Plant Archives Vol. 23, No. 1, 2023 pp.368-375 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2023.v23.no1.060

EFFECT OF CHEMICAL PRETREATMENTS ON THE PHYSICAL CHARACTERISTICS OF DEHYDRATED ONION SLICES

Srujana Eda*, V. Sudhavani , D. R. Salomi Suneetha and R.V. Sujatha
Department of Post Harvest Technology, Dr. YSR Horticultural University, Andhra Pradesh, India
*Corresponding author mail: srujanasrujeda7@gmail.com
(Date of Receiving : 23-01-2023; Date of Acceptance : 02-04-2023)

ABSTRACT

The present investigation entitled "Effect of chemical pretreatments on physical characteristics of dehydrated onion slices" was carried out in Department of Post Harvest Technology at College of Horticulture, Dr. Y.S.R. Horticultural University, Venkataramannagudem, West Godavari District of Andhra Pradesh during 2017-18 with an objective to study the effect of different pretreatments on physical characteristics of onion slices. In preparation of dehydrated onion slices, four pre-treatments *viz*., 0.5% KMS, 2% $CaCl_2$, 2% NaCl and control and two varieties *viz.,* Agrifound Dark Red and Phule Safed were used. The experiment was conducted in Completely Randomized Factorial Design with the above two factors at unequal levels and replicated thrice. Among the pretreatments and varieties, onion slices of Agrifound Dark Red pretreated with 0.5% KMS was superior in terms of recovery percentage (14.85%) and the untreated Phule Safed variety (9.05%) with lower recovery. Regarding moisture content, lowest (3.98%) was recorded in onion slices pretreated with 2% $CaCl_2$ and highest (4.69%) was recorded in untreated onion slices, among varieties lowest moisture content was observed in Agrifound Dark Red (4.24%) and highest in Phule Safed (4.29%). Among the pretreatments, lowest dehydration ratio was observed in the onion slices pretreated with 0.5% KMS (7.18) and highest in untreated onion slices (9.61) where as in varieties, lowest dehydration ratio was observed in Agrifound Dark Red (7.41) and highest was found in Phule Safed (8.85). Concerning rehydration ratio, maximum in 0.5% KMS (5.10) and minimum in untreated onion slices (4.80), maximum in Phule Safed (4.97) whereas minimum in Agrifound Dark Red (4.95). Among the pretreatments and varieties, water activity was recorded minimum in 0.5% KMS (0.52) and maximum in untreated onion slices (0.56) and minimum in Agrifound Dark Red (0.54) whereas maximum in Phule Safed (0.55). It was found that, onion slices pretreated with 0.5% KMS were best and recorded low microbial count.

***Keywords*:** onion slices, pretreatments, varieties, physical characteristics

Introduction

The onion (*Allium cepa* L), also known as bulb onion or common onion, is a vegetable and is the most widely cultivated species of the genus *Allium* which belongs to the family Alliaceae. Most of onion cultivars contain about 86.8% moisture, 11.6% carbohydrates, 4% sugar, 9 mg/100g ascorbic acid, 0.2-0.5% calcium, 0.05% phosphorus, 1.2% protein, 2% fibre, 0.1% fat and traces of iron, thiamine and riboflavin (Dev *et al.,* 2006 and Adarsh *et al.,* 2014).

Materials and Methods

The experiment was laid out in factorial CRD with unequal levels. Four pre-treatments *i.e.,* control (without any pretreatment), 0.5% KMS, 2% $CaCl_2$ and 2% NaCl with two varieties *i.e.,* Agrifound Dark Red (Red onion) and Phule Safed (White onion) were used in the experiment. The varieties 'Agrifound Dark Red' and 'Phule Safed' were procured from two different production catchments namely Kurnool and Nasik. Care was taken to select good quality onion by considering significant factors like size, shape and freedom from physical damage. The onion bulbs were then thoroughly cleaned to remove any dirt or dust particles attached to the surface. The cleaned onions were peeled manually by removing the skin and the first layer. After peeling, they were washed thoroughly with water and sliced to 2 to 5 mm thickness by using a sharp stainless steel knife in the direction perpendicular to the vertical axis. Slices were soaked in pretreatment solutions for about 10 minutes and were spread uniformly in thin layer on aluminum trays. Onion slices were then thoroughly dried at 50-60^{o}C temperature till they reached the desired product quality and moisture content *i.e.,* 4-7%. The slices were packed air tight quickly in 200 gauge LDPE (low density polyethylene) covers and subjected to storage studies at ambient conditions for a period of 2 months. The following parameters of dehydrated onion slices were estimated.

Results and Discussions

The fresh onion moisture content was recorded as 86.05 in Agrifound Dark Red and 92.11 in Phule Safed.

Moisture content (%)

The moisture content has steadily increased from initial day of processing to 60 days after storage (table 1). Among the pretreatments, lowest moisture content was recorded in

the onion slices pretreated with 2% $CaCl_2$ from the initial day of storage (3.98%) to 60th day of storage (7.09%) which was followed by onion slices pretreated with 2% NaCl from the initial day of storage (4.08%) to 60th day of storage (7.39%). Highest moisture content was recorded in untreated onion slices from initial day (4.69%) to the final day of storage (8.10%). Among the varieties, lowest moisture content was recorded in Agrifound Dark Red from the initial day of storage (4.24%) to the final day of storage (7.50%) and highest moisture content was recorded in Phule Safed on the initial day (4.29%) to 60th day of storage (8.16%). The interaction effect between pretreatments and varieties was found to be non significant. Lowest moisture content in onion slices pretreated with 2% $CaCl_2$ may be due to the reason that, the calcium ions promote the formation of open structure which results in the faster removal of water (Lewicki *et al*., 2002). A similar observation has been made by Davoodi *et al*. (2007) in dehydrated tomato powder.

Recovery percentage

Effect of pretreatments, varieties and their interactions was found significant on recovery percentage (table 2). Among the pretreatments, the maximum recovery was recorded in the onion slices pretreated with 0.5% KMS (13.97%) and the minimum recovery in the untreated onion slices (10.62%). Among the varieties, the maximum recovery was found in the Agrifound Dark Red variety (13.55%) and the minimum recovery recorded in the Phule Safed variety (11.52%). The increase in recovery may be attributed to reduction in osmotic losses. Similar results were also reported by Vaghini and Chundawat (1986) in Sapota. Maximum recovery percentage was also reported in dehydrated aonla pretreatment with KMS (0.1%) (Prajapati *et al.,* 2011). The Agrifound Dark Red variety (14.85%) pretreated with 0.5% KMS was recorded with higher recovery percentage andthe untreated Phule Safed variety (9.05%) with lower recovery.

Dehydration ratio

The results showed that there was significant difference on dehydration ratio of onion slices and a perusal of statistics were presented in table 3. Among the pretreatments, lowest dehydration ratio was observed in the onion slices pretreated with 0.5% KMS (7.18) followed by onion slices pretreated with 2% $CaCl_2$ (7.59), whereas, highest dehydration ratio was observed in untreated onion slices (9.61). Among the varieties, lowest dehydration ratio was observed in Agrifound Dark Red (7.41) and highest was found in Phule Safed (8.85). Whenever the recovery percent was found higher, dehydration ratio was lower. This reveals the inverse relationship between the percent recovery and its dehydration ratio.

Similar results were also reported by Vaghini and Chundawat (1986). Potassium metabisulphite, MgO and $NaHCO_3$ influenced dehydration ratio in dehydrated bitter gourd (Manimegalai *et al.,* 1998). When in interaction, lowest dehydration ratio was recorded in 0.5% KMS pretreated Agrifound Dark Red variety (6.73) and highest dehydration ratio was observed in untreated Phule Safed onion slices (11.04)

Rehydration ratio

The data pertaining to rehydration ratio recorded maximum in onion slices pretreated with 0.5% KMS from initial day (5.10) to 30th day of storage (4.70) which was followed by onion slices pretreated with 2% $CaCl_2$ from initial day (5.06) to 30th day of storage (4.63) and minimum rehydration ratio was recorded in untreated onion slices from initial day (4.80) to 30th day of storage (4.52) but on 45th day of storage, maximum rehydration ratio was recorded in onion slices pretreated with 2% $CaCl_2$ (4.67) whereas, minimum rehydration ratio was found in untreated onion slices (4.50) and on 60th day of storage, onion slices pretreated with 2% $CaCl_2$ recorded maximum rehydration ratio (4.57) whereas, minimum rehydration ratio was observed in untreated onion slices (4.44).

Among the varieties, maximum rehydration ratio was recorded in Phule Safed on initial day (4.97) to 60th day of storage (4.51) whereas, minimum rehydration ratio was recorded in Agrifound Dark Red on initial day (4.95) to 60th day of storage (4.48) (table 4). Though $CaCl_2$ and NaCl had desirable effects, KMS resulted in best rehydration properties and showed higher value due to the effectiveness of KMS on textural properties. While control sample showed minimum rate of rehydration in tomato (Ghavidel and Davoodi 2010).

As Phule Safed had higher rehydration ratio compared to Agrifound Dark Red it shows more suitability of cultivars for dehydration purpose. Our findings are thus in agreement with the findings of Brahma Singh and Kumar (1984).

Water activity (a_w)

Among the pretreatments, minimum water activity was recorded in the onion slices pretreated with 0.5% KMS from the initial day of storage (0.52) to 60th day of storage (0.62) whereas, maximum water activity was recorded in untreated onion slices (0.56) which was on par with onion slices pretreated with 2 % NaCl from initial (0.56) to 60th day of storage (0.67) (table 5).

Among the varieties, minimum water activity was recorded in Agrifound Dark Red from initial day (0.54) to final day (0.64) and maximum water activity was recorded in Phule Safed on the initial day (0.55) to the final day of storage (0.65). The interaction effect observed on the remaining days of storage between pretreatments and varieties was found to be non significant on all the days of storage. There was an increase in water activity due to the absorption of moisture from air by the samples with progress in storage.

Microbial count (CFU×10^6)

Among the pretreatments, minimum microbial growth was recorded in onion slices pretreated with 0.5% KMS and 2% $CaCl_2$ whereas, maximum microbial growth was observed in untreated onion slices followed by onion slices pretreated with 2% NaCl. Among the varieties, minimum microbial growth was recorded in Agrifound Dark Red and maximum microbial growth was found in Phule Safed (table 6).

By following serial dilution method, microbial growth of onion slices was not observed up to 30th day of storage. Pretreatments and removal of moisture might have aided in the storability of the onion slices. The microbial growth was observed from the 45th day of storage.

Increased microbial load was observed in all the treatments with the advancement of storage period. It was

found that, onion slices pretreated with 0.5% KMS were best and recorded low microbial count. The drying process substantially helped in reducing the microbial count of onion slices by reducing the water activity which resulted in providing safety for consumption and enhancing the shelf life of the product. The main objective of dehydration was removal of free water to the extent where microorganisms could not thrive.

Conclusion

Based on the results obtained from the investigations, it can be concluded that different chemical treatments marked influence on the physical characteristics of onion slices. It was summarized that moisture content and water activity showed increasing trend while rehydration ratio showed decreasing trend. However, better retention of physical attributes were observed in the onion slices prepared from Agrifound Dark Red variety pretreated with 0.5% KMS.

Table 1: Effect of chemical pretreatments on moisture content (%) of onion slices during storage at ambient conditions.

Pretreat-ments	Initial			15thday			30thday			45th day			60th day		
	Agri-found Dark Red	Phule Safed	Mean	Agrifound Dark Red	Phule Safed	Mean	Agrifound Dark Red	Phule Safed	Mean	Agrifound Dark Red	Phule Safed	Mean	Agrifound Dark Red	Phule Safed	Mean
0.5% KMS	4.29	4.33	**4.31**	5.07	5.10	**5.09**	5.69	5.74	**5.72**	6.78	6.80	**6.79**	7.56	7.63	**7.59**
2% $CaCl_2$	3.96	4.00	**3.98**	4.53	4.60	**4.56**	5.38	5.42	**5.40**	6.08	6.12	**6.10**	7.06	7.11	**7.09**
2% NaCl	4.05	4.11	**4.08**	4.78	4.81	**4.79**	5.49	5.52	**5.50**	6.57	6.62	**6.59**	7.36	7.43	**7.39**
Control	4.67	4.72	**4.69**	5.66	5.70	**5.68**	6.20	6.69	**6.44**	7.66	7.71	**7.68**	8.04	8.16	**8.10**
Mean	**4.24**	**4.29**		**5.01**	**5.05**		**5.69**	**5.84**		**6.77**	**6.81**		**7.50**	**8.16**	
	S.Em±	**CD at (0.05)**		**S.Em±**	**CD at (0.05)**		**S.Em±**	**CD at (0.05)**		**S.Em±**	**CD at (0.05)**		**S.Em±**	**CD at (0.05)**	
V	0.012	0.035		0.009	0.026		0.009	0.028		0.014	N.S		0.011	0.034	
P	0.016	0.050		0.012	0.037		0.013	0.040		0.020	0.059		0.016	0.048	
V×P	0.023	N.S		0.017	N.S		0.019	0.057		0.028	N.S		0.023	N.S	

Table 2: Effect of chemical pretreatments on recovery (%) of onion slices during storage at ambient conditions

Pretreatments	Agrifound Dark Red	Phule Safed	Mean
0.5% KMS	14.85	13.10	**13.97**
2% $CaCl_2$	14.00	12.42	**13.21**
2% NaCl	13.15	11.51	**12.33**
Control	12.20	9.05	**10.62**
Mean	**13.55**	**11.52**	
	S.Em±	**CD at (0.05)**	
V	0.009	0.028	
P	0.013	0.039	
V×P	0.018	0.055	

Table 3: Effect of chemical pretreatments on dehydration ratio of onion slices during storage at ambient conditions

Pretreatments	Agrifound Dark Red	Phule Safed	Mean
0.5% KMS	6.73	7.63	**7.18**
2% $CaCl_2$	7.14	8.05	**7.59**
2% NaCl	7.60	8.68	**8.14**
Control	8.19	11.04	**9.61**
Mean	**7.41**	**8.85**	
	S.Em±	**CD at (0.05)**	
V	0.006	0.019	
P	0.009	0.027	
V×P	0.013	0.038	

Table 4: Effect of chemical pretreatments on rehydration ratio of onion slices during storage at ambient conditions.

Pretreatments	Initial			15th day			30th day			45th day			60th day		
	Agrifound Dark Red	Phule Safed	Mean	Agrifound Dark Red	Phule Safed	Mean	Agrifound Dark Red	Phule Safed	Mean	Agrifound Dark Red	Phule Safed	Mean	Agrifound Dark Red	Phule Safed	Mean
0.5% KMS	5.09	5.11	**5.10**	4.88	4.90	**4.89**	4.69	4.70	**4.70**	4.62	4.64	**4.63**	4.49	4.52	**4.50**
2% $CaCl_2$	5.05	5.07	**5.06**	4.80	4.81	**4.81**	4.63	4.64	**4.63**	4.67	4.68	**4.67**	4.56	4.58	**4.57**
2% NaCl	4.87	4.92	**4.89**	4.74	4.75	**4.75**	4.60	4.62	**4.61**	4.53	4.54	**4.53**	4.47	4.44	**4.46**
Control	4.79	4.81	**4.80**	4.59	4.64	**4.61**	4.51	4.53	**4.52**	4.49	4.51	**4.50**	4.39	4.49	**4.44**
Mean	**4.95**	**4.97**		**4.75**	**4.77**		**4.61**	**4.62**		**4.58**	**4.59**		**4.48**	**4.51**	
	S.Em±	**CD at (0.05)**		**S.Em±**	**CD at (0.05)**		**S.Em±**	**CD at (0.05)**		**S.Em±**	**CD at (0.05)**		**S.Em±**	**CD at (0.05)**	
V	0.003	0.009		0.002	0.008		0.003	0.008		0.010	N.S		0.005	0.014	
P	0.004	0.012		0.004	0.011		0.004	0.011		0.014	0.041		0.007	0.020	
V×P	0.006	N.S		0.005	0.015		0.005	N.S		0.019	N.S		0.009	0.028	

Table 5: Effect of chemical pretreatments on water activity (a_w) of onion slices during storage at ambient conditions

Pretreatments	Initial			15th day			30th day			45th day			60th day		
	Agrifound Dark Red	Phule Safed	Mean	Agrifound Dark Red	Phule Safed	Mean	Agrifound Dark Red	Phule Safed	Mean	Agrifound Dark Red	Phule Safed	Mean	Agrifound Dark Red	Phule Safed	Mean
0.5% KMS	0.52	0.53	**0.52**	0.53	0.54	**0.53**	0.57	0.58	**0.57**	0.59	0.60	**0.60**	0.62	0.63	**0.62**
2% $CaCl_2$	0.54	0.55	**0.55**	0.56	0.57	**0.56**	0.59	0.60	**0.59**	0.61	0.62	**0.61**	0.64	0.65	**0.64**
2% NaCl	0.56	0.57	**0.56**	0.58	0.59	**0.58**	0.61	0.62	**0.61**	0.63	0.65	**0.64**	0.66	0.68	**0.67**
Control	0.55	0.57	**0.56**	0.57	0.58	**0.57**	0.59	0.61	**0.60**	0.61	0.63	**0.62**	0.63	0.64	**0.63**
Mean	**0.54**	**0.55**		**0.56**	**0.57**		**0.59**	**0.60**		**0.61**	**0.62**		**0.64**	**0.65**	
	S.Em±	**CD at (0.05)**		**S.Em±**	**CD at (0.05)**		**S.Em±**	**CD at (0.05)**		**S.Em±**	**CD at (0.05)**		**S.Em±**	**CD at (0.05)**	
V	0.002	0.006		0.002	0.006		0.002	0.006		0.002	0.005		0.002	0.006	
P	0.003	0.008		0.003	0.009		0.003	0.009		0.002	0.007		0.003	0.008	
V×P	0.004	N.S		0.004	N.S		0.004	N.S		0.003	N.S		0.004	N.S	

Table 6: Effect of chemical pretreatments on microbial count (CFU×10^6) of onion slices during storage at ambient conditions.

Pretreatments	Initial			15th day		30th day		45th day		60th day	
	Variety	Bacteria	fungi	Bacteria	Fungi	Bacteria	Fungi	Bacteria	fungi	Bacteria	Fungi
0.5% KMS	**Agrifound Dark Red**	0	0	0	0	0	0	0	$1x10^2$	$1x10^2$	$1x10^2$
	Phule Safed	0	0	0	0	0	0	$1x10^2$	$1x10^2$	$1x10^3$	$1x10^3$
2% $CaCl_2$	**Agrifound Dark Red**	0	0	0	0	0	0	0	$1x10^2$	$1x10^2$	$1x10^3$
	Phule Safed	0	0	0	0	0	0	$1x10^4$	$1x10^3$	$1x10^3$	$1x10^4$
2% NaCl	**Agrifound Dark Red**	0	0	0	0	0	0	$1x10^3$	$1x10^3$	$1x10^3$	$2x10^3$
	Phule Safed	0	0	0	0	0	0	$1x10^3$	$2x10^3$	$1x10^3$	$2x10^3$
Control	**Agrifound Dark Red**	0	0	0	0	0	0	$1x10^3$	$2x10^3$	$1x10^3$	$2x10^3$
	Phule Safed	0	0	0	0	0	0	$1x10^2$	$3x10^3$	$1x10^2$	$3x10^3$

Plate 1: Sequence of operations in preparation of onion slices

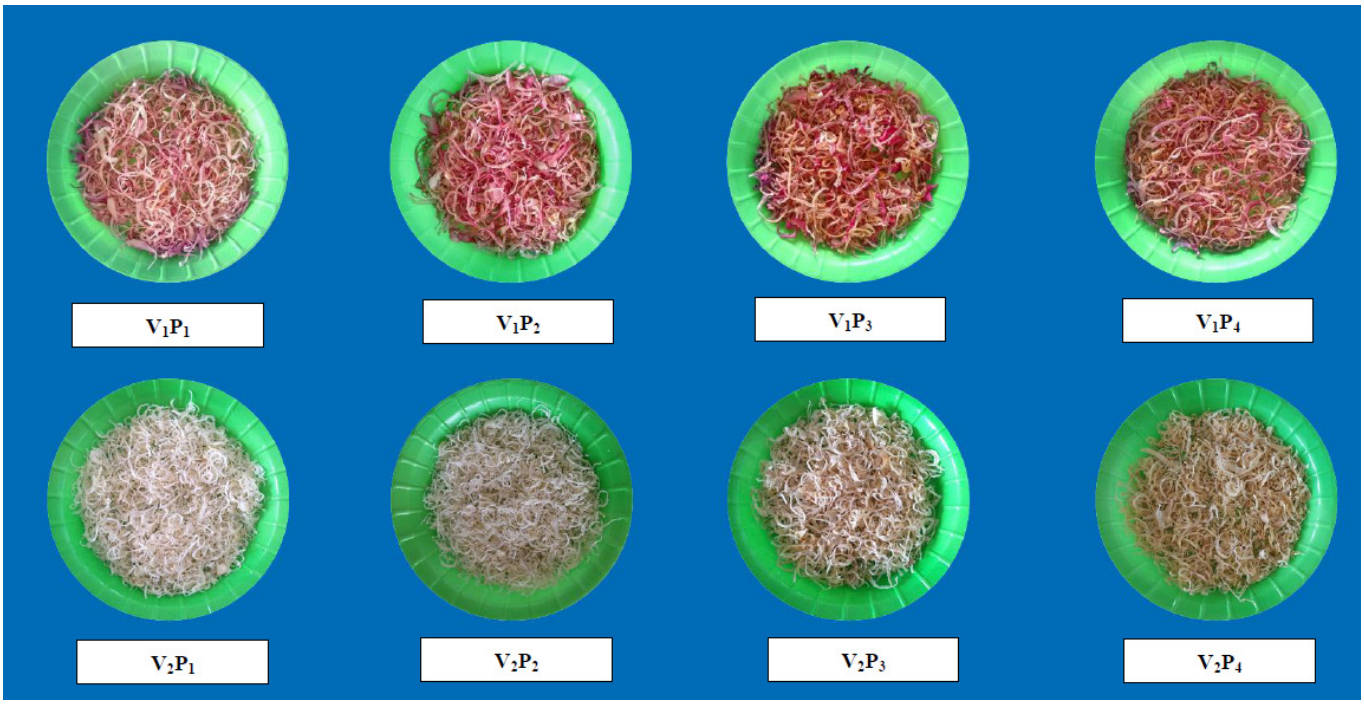

Plate 2: Effect of chemical pretreatments on the initial day of storage in preparation of onion slices during storage at ambient conditions

V_1P_1 - Red onion slices pretreated with 0.5% KMS
V_1P_2 - Red onion slices pretreated with 2% $CaCl_2$
V_1P_3 - Red onion slices pretreated with 2% NaCl
V_1P_4 -Untreated red onion slices
V_2P_1 - White onion slices pretreated with 0.5% KMS
V_2P_2 - White onion slices pretreated with 2% $CaCl_2$
V_2P_3 - White onion slices pretreated with 2% NaCl
V_2P_4 - Untreated white onion slices

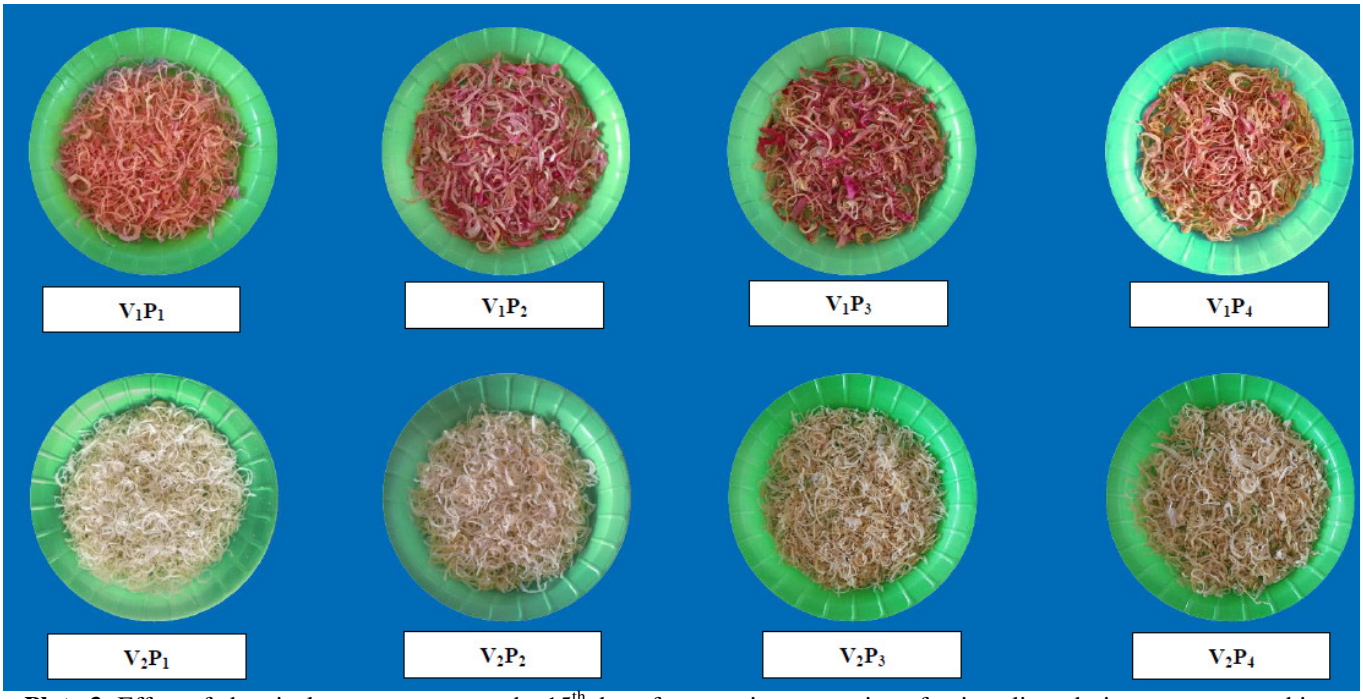

Plate 3: Effect of chemical pretreatments on the 15th day of storage in preparation of onion slices during storage at ambient conditions

V_1P_1 - Red onion slices pretreated with 0.5% KMS
V_1P_2 - Red onion slices pretreated with 2% $CaCl_2$
V_1P_3 - Red onion slices pretreated with 2% NaCl
V_1P_4 -Untreated red onion slices
V_2P_1 - White onion slices pretreated with 0.5% KMS
V_2P_2 - White onion slices pretreated with 2% $CaCl_2$
V_2P_3 - White onion slices pretreated with 2% NaCl
V_2P_4 - Untreated white onion slices

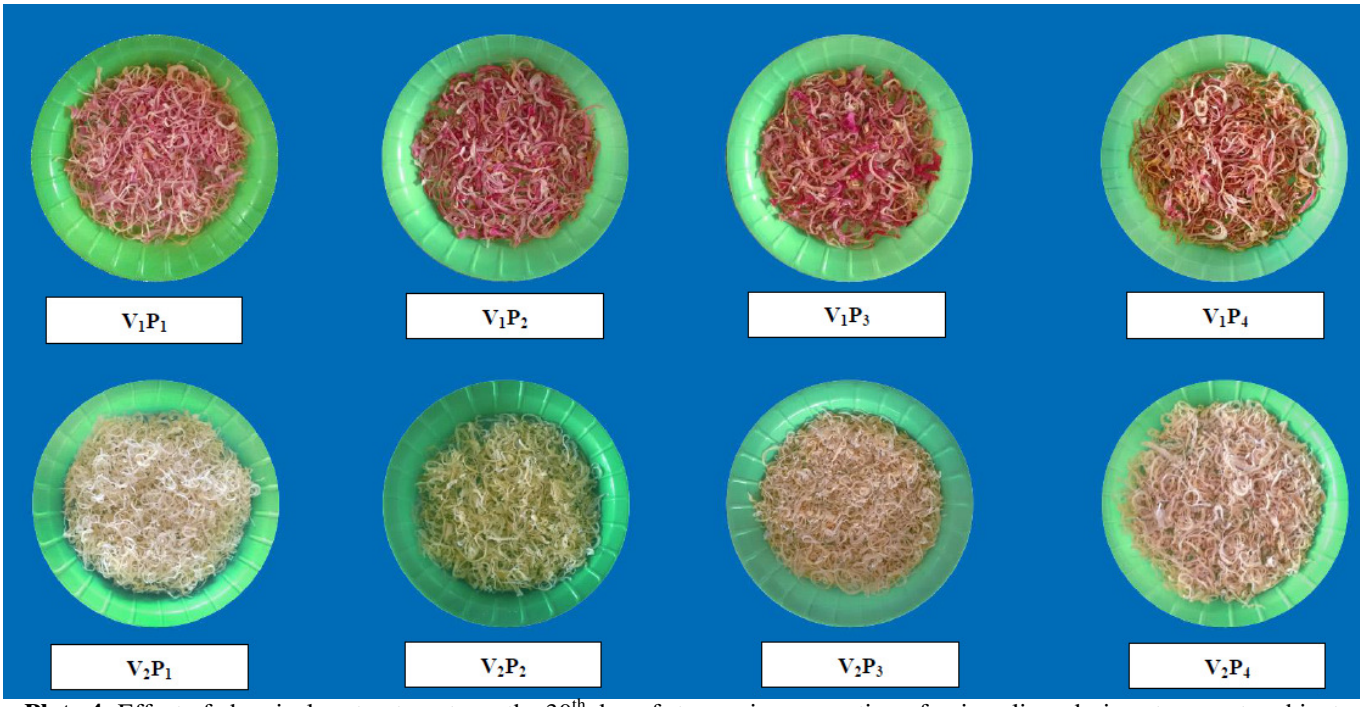

Plate 4: Effect of chemical pretreatments on the 30th day of storage in preparation of onion slices during storage at ambient conditions

V_1P_1 - Red onion slices pretreated with 0.5% KMS
V_1P_2 - Red onion slices pretreated with 2% $CaCl_2$
V_1P_3 - Red onion slices pretreated with 2% NaCl
V_1P_4 -Untreated red onion slices
V_2P_1 - White onion slices pretreated with 0.5% KMS
V_2P_2 - White onion slices pretreated with 2% $CaCl_2$
V_2P_3 - White onion slices pretreated with 2% NaCl
V_2P_4 - Untreated white onion slices

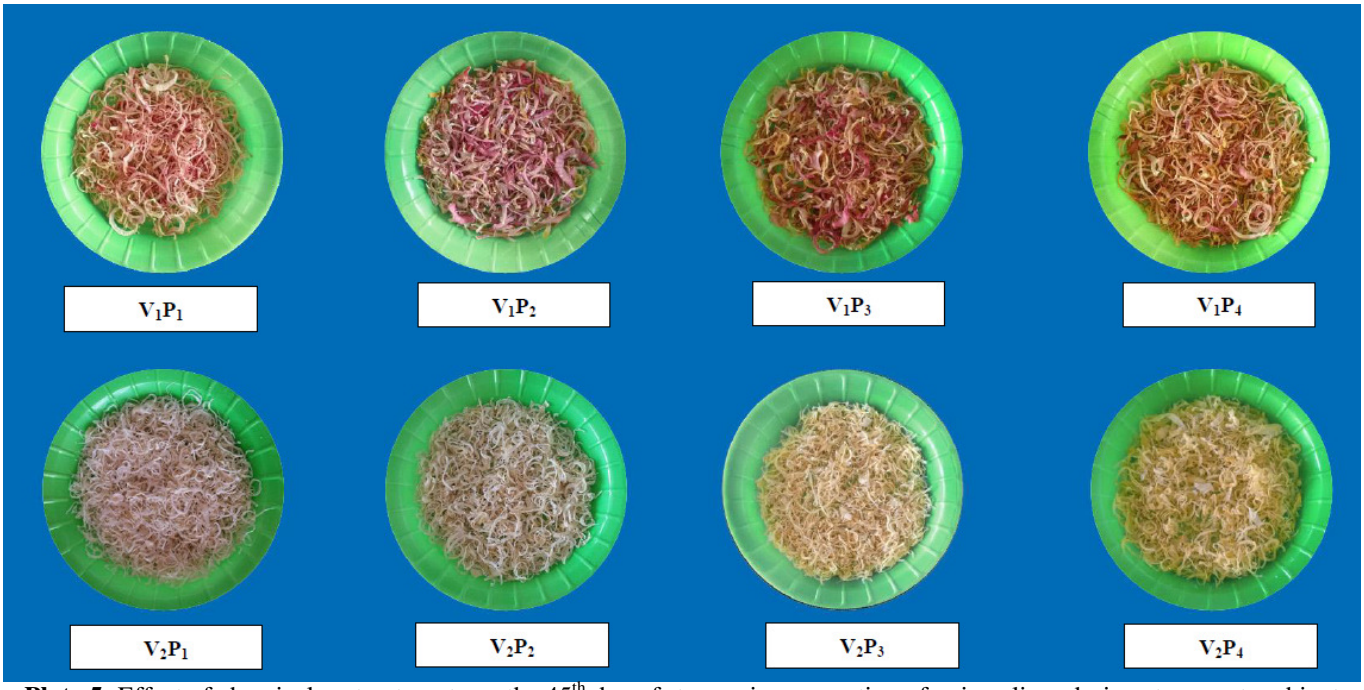

Plate 5: Effect of chemical pretreatments on the 45th day of storage in preparation of onion slices during storage at ambient conditions

V_1P_1 - Red onion slices pretreated with 0.5% KMS
V_1P_2 - Red onion slices pretreated with 2% $CaCl_2$
V_1P_3 - Red onion slices pretreated with 2% NaCl
V_1P_4 -Untreated red onion slices
V_2P_1 - White onion slices pretreated with 0.5% KMS
V_2P_2 - White onion slices pretreated with 2% $CaCl_2$
V_2P_3 - White onion slices pretreated with 2% NaCl
V_2P_4 - Untreated white onion slices

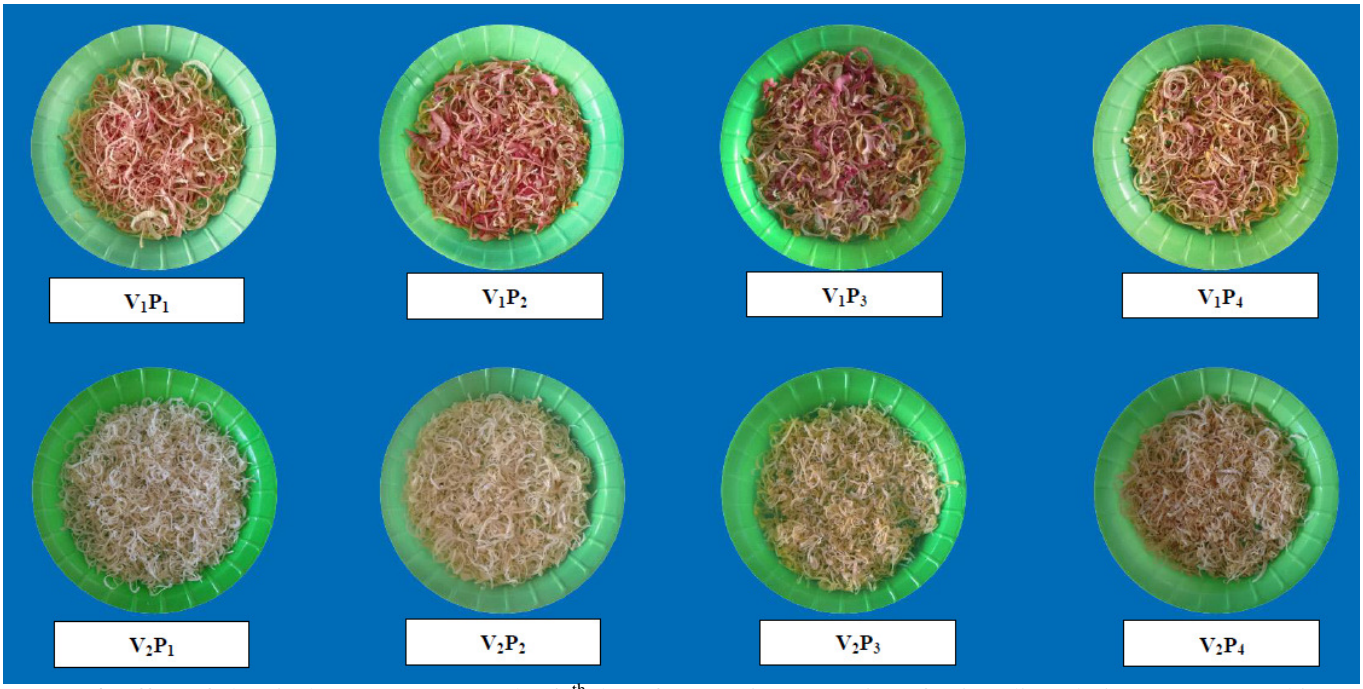

Plate 6: Effect of chemical pretreatments on the 60th day of storage in preparation of onion slices during storage at ambient conditions

V_1P_1 - Red onion slices pretreated with 0.5% KMS
V_1P_2 - Red onion slices pretreated with 2% $CaCl_2$
V_1P_3 - Red onion slices pretreated with 2% NaCl
V_1P_4 -Untreated red onion slices
V_2P_1 - White onion slices pretreated with 0.5% KMS
V_2P_2 - White onion slices pretreated with 2% $CaCl_2$
V_2P_3 - White onion slices pretreated with 2% NaCl
V_2P_4 - Untreated white onion slices

References

Adarsh, K.; Kukanoor, L.; Rekha, E. and Praveen, J. (2014). Influence of pretreatments on physical parameters of dehydrated onion slices. *Plant Archives*, 14(1): 525-528.

Brahma, S. and Mohan, K. (1984). Dehydration of onion varieties. *Indian Food Packer*, 38: 67-74.

Davoodi, M.; Vijayanand, P.; Kulkarni, S. and Ramana, K. (2007). Effect of different pre-treatments and dehydration methods on quality characteristics and storage stability of tomato powder. *Swiss Society of Food Science and Technology,* 40:1832-1840.

Dev, R.; Subanna, V.; Ahlawat, Pardeep, G. and Huddar, A. (2006). Effect of pretreatments on the quality characteristics of dehydrated onion rings during storage. *Journal of Food, Agriculture & Environment*, 4(1): 30-33.

Ghavidel, R. and Davoodi, M. (2009). Effect of chemical pretreatments and dehydration methods on quality characteristics of tomato powder and its storage stability. *International Journal of Biological, Biomolecular, Agricultural, Food and Biotechnological Engineering,* 3(9): 330-339.

Manimegalai, G. and Ramah, S. (1998). Effect of pre-treatments on the quality characterstics of dehydrated bitter gourd rings. *Indian Food Packer*, 52(4): 7-10.

Lewicki, P.; Witrowa, D.; Pomaranska, W. and Nowak, D. (1998) Rehydration properties of dried onion. *International Journal of Food Properties*, 1(3): 275-290.

Prajapati, V.; Prabhat, K. and Rathore, S. (2011). Effect of pretreatment and drying methods on quality of value-added dried Aonla (*Emblica officinalis*) shreds. *Journal of Food Science and Technology,* 48(1): 45-52.

Vaghini, S. and Chundawat, B. (1986). Sundrying of Sapota (*Achras sapota* L.) fruits. *Indian Food Packer*, 40(2): 23-28.