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RESEARCH PAPER

Processing and storage studies on water activity of dried moringa pods under tray dryer

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Abstract : Drumstick (*Moringa oleifera* L.) is an important vegetable rich in nutrients and minerals. It belongs to the family Moringaceae. The shelf-life of fresh moringa pods ranged between 3-5 days. Lower shelf-life have led to heavy post harvest losses during peak season. Fresh moringa pods (Annual Moringa type cv PKM-1) handpicked from Horticultural College and Research Institute, TNAU, Periyakulam, Tamil Nadu were used for the study. Pretreatment was given by dipping in boiling water with magnesium oxide (0.1%) for 15 seconds. Moringa pods were cut into chewable size of 5.0 cm length and used in tray dryer. Chewable size moringa pods at a moisture content of 751.35 ± 5.00 per cent (db) was spread as thin layer and deep bed layer dried at 40 and 50°C. Dried samples were packaged using polypropylene and multilayer packaging materials under vacuum and as normal air packaging condition and were stored at ambient (Normal Temperature Pressure (NTP) and at cold storage condition for three months. Dried, packaged and stored moringa pods of 5.0 cm length, dried as thin layer at 50°C in a tray dryer, packaged in multilayer packaging material, sealed under vacuum and stored at cold storage condition recorded minimum water activity value of 0.452 on 90th day of storage.

Key Words : Moringa, Tray dryer, Water activity, Different storage, Packing method, Packaging material, Shelf- life

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INTRODUCTION

Moringa (pod) is a very popular vegetable in South Indian cuisine and valued for its distinct flavour and its nutritional values and significant quantities of vitamin C, calcium, iron, etc. and a good balance of all the essential amino acids. Water activity is widely recognised as an indicator of food stability because, it may correlate with microbial growth and with the rate of chemical reactions such as browning and oxidation, enzymatic reactions and structural or textural changes (Sablani, 2006 and Graciela, 2011).

MATERIAL AND METHODS

Fresh moringa pods (Annual Moringa type cv PKM-1) handpicked from Horticultural College and Research Institute farm, TNAU, Periyakulam, Tamil Nadu were used for the study. Fresh moringa pods were washed in running tap water and pretreatment was given by dipping

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moringa pods in boiling water (96°C) with magnesium oxide (0.1%) for 15 seconds. As the moringa pod is too long to use as such, it was cut into of 5.0 cm in length (ready to cook size) and then used to conduct experiment. Drying reduces moisture content thereby it reduces water activity of the produce to a level at which deterioration does not occur for a definite period of storage. Chewable size moringa pods were dried in tray dryer.

Chewable size moringa pod samples (5.0 cm) were spread as thin layer (density 11.14 kg / m^2) and deep bed (density 22.25 kg / m^2) on perforated aluminium trays and placed inside the tray drier and dried until constant weight (equilibrium moisture content) was reached. Chewable size moringa pods were dried at two different temperatures at 40 and 50°C in a tray dryer with 24 trays at a hot air flow rate of 97.2 m^3 / h. Cross flow cabinet tray dryer (Fig. A) mainly consisted of heating coils, blower, drying chamber, air inlet and outlet openings and thermostat (regulate the temperature inside the drying chamber to a predetermined value). The 18 heating coils (500 watts) were fixed in vertically placed on two sides (opposite to each other) of the drying chamber and to remove the moisture from the samples. Samples at a moisture content of 751.35 ± 5.00 per cent (db) was spread as thin layer and deep bed. Then, samples filled trays were placed on the tray. Thermostat was set to maintain the required temperature inside the drying chamber. Drying was stopped when the sample attained equilibrium moisture content. At the end of each experiment, the dried samples were kept for 30 minutes for moisture and temperature equalization and then stored for further analysis.

Fig. A : Tray dryer

Quality analysis of dried, packaged and stored moringa pods is important to increase shelf-life and availability during off season. After drying, moringa pods were packaged in multilayer (ML) pouch (120 microns) and polypropylene (PP) pouch (100 microns) following the vacuum packaging and normal air packaging methods and samples were stored in cold storage (7±1°C and 80±5% relative humidity), at room condition (temperature 28±2°C and relative humidity 60±5%) storage conditions for three months.

The concept of water activity is important in determining product quality and safety in a particular environment. Water activity meter (M/s Aqua Lab, USA) was used to measure (atmospheric temperature 28 ± 2°C) and recorded triplicate of dried samples and average value water activity was recorded in the present study. During three months of storage period, studies on changes in water activity was carried out at monthly intervals and recorded. The data collected on water activity during the study were statistically analyzed using software IRRISTAT 3/93 version for four Factorial Complete Randomized Design and reported.

RESULTS AND DISCUSSION

Moringa pods were cut into 5.0 cm length and dried as thin layer and deep bed in a tray dryer at 40 and 50°C. Dried samples were packaged using polypropylene and multilayer packaging materials under vacuum condition and as normal air packaging and stored at ambient condition [Normal Temperature Pressure (NTP),] and at cold storage for three months. Water activity values of dried and stored moringa pod samples were determined at monthly intervals and shown in Fig. 1.

Moringa pods of 5.0 cm length, dried as thin layer (density = 11.06 kg/ m^2) at 50°C in a tray dryer recorded an increase in water activity value with increase in storage period irrespective of packaging materials used, packaging methods followed and storage conditions adopted. Among two packaging materials used, multilayer packaging material having good barrier properties recorded minimum increase in water activity value as compared to polypropylene material and shown in Fig. 1 Among two different packaging methods followed, vacuum packaging recorded minimum increase in water activity value as compared to normal air packaging and among two storage conditions adopted, cold storage recorded minimum increase in water activity value as

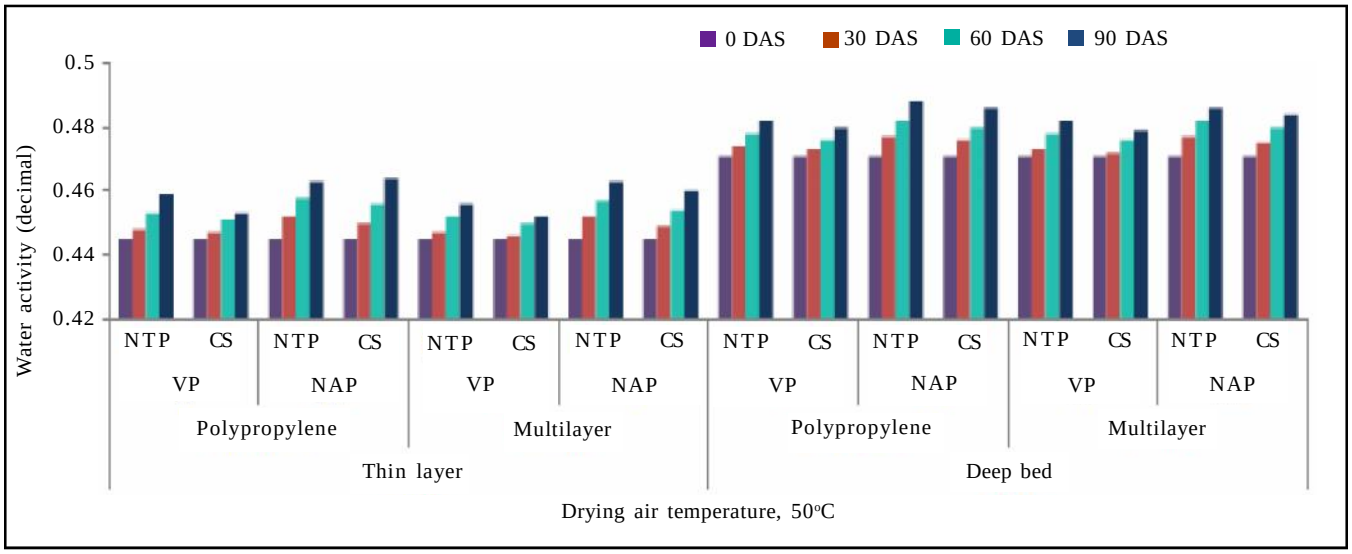

Fig. 1: Effects of drying air temperatures, bed thicknesses, packaging materials, methods of packaging, storage conditions and days of storage on water activity value of 5.0 cm length moringa pods dried at 50°C in a tray dryer

compared to NTP storage. Moringa pods, which recorded a water activity value of 0.445 on the day of start of storage recorded a minimum increase in water activity value in the treatment of moringa pods, packaged under vacuum, stored at cold storage using multilayer film and recorded a value of 0.452 on 90thday of storage. Samples of moringa pods dried as above, packaged in polypropylene as normal air packaging and stored at NTP recorded a maximum water activity value of 0.463 after 90 days of storage. All the other treatments recorded values in between them.

Water activity values recorded during 90 days of

Table 1: Analysis of variance for the effects of days of storage, packaging materials, methods of packaging and storage conditions on water activity value of 5.0 cm length moringa pods dried as thin layer at 50°C in a tray dryer

SV	DF	SS	MS	F
Rep (R)	2	0.00031275	0.00015638	15.17 **
Treatment	31	0.00258963	0.00008354	8.10 **
Days of storage (D)	3	0.00197288	0.00065763	63.78 **
Storage condition (S)	1	0.00008067	0.00008067	7.82 **
Method of packaging (M)	1	0.00028704	0.00028704	27.84 **
Packaging materials (P)	1	0.00005104	0.00005104	4.95 *
D x S	3	0.00002975	0.00000992	NS
D x M	3	0.00011388	0.00003796	3.68 *
D x P	3	0.00001721	0.00000574	NS
S x M	1	0.00000417	0.00000417	NS
S x P	1	0.00000267	0.00000267	NS
M x P	1	0.00001204	0.00001204	NS
D x S x M	3	0.00000525	0.00000175	NS
D x S x P	3	0.00000175	0.00000058	NS
D x M x P	3	0.00000788	0.00000263	NS
S x M x P	1	0.00000267	0.00000267	NS
D x S x M x P	3	0.00000075	0.00000025	NS
Error	62	0.00063925	0.00001031	
Total	95	0.00354163		

cv =0.71%, * and** indicate significance of value at P=0.05 and 0.01, respectively, NS= Non- significant

storage studies were statistically analyzed and reported in ANOVA Table 1. From table, it is seen that the effects of single factors, days of storage (D), methods of packaging (M), storage conditions (S) are highly significant at one per cent level. The effect of packaging materials (P) and two factor interaction D x M were significant at five per cent level. Other two factor interactions namely D x S, D x P, S x M, S x P, M x P, three factor interactions D x S x M, D x S x P, D x M x P, S x M x P and four factor interaction D x S x M x P were non-significant.

Among different treatments studied, treatments D1S1M1P1, D1S1M1P2, D1S1M2P1, D1S1M2P2, D1S2M1P1, D1S2M1P2, D1S2M2P1 and D1S2M2P2 are grouped as 'a'. D2S1M1P1, D2S1M1P2, D2S1M2P1, D2S1M2P2, D2S2M1P1, D2S2M1P2, D2S2M2P1, D2S2M2P1, D3S2M1P2 and D3S1M1P2 are grouped as 'b'.D3S1M1P1, D3S1M1P2, D3S1M2P1, D3S1M2P2, D3S2M1P1, D3S2M1P2, D3S2M2P1, D3S2M2P1, D4S2M1P1, D4S1M2P2 and D2S1M2P1 are grouped as 'c'. D4S1M1P1, D4S1M1P2, D4S1M2P1, D4S 1M2P2, D4S2M1P1, D4S2M1P2, D4S2M2P1, D4S2M2P1 and D3S1M2P2 are grouped as 'd'. As the co-efficient of variance (cv) = 0.71 per cent and four factor interaction is non-significant, the water activity value observed between treatments may be considered as on par with each other.

Among group b, D2S2M1P2 is having low mean value; among group c, D3S2M1P2 is having low mean value and among group d, D4S2M1P2 is having low mean value.

Storage period: D1-0th Day, D2-30th Day, D3-60th Day and D4-90th Day; Storage condition: S1-Ambient condition, S2- Cold storage; Packaging Method: M1-Vacuum packaging, M2- Normal air packaging and Packaging material: P1- Polypropylene, P2 –Multilayer.

However, the treatment D4S2M1P2, which recorded minimum water activity value of 0.452 after 90 days of storage may be considered as the best treatment for 90 days of storage for 5.0 cm length tray dried moringa pods.

Conclusion:

Kaleemullah and Kailappan (2006) also reported an increased water activity value in dried and packaged chillies during storage. The increased water activity values observed in dried, packaged and stored moringa pods in the present study are inline with published results. Moringa pods of 5.0 cm length, dried as thin layer at 50^{o}C in a tray dryer, packaged in multi layer packaging material, sealed under vacuum and stored at cold storage condition recorded minimum water activity value after first, second and third month of storage, respectively and this treatment is highly suitable for export purpose.

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