has been established. Steam blanching method observed superior among all blanching treatments. It retained maximum amount of crude protein, carbohydrate and crude fibre while crude fat was much more when steam blanching used. Cabinet tray dried leaves powder retained higher protein and fat content as compared to other dried powders.

Authors' affiliations:
A.R. SAWATE, S.K. SADAWATE, B.M. PATEL AND M.A. ZAKER, Department of Food Engineering, College of Food Technology, Vasantrao Naik Marathwada Krishi Vidyapeeth, PARBHANI (M.S.) INDIA

REFERENCES

Adeyemi, S.B., Ogundele, K.O. and Animasaun, M.A. (2014). Influence of drying methods on the proximate and phytochemical composition of *Moringa oleifera* Lam. *Glob. J. Med. Plant Res.*, **2**(1):1-5

Anwar, F.S., Latif, M.A. and Gilani, A.H. (2007). *Moringa oleifera*: A food plant with multiple medicinal uses. *Phytotherapy Res.*, **21**:17-25.

AOAC (2005). *Official methods of analysis*. Association of official Analytical Chemistry, 16th Ed. Washington DC, U.S.A. p.19.

FAO (1980). Carbohydrates in human nutrition, a Joint FAO/ WHO Report. FAO Food and Nutrition Paper 15, Rome.

Fellows, P. (1990). *Food processing technology*: *Principles and practice*. West Sussex, England. Ellis Horwood Limited; pp. 31-35, 197-208.

Fuglie, L.J. (2001). *The miracle tree: Moringa oleifera: Natural nutrition for the tropics*, (Church World Service, Dakar, 1999). pp. 68. revised in 2001 and published as The Miracle Tree: The multiple attributes of Moringa, p. 172.

Gernah, D.I. and Sengev, I.A. (2011). Effect of processing on some chemical properties of the leaves of drumstick tree (*Moringa oleifera*). *Niger. Food J.*, **29** (1) : 70-77.

Greve, L.C., Shackel, K.A., Ahmadi, H., McArdle, R.N. and Gohlke, J.R. (1994). Impact of heating on carrot firmness: Contribution of cellular turgor. *J. Agric. Food Chem.*, **42**: 2896-2899.

Makkar, H.P.S. and Becker, K. (1996). Nutrional value and anti-nutritional components of whole and ethanol extracted *Moringa oleifera* leaves. *Animal Feed Sci. Technol.*, **63** : 211-228.

Morris, A., Barnett, A. and Burrows, O. (2004). Effect of processing on nutrient content of foods. *Cajanus*, **37**(3) : 160-164.

Mosha, T.C., Gaga, H.E., Pace, R.D., Laswai, H.S. and Mtebe, K. (1995). Effect of blanching on the content of antinutritional factors in selected vegetables. *Plant Foods Human Nutr.*, **47** (4) : 361-367.

Nambiar, V.S., Mehta, R. and Daniel, M. (2003). Polyphenol profile of three Indian green leafy vegetables. *J. Food Sci. & Technol.*, **42**: 503–505.

Njoroge, E.W., Matofari, J.W., Mulwa, R.M.S. and Anyango, J.O. (2015). Effects of blanching time/temperature combination coupled with solar-drying on the nutritional and microbial quality of indigenous leafy vegetables in Kenya. *African J. Food Sci. & Technol.*, **6** (7) : 209-219.

Nkafamiya, I.I., Oseameahon, S.A., Modibbo, U.U. and Haggai, D. (2010). Vitamins and effect of blanching on nutritional and antinutritional values of nonconventional leafy vegetables. *African J. Food Sci.*, **4**(6):335 341.

Osum, F.I., Okonkwo, T.M. and Okafor, G.I. (2013). Effect of processing methods on the chemical composition of *Vitex doniana l*eaf and leaf products. *Food Sci. & Nutr.*, **1**(3): 241–245.

Rajangam, J.A., Manavalan, R.S., Thangaraj, T., Vijayakumar, A. and Muthukrishan, N. (2001). Status of production and utilisation of *Moringa* in Southern India. In: *J. F. Lowell (Ed.), The miracle tree/ the multiple attributes of Moringa. CTA. USA.*

Satwase, A.N., Pandhre, G.R., Sirsat, P.G. and Wade, Y.R. (2013). Studies on drying characteristic and nutritional composition of drumstick leaves by using sun, shadow, cabinet and oven drying methods. Doi: 10.4172/*Scientific Reports* 584 **2**(1):1-4.

Stevel, I.O. and Babatunde, O.I. (2013). Chemical compositions and nutritional properties of popcorn-based complementary foods supplemented with *Moringa oleifera* leaves Flour. *J. Food Res.*, **2**(6) : 117-132.

Tete-Benissan, A., Quashie, M.L.A., Lawson-Evi, K., Kokou, K. and Gbeassor, M. (2012). Nutritional recovery of HIV positive and HIV negative undernourished patients utilizing *Moringa oleifera* leaves. *J. Anim. & Plant Sci.*, **15** (2) : 2184-2199.

Ukey, A., Diamond, J.R., Raheem, A. and Karande, D. (2014). Development of low cost weaning food by the incorporation of drumsticks leaves powder and its quality analysis. *Internat. J. Res. Engg. & Adv. Technol.*, **2**(3):2320 – 8791.

Vimala, V. (2000). Nutritive value of dehydrated green leafy vegetable powders. *J. Food Sci. Technol.*, **37**: 465-471.

Waldron, K.W., Parker, M.L. and Smith, A.C. (2003). Plant cell wall and food quality. *Comprehensive Rev. Food Sci. & Food Safety*, **2** : 128-146.

Waldron, K.W., Parker, M.L. and Smith, A.C. (2003). Plant cell wall and food quality. A review. *J. Sci. Food Technol.*, **2**: 109 – 110.

Yousif, A.N., Scaman, C.H., Durance, T.D. and Girard, B. (1999). Flavor volatiles and physical properties of vacuum-microwave- and air-dried sweet basil (*Ocimum basilicum* L.). *J. Agric. Food Chem.*, **47**: 4777-4781.