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Different Packaging and Storage Conditions of Water Activity in Dried Moringa Under Rotary Dryer

KEYWORDS

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ABSTRACT *Drumstick (Moringa oleifera Lam) is belongs to the moringa family Moringaceae. The shelf life of fresh moringa pods ranged between 3-5 days. This leads 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 5.0cm length and used in rotary dryer. Moringa pods filled to 65 and 80 per cent of dryer volume. 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. Moringa pods of 5.0 cm length dried at 50^{0}C, filled to 65 per cent dryer volume in a rotary dryer, packaged in multi layer film, sealed under vacuum and stored at cold storage condition recorded minimum water activity value in multilayer packaging material and among two storage conditions adopted, cold storage recorded minimum increase in water activity value as compared to NTP storage.*

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, protein, potassium, magnesium, selenium, zinc 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, Graciela W.Padua, 2011)

Materials and methods

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

Rotary dryer

Rotary dryer which was used for drying of chewable size (5.0cm) moringa pods in this study was a batch type lab model dryer (Kaleemullah and Kailappan, 2007). It consisted of a heater, blower, drying chamber, mechanism for rotating drying chamber, main frame, thermocouples and thermostat. The schematic diagram of the rotary dryer is shown in Fig. 1.

The experiments were conducted at 20 rpm of drying chamber so that the chewable size moringa pods could be mixed and exposed uniformly to the drying air without the effect of centrifugal force. Chewable size moringa pods weighing 2778 and 3420 gram filled to 65 and 80 per cent of dryer volume at a moisture content 757.65±5.00 per cent (db) were dried in the rotary dryer at temperatures 40 and 50°C using hot air flow rate of 180 m^3/h. The drying process was continued until a constant weight was reached (equilibrium moisture content).

Quality analysis of dried, packaged and stored moringa pods is important to suggest suitable method for processing, packaging and storage of moringa pods to reduce post harvest losses during peak season and 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 different packaging methods *i.e.,* vacuum packaging and normal air packaging. Sealed normal air packaged pouches and vacuum packaged pouches were stored in two different storage conditions *i.e.,* i) cold storage, (7±1°C and 80±5 per cent relative humidity) ii) at room condition (temperature 28±2°C and relative humidity 60±5 per cent) 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 water activity of dried morings pod samples in the present study. The water activity of dried moringa pods were recorded at atmospheric temperature (28 ± 2°C) and was done in triplicate. The average value was recorded as water activity of given sample. During three months of storage period, studies on changes in water activity was carried out at monthly intervals and recorded. The data collected on various quality parameters 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 5.0cm length filled to 65 and 80 per cent dryer volume dried in a rotary dryer at 40 and 50^{0}C. Dried samples were packaged using polypropylene and multilayer packaging materials (ML) under vacuum

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condition (VP) and as normal air packaging. Packaged samples were stored at ambient condition Normal Temperature Pressure (NTP) and at cold storage (CS) for three months. Water activity values of dried and stored moringa pod samples were determined at monthly intervals and shown in Fig. 2.

Dried, packaged and stored moringa pods, moringa pods of 5.0 cm length, filled to 65 per cent dryer volume (2.778 kg) at 50^0C in a rotary dryer recorded an minimum 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. 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 compared to NTP storage. Moringa pods, which recorded a water activity value of 0.358 on the day of start of storage recorded a minimum increase in water activity value in the treatment of moringa pods, packaged in multilayer film under vacuum and stored at cold storage and recorded a value of 0.370 on 90th day 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 0.378 after 90 days of storage. All the other treatments recorded values in between them.

Water activity values recorded during 90 days of 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) and two factor interaction namely DxM were highly significant at one per cent level. All other single factors storage conditions (S), packaging materials (P), two factor interactions namely DxS, DxP, SxM, SxP, MxP, three factor interactions DxSxM, DxSxP, DxMxP, SxMxP and four factor interaction DxSxMxP 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, D3S1M1P1, D3S2M1P1 and D3S2M1P2 are grouped as 'b'. D3S1M1P1, D3S1M1P2, D3S1M2P1, D3S1M2P2, D3S2M1P1, D3S2M1P2, D3S2M2P1, D3S2M2P1, D4S2M1P1, D4S1M1P1, D4S2M1P1 and D2S1M2P1 are grouped as 'c'. D4S1M1P1, D4S1M1P2, D4S1M2P1, D4S1M2P2, D4S2M1P1, D4S2M1P2, D4S2M2P1, D4S2M2P1, D3S1M1P1 and D3S1M1P2 are grouped as 'd'. As the coefficient 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. However, the treatment D4S2M1P2, which recorded minimum water activity value of 0.370 after 90 days of storage may be considered as the best treatment for 90 days of storage for5.0 cm length moringa pods filled to 65 per cent dryer volume at 50^0C in a rotary dryer.

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

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 5.0cm length dried at 50 C, filled to 65 per cent dryer volume in a rotary 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.

Fig.1. Rotary dryer

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 at 50^0C in a rotary dryer filled to 65 per cent dryer volume

SV	DF	SS	MS	F
Rep (R)	2	0.00022640	0.00011320	15.12 **
Treatment	31	0.00255267	0.00008234	11.00 **
Days of storage(D)	3	0.00197992	0.00065997	88.13 **
Storage condition (S)	1	0.00002400	0.00002400	ns
Method of packaging (M)	1	0.00026667	0.00026667	35.61 **
Packaging Materials (P)	1	0.00000004	0.00000004	ns
DxS	3	0.00003542	0.00001181	ns
DxM	3	0.00010642	0.00003547	4.74 **
DxP	3	0.00000754	0.00000251	ns
SxM	1	0.00001667	0.00001667	ns
SxP	1	0.00000204	0.00000204	ns
MxP	1	0.00001838	0.00001838	ns
DxSxM	3	0.00001858	0.00000619	ns
DxSxP	3	0.00002438	0.00000812	ns
DxMxP	3	0.00002638	0.00000879	ns
SxMxP	1	0.00000937	0.00000937	ns
DxSxMxP	3	0.00001688	0.00000563	ns
Error	62	0.00046427	0.00000749	
Total	95	0.00324333		

cv = 0.71%, ** = significant at 1% level; ns= non significant

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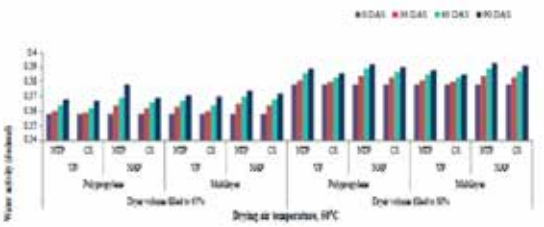

Fig. 2. Effects of days of storage, packaging materials, methods of packaging and storage conditions on water activity value of 5.0 cm length moringa pods dried at 50^{0}C in a rotary dryer filled to 65 per cent dryer volume

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