INFLUENCE OF DIFFERENT STORAGE AND CURING METHODS ON THE QUALITY OF ONION BULB

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ABSTRACT

Onion (*Allium cepa* L.) is an important vegetable crop of Sindh province of Pakistan. In general onion bulbs are stored in respect to their cultural and economical practice. The losses due to sprouting, physiological weight loss and rotting observed in storage are quite higher, and it compels to select an advanced technique. A trial was conducted at farmers field at Kunri, district Umerkot, Sindh on "Influence of different storage and curing methods on the quality of onion bulb" during the year 2016-17. The experiment was conducted on Phulkara variety of onion**.** In the study different storage methods viz. (1) storage on iron wire mesh cage (2) storage on ground in mud store, (3) storage on 2-inch-thick clayin mud store(4) storage in cemented store on ground and two curing methods viz. (1) storage with 2 inch foliage (2) storage without foliage were used. The parameters studied were physiological weight loss (%), bulb sprouting (%) and bulb rotting (%). The results showed that, the maximum physiological weight loss, sprouting and rotting (7.33%, 5.97% and 5.21%) respectively was recorded when onion bulbs were stored in cemented room, whereas lowest physiological weight loss, sprouting and rotting (4.86%, 0.77% and 1.18%) was recorded in wire mesh cage. Highest physiological weight loss, sprouting and rotting (8.25%, 5.97% and 6.02%) respectively was recorded in cemented room and not cured with foliage, the lowest physiological weight loss, sprouting and rotting (4.66%, 0.33%,0.94%) was observed in wire mesh cage and cured with foliage. The results also revealed that, physiological weight loss, sprouting and rotting started after 30 days and maximum loss (11.95%) was recorded in bulbs cured without foliage and stored in mud room+ 2" loose silt.

Key words: Curing, foliage, Physiological weight loss, sprouting, rotting

INTRODUCTION

Onion (*Allium cepa* L.) is the oldest known vegetable, as it is mentioned in the Holy Quran and also in Bible (Shah *et al*., 2012).It is cultivated as vegetable throughout the world. In Pakistan, the onion (*Allium cepa* L.) is grown over an area of 0.147 million hectares with a total production of 1.98 million tons (Fruit, vegetable and condiments statistics of Pakistan, 2018).

The production of onion in Pakistan is generally in excess and the growers temporarily stock their produce in field, under shelters, sheds and rooms under ambient conditions (Ahmad and Khan, 2005)which increase postharvest rots and decrease quality (Milenkovic *et al*., 2009).

The onion is a rich source of phosphorous, calcium sodium and fiber with no fat and is an important component of folk medicine (Marwat *et al*., 2011).It also contains carbohydrates, protein, vitamin A, thiamine, riboflavin, niacin and ascorbic acid (Hanen *et al*., 2012) and is an important constituent of traditional medicines (Marwat *et al*., 2011). The onion is low perishable crop, but significant deterioration may occur during storage due to rotting, sprouting and physiological weight loss, the storage losses could be as high as 66% (Biswas *et al*., 2010; Rabbani 1986).

Storage of onion for prolonged period to catch the high prices in off season can result in more return (Jahanzab and Nabi. 2005). Provision of optimum curing and storage condition may increase the storage performance of onion bulbs (Maw *et al.,* 1997). Physical injury, rotting and sprouting (re-growth of roots and shoots) are the main contributory aspects of deterioration in onion bulbs during storage. These factors increase respiration rate and generate heat, which consequently increase moisture loss and reduce the shelf life of the produce (Nandasana *et al.,* 1998).

Due to rotting and sprouting the rate of respiration increases and heat is generated and eventually enhance moisture loss and reduce the shelf life (Trevisan *et al*., 1999). The quality of onion bulbs is better retained at low temperature (0°C), which prevent sprouting and decay, thus ensure longer storage life (Doug, 2004). Variety of

onion bulb plays an important role in the retention of bulb quality during storage. Generally, the more pungent the onion (i.e., yellows and reds), the longer is the storage potential (Doug, 2004).

Curing is the most important process in the post-harvest technology of onion. Postharvest losses may be minimized by curing, it helps in reducing the post-harvest loss instigated by the removal of excess moisture from neck and the outer skin of freshly harvested onion to a level where shrinkage from the interior will be less and reduction in microbial infection. Curing treatment and foliage attachment with bulbs during curing and storage had good effect on the postharvest life of onion because it minimizes weight loss and bulb sprouting (Pandey *et al.,* 1992; Pandey *et al.,* 1993).

Storage methods and condition have their own impact on post-harvest life and keeping quality of onion. Storage temperature and relative humidity are related with sprouting, rotting, and physiological weight loss and with storage periods. Imoukhuede and Ale (2015)found that basket kept at room temperature is the best option for onion storage than those of asbestos, thatched and iron roof. The onions stored in conventional storage structures have no aeration at bottom, which results in bruising and decaying of onions. However, onions stored in full ventilated conditions at bottom and sides with raised structure above ground reduce the storage losses from 70.0 to 99.2% during five months of storage (Ranpise *et al.,* 2001).This paper aims to investigate changes in the quantitative properties of onion varietyPhulkarafor3-month storage period.

MATERIALS AND METHODS

Research trials were conducted at farmer's field at Kunrion "Influence of different storage and curing methods on the quality of onion bulb" during the year 2016-17. The experiment was conducted on Phulkara variety of onion**.** In the study different storage methods viz. (1) storage on wire mesh cage (2) storage on ground in mud store, (3) storage on 2-inch-thickclayin mud store and (4) storage in cemented store on ground and two curing methods viz. (1) storage with 2-inch foliage (2) storage without foliage were used. The samples were taken randomly from the bulk of newly harvested crop as per requirement of the experiment. Initial weight was recorded when the bulbs were taken from the harvested field using electric balance. Further, the weight of bulbs was recorded at 30-60-90 days of storage period. Each reading was replicated three times to get the average of each interval. The physiological loss (%), rotting (%) and sprouting (%) of onion bulbs were determined by following formulae.

Physiological loss in Weight (%):

It was calculated by using the formula given below:

$$PLW(\%) = \left[\frac{P_0 - P_n}{P_0} \right] X100$$

Where,

P_0 = initial Weight

P_n = Weight after n days

Sprouting (%):

For determination the sprouting %, the bulbs showing a sprout were separated from the experimental lot and weighed on electric balance. It was calculated by using the formula given below:

$$\text{Sprouting \%} = \frac{\text{Weight of the sprouted bulb}}{\text{Initial weight of bulb}} X\ 100$$

Rotting %:

It is determined by observing onion bulb showing symptoms of rotting. The rotted bulbs were separated and weighed. It was calculated by using the formula given below:

$$\text{Rotting \%} = \frac{\text{Weight of the sprouted bulb}}{\text{Initial weight of bulb}} X100$$

The experiment was arranged in a randomized complete design (RCD) with 2 factors (curing methods and different storage conditions) and three replications. The ambient temperature was 42 to47°C. The data was analyzed in accordance with Steel and Torrie (1980) statistical analysis procedure.

RESULTS AND DISCUSSION

Physiological weight loss (%)

In physiological weight loss% significant differences were observed for storage conditions ($p \leq 0.005$) and curing methods ($p \leq 0.005$). The maximum weight loss (7.33%) in bulbs was recorded stored in cemented room, whereas lowest weight loss (4.86%) was recorded in wire mesh cage (Table 1). Weight loss in onion bulbs during storage due to moisture loss in respiration (Ward, 2008) and hence depends on temperature high storage temperature tends to increase weight loss by increasing the rate of respiration and water loss from the bulbs (Biswas *et al*., 2010). Same results were reported by BanuPriya *et al*. (2014), who reported that wooden packed storage structure completely ventilated from bottom allowed adequate ventilation for maintaining the relative humidity. The results are also in agreement with Shakeel *et al*. (2016) who reported that wooden packed structure ventilated from all sides on raised platform proved better in providing the desired environment to onion bulbs during storage period. In the comparison of curing with foliage versus non curing without foliage methods, maximum weight loss (8.25%) was recorded in non-cured method and stored in cemented room, while lowest weight loss (4.66%) was recorded in cured method and bulbs were stored in wire mesh cage.

Physiological weight loss increased during storage from the minimum of 2.98% after 30 days in wire mesh cage cured with foliage to the maximum of 10.54% with storage for 90 days in cemented room and cured without foliage (Table 1). The results are in agreement with Jamali *et al*. (2012) who reported that the physiological weight loss after 60 days of storage at raised platform under ambient condition was 7.74%, 8.86 % and 10.89% in Nasarpuri, Phulkara and Indian White bulb varieties, respectively.

Table 1. Effect of storage methods and curing methods on physiological weight losses %.

Storage methods	Curing methods	Storage Duration (days)			Mean curing Methods	Mean Storage types
		30	60	90		
Wire mesh cage	With foliage	2.98 ± 0.2 g	4.5 ± 0.2 f	6.50 ± 0.3 d	4.66 ± 0.3 d	4.86 ± 0.3 d
	Without foliage	3.25 ± 0.2 fg	4.98 ± 0.3 f	7.00 ± 0.4 c	5.07 ± 0.3 c	
Mud room	With foliage	3.25 ± 0.2fg	4.99 ± 0.3 f	7.80 ± 0.4c	5.34 ± 0.3 c	6.16 ± 0.4 b
	Without foliage	4.99 ± 0.3 f	6.99 ± 0.4 d	8.98 ± 0.4 b	6.98 ± 0.4 b	
Mud room + 2" loose silt	With foliage	3.12 ± 0.2 g	5.00 ± 0.3 e	7.50 ± 0.4 c	5.20 ± 0.3 c	5.89 ± 0.3 c
	Without foliage	4.25 ± 0.25 f	5.98 ± 0.3 e	9.51 ± 0.5 a	6.58 ± 0.3 b	
Cemented room	With foliage	3.87 ± 0.2fg	6.70 ± 0.3 d	8.70 ± 0.4 b	6.42 ± 0.3 b	7.33 ± 0.4 a
	Without foliage	5.78 ± 0.3e	8.34 ± 0.4 b	10.54 ± 0.5 a	8.25 ± 0.4 a	
Mean		3.93 ± 0.22f	5.93 ± 0.3 e	6.29 ± 0.3 d		
LSD 0.05		1.20	0.62	0.98	1.02	0.89

In each column, means followed by same letters are not significantly different at 5% probability level.

Table 2. Effect of storage methods and curing methods on sprouting %.

Storage methods	Curing methods	Storage Duration (days)			Mean curing Methods	Mean Storage types
		30	60	90		
Wire mesh cage	With foliage	0	0	1.00 ± 0.1 c	0.33 ± 0.1 e	0.77 ± 0.1 c
	Without foliage	0	1.00 ± 0.1 d	2.66 ± 0.2 c	1.22 ± 0.1d	
Mud room	With foliage	0	4.40 ± 0.2 b	7.74 ± 0.4 b	4.04 ± 0.2 b	4.38 ± 0.2 b
	Without foliage	0	6.43 ± 0.3 a	7.74 ± 0.4 b	4.72 ± 0.2 b	
Mud room + 2" loose silt	With foliage	0	2.80 ± 0.2 c	7.00 ± 0.4 b	3.26 ± 02 c	4.38 ± 0.2 b
	Without foliage	0	4.60 ± 0.3 b	11.95 ± 0.5 a	5.51 ± 0.3a	
Cemented room	With foliage	0	4.40 ± 0.3 b	7.74 ± 0.4 b	4.04 ± 0.2b	5.00 ± 0.3 a
	Without foliage	0	6.43 ± 0.3 a	11.50 ± 0.5 a	5.97 ± 0.3a	
Mean		0	3.75 ± 0.2 b	7.17 ± 0.4 b		
LSD 0.05			1.03	3.32	0.98	0.43

In each column, means followed by same letters are not significantly different at 5% probability level.

Table 3. Effect of storage methods and curing methods on rotting %.

Storage methods	Curing methods	Storage Duration (days)			Mean curing Methods	Mean Storage types
		30	60	90		
Wire mesh cage	With foliage	00	0.33 ± 0.1 d	2.50 ± 0.2 d	0.94 ± 0.1 d	1.18 ± 0.1 c
	Without foliage	00	0.66 ± 0.1 d	3.60 ± 0.2 c	1.42 ± 0.2 d	
Mud room	With foliage	2.60 ± 0.2 b	4.50 ± 0.2 b	6.10 ± 0.3 b	4.40 ± 0.2 b	5.21 ± 0.3 a
	Without foliage	3.95 ± 0.2 a	6.00 ± 0.3 a	8.11 ± 0.4 a	6.02 ± 0.3 a	
Mud room + 2" loose silt	With foliage	1.50 ± 0.1 c	2.99 ± 0.2 c	4.00 ± 0.2 bc	2.83 ± 0.2 c	3.47 ± 0.2 b
	Without foliage	2.57 ± 0.2 b	4.26 ± 0.2 b	5.54 ± 0.3 b	4.12 ± 0.2 b	
Cemented room	With foliage	2.60 ± 0.2 b	4.50 ± 0.2b	6.10 ± 0.3 b	4.40 ± 0.2 b	5.21 ± 0.3 a
	Without foliage	3.95 ± 0.2 a	6.00 ± 0.3 a	8.11 ± 0.4 a	6.02 ± 0.3 a	
Mean		2.14 ± 0.2 c	3.65 ± 0.2 b	5.50 ± 0.3 b		
LSD 0.05		1.02	0.99	1.55	1.34	1.26

In each column, means followed by same letters are not significantly different at 5% probability level.

Bulb sprouting (%)

In bulb sprouting, there were significant differences ($p \leq 0.005$) among the different storage conditions and curing methods ($p \leq 0.005$). The maximum sprouting (5.97%) was observed in onion bulbs stored in cemented room, whereas lowest sprouting (0.77%) recorded in wire mesh cage (Table 2). Same results were reported by Shakeel *et al*. (2016) who concluded that wooden packed structure ventilated from all sides on raised platform proved better in providing the desired environment to onion bulbs during storage period. The storage temperature has a significant effect on all biological processes and the bulbs stored at high temperature tend to sprout earlier (KoSweesuak *et al*., 2002; Krawiec, 2002). Thus, the lowest sprouting percentage in cold storage could be attributed to lower rates of respiration and other metabolic processes required for sprouting (Doug, 2004). The data reveals that, in curing methods minimum (0.33%) sprouting of onion bulbs was recorded in curing of bulbs with foliage and stored in wire mesh cage, whereas maximum (5.97%) sprouting was witnessed in curing of bulbs without foliage and were stored in cemented room.

Table 2, also discloses that, no any sprouting of onion bulbs was observed before 30 days. Same results were reported by Priya *et al.* (2014), who concluded that, sprouting does not start immediately after harvest and there is usually a dormant period, which may last several weeks before growth resumes. The dormancy period depends on variety, climatic conditions during growth, harvest maturity, mechanical damage, microbial infections, and the storage environment particularly the temperature. Minimum sprouting (1.0%) of onions recorded after 90 cured with foliage and were stored in wire mesh cage and maximum (11.95%) sprouting was recorded in bulbs cured without foliage and stored in mud room+ 2" loose silt. Same results were concluded by Adamicki (2005) who reported that, rooting and sprouting are the main reasons that cause the deterioration of onion bulb during long term storage

Bulb rotting (%)

Rotting of bulbs was significantly affected by storage conditions ($p \leq 0.005$) and curing methods ($p \leq 0.005$). The maximum rotting (5.21%) was observed in bulbs stored in cemented room and the lowest bulb rotting (1.18%) was recorded in wire mesh cage (Table 3). The results are in accordance with (Ranpise *et al*., 2001; Tripathi and Lawande, 2003) who reported that onions stored in full ventilated conditions at bottom and sides with raised structure above ground reduce the storage losses from 70.0 to 99.2% during five months of storage.

The data presented in table 3 discloses that, rotting of onion bulb in curing methods was minimum (0.94%) with foliage and stored in wire mesh cage, while maximum (6.02%) onion bulb rotting was recorded in the treatment in which onion bulbs were stored without foliage in cemented room and mud room.Data also revealed that, rotting of onion bulbs started after 30 days and minimum (1.50%) rotting was recorded in mud room with 2" loose silt. After 90 days, the maximum (8.11%) rotting was recorded in cemented room and mud room when bulbs were cure without foliage and minimum (2.5%) was observed in wire mesh cage cured with foliage. Since rotting is a biological activity resulting from the degradation of the bulbs (KoSweesuak *et al*., 2002; Krawiec, 2002; Khan *et al*., 2004), it is reasonable to get lower and delayed rotting at low temperature (Nabi *et al*., 2010).

Conclusion

It is concluded from the study that the iron wire mesh cage, well ventilated structure and onion bulbs cured with 2-inchfoliage prolongs the storage life and provided better results during 90 days of storage period with minimum losses as compared to those of storage on ground in mud store, storage on 2-inch-thick but loose silt in mud store and storage in cemented store on ground. Therefore, it is recommended that, for better storage, onion bulbs should be left with 2- inch foliage and stored in properly ventilated structure.

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