International Journal of Agriculture Sciences
ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 11, Issue 9, 2019, pp.-8408-8411.
Available online at https://www.bioinfopublication.org/jouarchive.php?opt=&jouid=BPJ0000217

Research Article

POSTHARVEST QUALITY AND CURING TIME OF *AGGREGATUM* ONION (CO-5) SUBJECTED TO DIFFERENT CURING METHODS

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Received: May 02, 2019; Revised: May 11, 2019; Accepted: May 12, 2019; Published: May 15, 2019

Abstract: The harvested *Aggregatum* onion bulbs (CO-5) were cured by field curing, shade curing and artificial curing at three velocities of the blower (2, 4 and 6ms^{-1}). The objective of the study is to use the developed artificial curing system as an alternative method during unfavorable weather conditions. The curing time and quality parameters like geometrical properties, PLM%, pyruvic acid, total soluble solids and redness (a*) value were studied. Among all the methods, the curing was faster in artificial curing (6ms^{-1}) whereas shade curing took maximum time for complete curing. The PLM%, pyruvic acid, TSS and the color value were found to increase significantly during curing. The PLM% was found to be minimum for artificial curing-6ms^{-1} (16.3%).The redness value was higher for shade curing and lower for field curing. The curing of bulb was faster with artificial curing (6ms^{-1}) and therefore it is recommended for curing onion bulbs.

Keywords: *Aggregatum onion, Curing method, Ambient air, Physical and chemical properties*

Citation: Nivedida J.A., *et al*., (2019) Postharvest Quality and Curing Time of *Aggregatum* Onion (Co-5) Subjected to Different Curing Methods. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 11, Issue 9, pp.- 8408-8411.

Academic Editor / Reviewer: Dr V Arun Prasath, Kapil Kumar Sharma

Introduction

Onion a semi-perishable commodity needs to be properly cured before it is stored. In tropical countries like India, onions are traditionally cured in field for 5 to 7 d. The major loss is encountered during the post-harvest life. During 2016-17, India produced 21.7 million metric tonnes of onions which is about 20 % of global production. India is the second largest producer of onion second to China. Out of the total production in India 60 % comes during *rabi* season (April and May) and this output is stored by farmers and traders to meet the domestic and export market up to the next *kharif* crop (October-November and January-February). Onion produced during *kharif* season is of poor quality and 40 percent of the production is lost due to decay and other factors [1]. Curing is one of adopted to enhance the biological stability, which decides the shelf life of onion during storage. It is the process of drying the outer scale until it reaches a rustling dry stage, accompanied by internal changes, drying and closes of neck. The simple compounds present in the outer scale get polymerized and produce some chemicals which have antibiotic properties effective against fungi attacking bulbs [15]. Curing can reduce the incidence of neck rot, reduces water loss during storage, and it is essential for the development of good scale color [12]. Curing temperatures less than 35ºC for a limited duration can reduce the severity of sour skin or slippery skin in storage significantly [14]. Proper curing technique can prevent the onion bulbs from shrinkage and sloughing due to excessive drying [11]. Curing onion with forced air at 30ºC for 3-5 d can curtail the spread of fungal pathogens during long-term storage. It is also recommended, curing of onions in an air current of 30ºC for 4-8 d [1]. During unfavorable weather conditions, the removal of surface moisture and vital heat from the onion bulb becomes a problem. The farmers face a difficult situation as the traditional methods of curing is unfit and storing of the onions becomes a challenging task. So, the farmers tend to sell the bulk produce at a lower price suffering huge loss. This study was undertaken 1) To develop an artificial curing system to accelerate the curing process as an alternative to traditional curing process. 2) Performance evaluation of the designed curing system and compare with the other methods of curing.

Materials and methods

The *Aggregatum* onions bulbs (CO-5) were harvested from a field in Theethipalayam, Coimbatore, Tamil Nadu during February, 2018. The curing study were conducted in Field curing (T_1), Shade curing (T_2) and Artificial curing with blower velocity of 2ms^{-1}, 4ms^{-1} and 6ms^{-1} (T_3,T_4 and T_5). The field curing was done for 50 kg of onion by subjecting it to windrow method for 1 d and heap method for 4 d (may vary based on the environmental conditions). Shade curing was performed by placing 50 kg of onion under the shade of cement sheet roof. Artificial curing system was developed with a capacity to cure 50 kg of *Aggregatum* onion. The artificial curing system consists of a blower, plenum chamber, reducer and cubic chamber to hold onions with two perforated plates. The air is supplied by centrifugal fan (1 hp) with forward curved blade that blows air to the curing chamber. The velocity of the air can be adjusted using gate valve and was measured using an anemometer (Model:EQUINOX, EQ619). Plenum chamber of 0.385m x0.385 x 0.385m was made using 18 gauge GI materials. The plenum chamber was connected to the curing chamber (0.5x0.5x0.5m) by a reducer of frustum shape with large and small diameter of 0.285mm and 1.105mm. The curing chamber is open at the top and the bottom is provided with a galvanized iron mesh of 12.7x12.7 mm square holes which supplies air to the bulbs. The ambient air temperature recorded during curing was 27 to 33º C which was employed for artificial curing system.

Table-1 *Geometrical properties of Aggregatum onion before and after curing in different methods*

Geometric properties		T1	T2	T3	T4	T5
Equatorial diameter,cm(E)	Initial	3.24±0.06	3.28±0.10	3.01±0.08	3.01±0.11	3.6±0.11
	Final	2.25±0.07	2.28±0.05	2.25±0.08	2.39±0.08	2.98±0.11
Polar diameter,cm(P)	Initial	3.18±0.04	3.07±0.12	2.87±0.06	2.87±0.04	3.11±0.04
	Final	3±0.11	2.16±0.08	2.24±.0.10	2.03±0.06	2.55±0.08
Thickness,cm(T)	Initial	2.64±0.01	2.64±0.04	2.48±0.04	2.48±0.11	2.55±0.11
	Final	2.02±0.09	2.02±0.06	2.10±0.06	2.12±0.04	2.39±0.07
Arithmetic mean diameter, cm(A)	Initial	3.02±0.01	3.01±0.01	2.80±0.01	2.83±0.03	3.09±0.02
	Final	2.43±0.04	2.15±0.06	2.22±0.04	2.15±0.04	2.51±0.14
Frontal surface area, cm2(F)	Initial	7.17±0.03	7.12±0.06	6.18±0.06	6.28±0.11	7.50±0.11
	Final	4.62±0.17	3.63±0.20	3.86±0.12	3.64±0.12	4.97±0.54
Cross surface area,cm(C)	Initial	8.10±0.05	8.02±0.18	6.91±0.13	7.07±0.10	8.82±0.19
	Final	5.30±0.05	3.85±0.21	4.06±0.10	3.68±0.13	5.12±0.67
Shape index(S.I)	Initial	1.12±0.03	1.14±0.05	1.13±0.01	1.18±0.06	1.28±0.07
	Final	0.90±0.05	1.09±0.01	1.04±0.04	1.10±0.06	1.07±0.11

*all values were expressed in mean± standard deviation

Methods: T_1 -Field curing, T_2 -Shade curing, T_3-Artificial curing at 2ms^{-1}, T_4 -Artificial curing at 4ms^{-1} and T_5 -Artificial curing at 6ms^{-1}

Table-2 *Effect of curing on physical and chemical characteristics of onion*

Treatments	Physiological mass loss (%)	Pyruvic acid (µmolg^{-1})		Total soluble solids (Brix)		Color value (Redness a*)	
		Initial	Final	Initial	Final	Initial	Final
T_1	16.3±0.08	1.39±0.01	2.68±0.01	10.42±0.11	14.29±0.23	13.16±0.26	18.69±0.33
T_2	15.66±0.4	1.26±0.01	2.31±0.02	10.11±0.24	14.33±0.18	13.42±0.07	22.81±0.38
T_3	11.56±0.11	1.44±0.01	1.82±0.01	10.60±0.19	14.36±0.33	13.57±0.33	20.54±0.28
T_4	8.5±0.12	1.39±0.01	1.74±0.01	10.24±0.04	14.41±0.16	13.86±0.06	19.92±0.48
T_5	6.3±0.13	1.32±0.01	1.70±0.01	10.52±0.04	14.47±0.35	13.49±0.05	19.77±0.22

*all values are expressed in mean± standard deviation

Methods: T_1 -Field curing, T_2 -Shade curing, T_3-Artificial curing at 2ms^{-1} T_4 -Artificial curing at 4ms^{-1} and T_5 -Artificial curing at 6ms^{-1}

The curing was performed until complete drying and closing of the neck of bulbs, and checked by the visual lack of moisture by pressing the bulbs with the fingers [5]. The physical and chemical quality parameters like pyruvic acid [16], total soluble solids using pocket refractometer (PAL-1 (M/s. Atago, Tokyo) with a range of 0-53° Brix), color by Colour flex meter, Hunter Associates Laboratory, Inc., model: 65/10°) were observed and compared. The value of "a" specify the tendency of the color change from green to red (negative to positive value). The physiological mass loss was calculated and expressed in percentage using the formula as follows

$$PLM\ (\%) = \frac{Initial\ weight(g) - Final\ weight(g)}{Initial\ weight(g)} \times 100 \qquad (1)$$

Selected geometrical properties namely polar diameter, equatorial diameter, thickness and shape were measured. The linear dimensions of onion bulb namely polar diameter (P), equatorial diameter (E) and thickness (T) were measured using a digital Vernier calliper (M/s. Mitu Toyo, Japan) of 0.01 mm least count. Polar diameter is the distance between the onion crown and the point of root attachment to the onion. Equatorial diameter is the maximum width of the onion in a plane perpendicular to the polar diameter. The thickness is measured as the dimension between equatorial and polar diameter surfaces of onion bulbs which is smaller than other two dimensions. The shape of onion bulbs is oval if the shape index is >1.5, whereas, if the shape index <1.5 it is spherical. The arithmetic mean diameter (A), frontal surface (F), cross-sectional of areas (C) and shape index of the bulbs were calculated using the following relationships [3],

$$PLM\ (\%) = \frac{Initial\ weight(g) - Final\ weight(g)}{Initial\ weight(g)} \times 100 \qquad (2)$$

$$Frontal\ surface\ area, cm2\ (F) = \frac{\pi}{4} \times E \times P \qquad (3)$$

$$Cross\ sectional\ area, cm2\ (C) = \frac{\pi}{4} \times \frac{(E+P+T)^{\wedge}2}{9} \qquad (4)$$

$$Shape\ Index(S.I) = \frac{E}{\sqrt{P \times T}} \qquad (5)$$

Data were subjected to the analysis of variance with $p < 0.05$ using statistical package SPSS software for Windows Version 16. Mean and standard deviation (SD) were also calculated [Table-1] and [Table-2]

Results and Discussion

The effect of field curing, shade curing and artificial curing was evaluated by comparing periodical observation of quality parameters and the results were tabulated in [Table-2]. Field curing (T1) required 132h whereas; shade curing (T2) took maximum time of 156h for complete curing onion. The artificial curing system at velocity 2ms^{-1}, 4ms^{-1}and 6ms^{-1} (T_3, T_4 and T_5) required 84h, 60h and 48h for complete curing respectively. This may be due to uniform supply of air with minimum pressure drop around the bulbs with artificial curing when compared to natural curing.

Geometrical properties

The mean values of polar diameter, equatorial diameter, thickness, cross sectional area, frontal surface area, arithmetic mean diameter and shape index of onion for different methods were presented in the [Table-1]. These results were in compliance with the observation of equatorial diameter and polar diameter was 6.2 ± 1.4 and 4.2 ± 0.8 respectively for Granex-Grano type sweet onions respectively [9]. For all the methods of curing, shape index was < 1.5, the *Aggregatum* onions bulbs were in spherical shape. Similar results were reported in [4] for CO-4 onion bulbs.

Physiological mass loss

The physiological mass loss increased linearly for all methods of curing as the time progressed. The physiological mass loss was maximum in T_1 (16.3 %) followed by T_2 (15.7 %) and it was minimum in T_5 (6.3 %). The onions cured by T_3 and T_4 found to have physiological mass loss of 11.6 and 8.5 percent respectively. The physiological mass loss increased over the time of curing and was highly significant for T_1, T_4 and T_5 ($p<0.01$). Thus the longer exposure of T_1 cured onion to sun radiation could have led to more loss in moisture there by leading to higher weight loss of onion. The moisture content loss is related to the curing time from 7.2% at 24 h, to 8.3% at 48 h, to 9.3% at 72 h, to 10.3% at 96 h [10].

Pyruvic acid

The pyruvic acid content increased for all the method of curing as the time increased. The pyruvic acid was highly significant for all the treatment and was significant for T_1. At the end of curing, T_1 attained the maximum pyruvic acid content of 2.68±0.01µmolg^{-1} whereas T_5 had minimum of 1.70±0.01µmolg^{-1}.

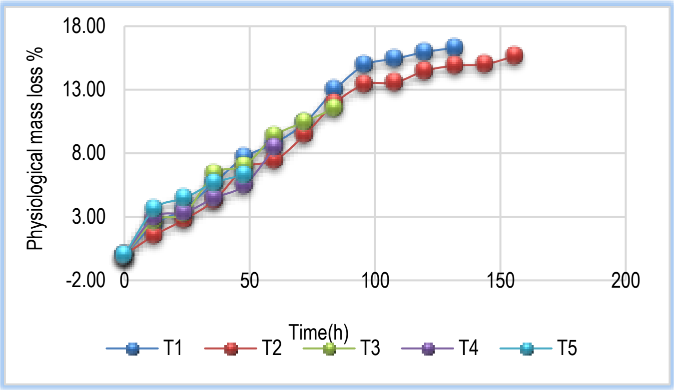

Fig-1 Effect of curing method on physiological mass loss

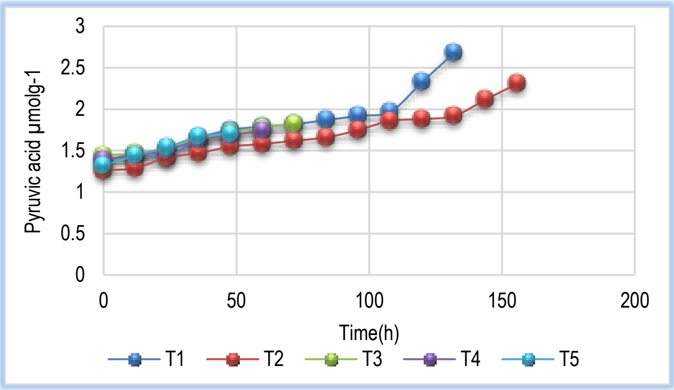

Fig-2 Effect of curing method on Pyruvic acid

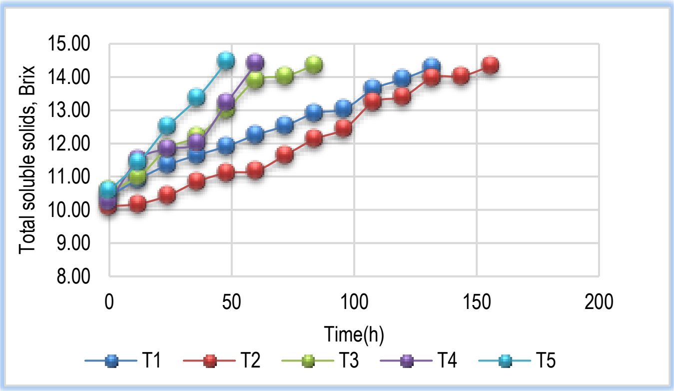

Fig-3 Effect of curing method on total soluble solids

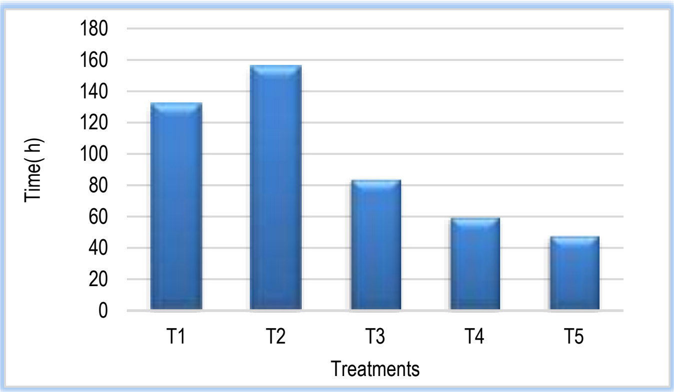

Fig-4 Curing duration for all methods of curing

Methods: T1 -Field curing, T2 -Shade curing, T3- Artificial curing at 2ms-1, T4 -Artificial curing at 4ms-1 and T5 -Artificial curing at 6ms-1

Onion pungency changes are allied with breaking the dormancy during curing [6]. Thus curing resulted in increasing the dormancy of the bulbs, the pyruvic acid content increased with increase in curing time.

Total soluble solids

The TSS increased as the curing time increased for all the methods of curing and was highly significant at 1 percent level. The increase in TSS content with curing time is in agreement with that observed by [11] for Bellary onion and [7] for *aggregatum* onion. Similar results were reported in [8] observed half-siblings progenies of multiple onion bulbs dry matter and total soluble solids had increased as the weight decreased over storage period.

Color value (Redness a*)

The color value was compared between all method of curing and it was found to be significant at $p<0.01$. The redness a* value was higher for T_2 (22.81±0.38) followed by T_3 (20.54±0.38) and lower for T_1 (18.69±0.33). The longer exposure to sun might have resulted in lower color development in T_1 when compared to other method. Results showed that onions cured artificial curing system developed more enhanced color than field cured bulbs. Similar results were reported in [13] that artificial cured onions had lower weight loss and enhanced color development compared to field cured onion bulbs.

Conclusion

The *Aggregatum* onion bulbs cured by artificial curing ($6ms^{-1}$) recorded a minimum physiological weight loss and minimum change in the quality parameters like pyruvic acid and TSS. The field cured onion recorded the highest weight loss and reduction in the quality parameters. The onions bulbs cured by shade curing and artificial curing ($2ms^{-1}$) developed more color when compared to other methods of curing. Results revealed that artificial curing of onion is efficient and faster (by 48h) providing bulbs with complete dried skin and can be suggested during the unfavorable condition to proceed with natural curing.

Application of research: Curing is the process adopted in fresh produce to enhance the biological stability of the produce. It helps to optimizes maximum storage life and protect quality against handling damage, diseases and promotes natural dormancy.

Research Category: Onion curing, handling and storage

Abbreviations: PLM- Physiological mass loss

Acknowledgement / Funding: Authors are thankful to Agricultural Engineering College & Research Institute, Tamil Nadu Agricultural University, Coimbatore, 641003, Tamil Nadu, India.

***Research Guide or Chairperson of research: Dr S. Ganapathy**

University: Tamil Nadu Agricultural University, Coimbatore, 641003, India

Research project name or number: PhD Thesis-Development of improved forced air ventilated storage structure for *Aggregatum* onion (CO-5)

Author Contributions: All authors equally contributed

Author statement: All authors read, reviewed, agreed and approved the final manuscript. Note-All authors agreed that- Written informed consent was obtained from all participants prior to publish / enrolment

Study area / Sample Collection: Theethipalayam, Coimbatore, Tamil Nadu

Cultivar / Variety name: *Allium cepa* - aggregatum onion

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.

Ethical Committee Approval Number: Nil

References

[1] Anonymous (1989) *International standards ISO/DIS* 1673.
[2] *Financial express report* (2017).
[3] Bahnasawy A.H., El-Haddad Z.A., El-Ansary M.Y. and Sorour H.M. (2004) *Journal of Food Engineering*, 62, 255–261.
[4] Banuu Priya E. P., Esther Magdalene Sharon M., Sinja V. R. J. and Alice R.P.S. (2015) *International Journal of Agricultural Science and Research*, 5(5), 323-332.
[5] Cardoso D. S. C. P., Pereira A. M., Correia T.D. and Finger F.L. (2016) *Rev. Ceres, Viçosa*, 63(6), 822-828.
[6] David E.K. and William M.R. (1997) *HortScience*, 32(7), 1260-1263.
[7] Kaveri G. (2014) *Optimization of storage parameters for shelf life enhancement of CO 4 onion bulbs (Allium cepa L. var. aggregatum Don.), Unpublished Ph.D. Thesis, Department of Food and Agricultural Process Engineering, Tamil Nadu Agricultural University, Coimbatore*.
[8] Maia M.C.C., Pedrosa J.F., Torres filho J., Negreiros M.Z de. and BezerraNeto F. (2000) *Horticultura Brasileira*, 18,61-64.
[9] Maw B.W., Hung Y.C., Tollner E.W., Smittle D.A. and Mullinix B.G. (1996) *Transactions of the ASAE*, 39 (2), 633-637.
[10] Maw B.W. and Mullinix B.G. (2005) *Postharvest Biology and Technology*, 35, 223–227.
[11] Matson W. E., Mansour N. S. and Richardson D. G. (1985) *Onion Storage - Guidelines for Commercial Growers (No. PNW 277), OSU Pacific Northwest Extension Program*, 1-16.
[12] Sandeep S.R. and Sinija V.R. (2014) *International Journal of Latest Trends in Engineering and Technology*, 4 (4), 150-156.
[13] Sanguansri P. and Gould I.V. (1990) *Onion: artificial curing system and objective quality evaluation, Proceedings of Agricultural Engineering Conference, Toowoomba Australia, 11-14 November*, 90(13),333-337.
[14] Schroeder B.K., Humann J.L. and Du Toit L.J. (2012) *Plant Dis*, 96(10),1548-1555
[15] Takahama U. and Hirota S. (2000) *Plant Cell Physiology*, 41,1021-1029.
[16] Yoo K.S., Pike L.M. and Hamilton B.K. (1995) *Hort. Science*, 30(6), 1306.