Study on curing of big Bellary onion when cured in Modular Ventilated Structure and by other popular curing practices

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Abstract - Onion (Allium cepa L.) is highly valued for their flavour and for their nutritional value in supplying minor constituents such as minerals and trace elements. The pungency in onion is mainly due to the presence of volatile componentallyl propyl disulphide in the bulb.Curing removes excess moisture from the outer layers of the bulb prior to storage. In wet weather, the bulbs can take longer time to dry and may develop higher level of rots during storage. The curing practice is completely dependent on climatic condition and any change in environment causes a drastic change in production of onion and this also influence price of onion in market. Thus, there was an urgent need to develop an onfarm curing method, which helps to achieve a stable onion production and minimizes the post-harvest losses. So, a modular ventilated structure was developed with the capacity of 150 kg.Curing studies were conducted with fresh Bellary big onion Variety to evaluate the performance of modular ventilated structure. Various physical and chemical parameters were analysed during curing and the results were compared with traditional curing methods like windrowing, shade curing, sun drying and also with artificial methods. During research it was found that there is significant increase in parameters like TSS, quercetin content, colour values and pyruvate contents with increase in curing period, As curing proceeds parameters like weight, size and ascorbic acid was decreasing with increase. From the experiments it was found that modular ventilated structure was proven as the most effective and efficient gadget for on-farm curing of onions for big onions.

Keywords: Curing, post-harvest losses, harvesting, total soluble solids, windrowing, modular ventilated structure

I. INTRODUCTION

Onion, the most important of the bulb crops is a high moisture and semi perishable produce. The post-harvest life of onion depends upon the curing process. India is the second largest in production of onion after China. India contributes as much as 12 per cent to the world onion production. India's recent export of onion in various forms is to the tune of Rs. 350 crores to the other countries. However, large quantity of onion is consumed domestically in India. Curing is the most important operation in the post-harvest processing of onion to be followed immediately after harvesting. Curing can be defined as removing the excess moisture from one or two outer most layers of onion. Curing decreases the incidence of neck rot, reduces water loss during storage, prevents microbial infection, and is desirable for development of good scale colour. At present, Indian farmers practicing natural curing of onions in fields by windrowing method. Often the climate, especially the rainfall during curing, can destroy the entire yield. Further, farmer's knowledge level is very little about the curing techniques and other post-harvest practices. Further, Farmers need on farm curing and storage techniques which they can easily adopt with low initial investment.

The present study was done to develop an on farm curing technique which should be faster, precise and safe for curing so that losses can be minimized during curing of onion and onion quality can be maintained. Therefore based on the needs of farmers this research work was carried with the following objectives: 1) To design and develop a modular ventilated structure for on-farm curing of onions. 2) Performance evaluation of the designed structure and compare it with existing curing practices.For performance evaluation of structure curing studies were done. Freshly harvested onions (Bellary big variety onions) were bought from various farms in Tamil Nadu in the month of august

and September (as rabi crop) and kept for curing by six methods namely curing in modular ventilated structure, curing by shade method, curing in solar tunnel drier, artificial curing (tray drier), windrowing method and curing by sun drying method. Curing was done properly in all methods and observations were taken for curing studies and performance was compared.

II. MATERIAL AND METHOD

In the present study, a modular ventilated structure was designed and fabricated to cure onion in bulk and on-farm. Curing of freshly harvested onions was done traditionally (sun dried or shade cured) and artificially (forced hot air driers or solar tunnel driers). In each method, the bulbs were cured separately by retaining the foliage or without the foliage (cut the stem by 2.5 to 3.5 cm from the neck). The modular ventilated structure was designed for the capacity to cure 150 kg (only designed for experimental purpose). For commercial purpose the capacity can be increased by adding up similar structures with same design. It's basically like a cuboidal chamber designed with the dimensions 1.5m × 1.25m × 0.5m over which a truss was designed to fix coconut sheaths over it. All four sides and bottom platform were made of ½ inch GI wire mesh for maximum ventilation inside the chamber. There are two platforms in structure; distance between those two platforms was 20 cm. Capacity of each platform is 75 kg. Onions were cured in thin layer of 10 cm over ventilated platforms, so that there was always a gap of 10 cm between onions laid over bottom layer and bottom of top platform for complete circulation of wind inside the chamber which help to maintain temperature and relative humidity inside chamber. The cost economics of the modular ventilated structure was worked out and the cost incurred for curing of onion was estimated.

Big onion variety was used to find out the influence and performance of modular ventilated structure over the other methods used for curing of onion. The samples used of big onion of were of Bellaryvariety, collected from Ottanchathram farm of Dindigual district. The results were very promising and almost following the similar trend as that of small onion variety. Physical properties like size (i.e. equatorial diameter, polar diameter), shape index, density, bulk density was found and are tabulated in Table 2.1.

Table 2.1: Physical Properties of Freshly Harvested And Completely Cured Big Onions.

Parameters	**Freshly Harvested**	**Completely Cured**
Equatorial Diameter (cm)	7.543 ± 1.908	7.332 ± 1.958
Polar Diameter (cm)	8.423 ± 2.216	8.118 ± 2.765
Neck diameter	0.961 ± 0.421	0.99 ± 0.517
Shape index	1.188 ± 0.106	1.044 ± 0.154
Volume (cm^3)	10.180 ± 1.810	10.033 ± 1.877
Density (g/cm^3)	1.260 ± 0.911	1.001 ± 0.742

III. RESULT AND DISCUSSION

3.1 Weight Loss

In modular ventilated structure big onions with foliage took 6 days for complete curing may be because of combined effect of change in ambient conditions and physical properties of freshly harvested onions.Maximum time 11 days were taken when onions were cured by shade curing method in both treatments with or without foliage to reach 20

per cent of weight loss. The reason for that may be low temperature and higher relative humidity around the onions because of shade. The shortest time 2 days were taken when onions were cured in tray drier for both treatments with or without foliage. In big onion there was no significant difference in weight loss when onions were cured with or without foliage by any method of curing at 5 per cent level of significance. Samples took same number of days in trials without foliage as they had taken in with foliage.

3.2 Colour

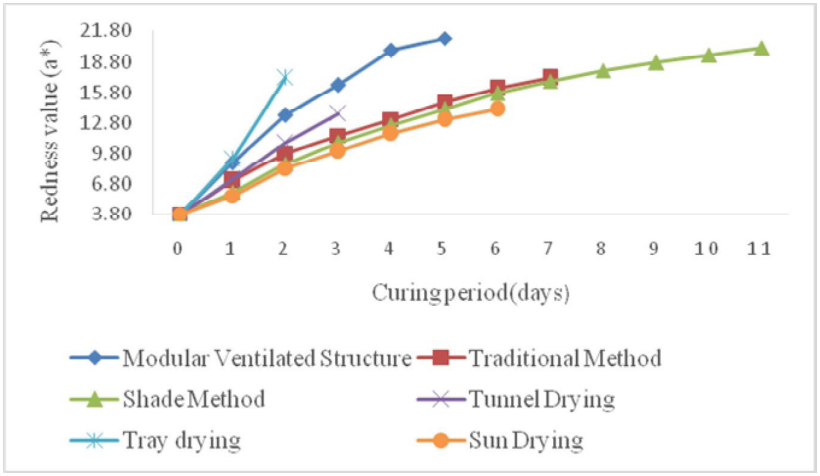

Fig.3.2.1: Colour Value of Big Onion with Foliage

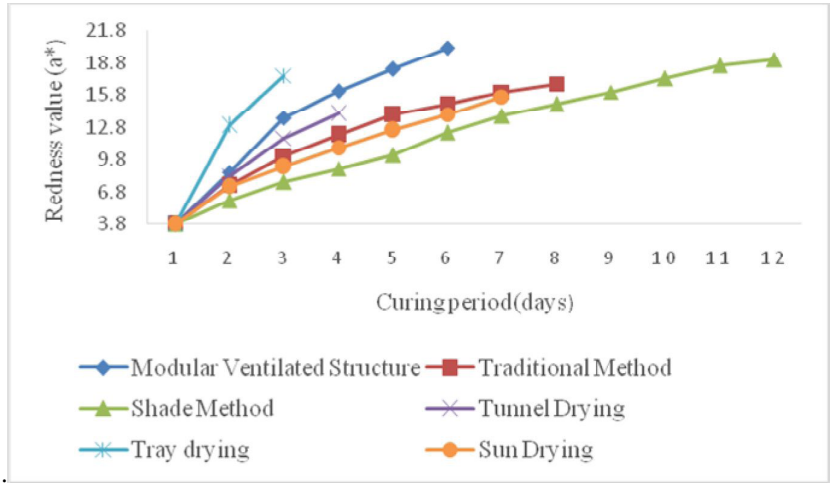

Fig 3.2.2: ColourValue of Big Onion without Foliage

Colour values of big onions were taken and compared with each other with the statistical tool ANOVA, and students paired 'T' test was done to compare the mean of various treatments to find the significance of variation at 5 per cent level of significanceColour values were increasing with increase in curing time. As curing is going on there is

significant colour development in all samples with and without foliage irrespective of the method, used for curing but significantlydifferent when compared with other the treatments. The samples which are cured with foliage had gained more colour in comparison to the respective samples without foliage.

3.3 Total Soluble Solids

The brix value for big onions ranged from 16 to 20 per cent. It was found that for both the treatment brix value was increasing with increase in curing time till the complete curing of samples in all methods. In big onion the value for TSS was less in all samples when onion was cured without foliage than samples cured with foliage at 5 per cent level of significance.

3.4 Ascorbic Acid

An initial increase in ascorbic acid was recorded in samples cured with foliage because the ascorbic acid from foliage was transferred to bulb during curing. And after reaching to its maximum level there was decrease in ascorbic acid content in all samples. The maximum value 6.18 ± 0.55mg/100 g for ascorbic was for samples with foliage and cured in modular ventilated structure.

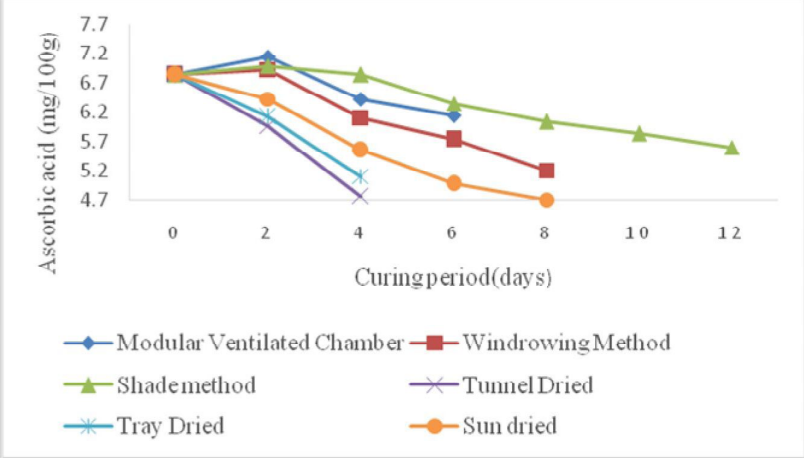

Fig. 3.4.1: Ascorbic Acid of Big Onion with Foliage

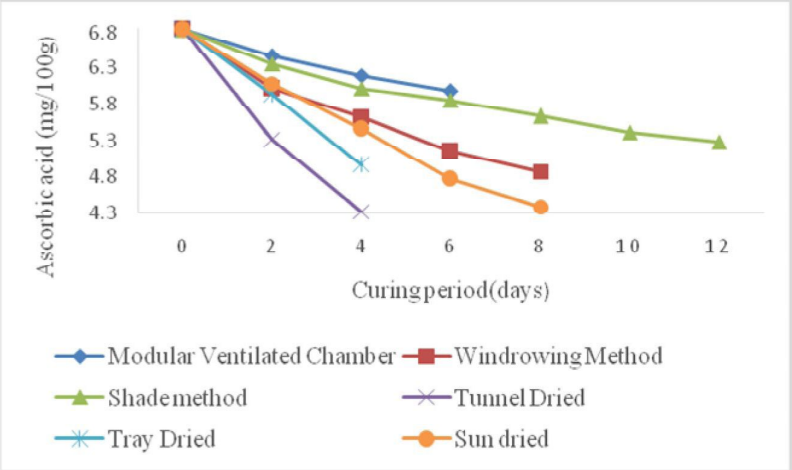

Fig. 3.4.2: Ascorbic Acid of Big Onion without Foliage

Ascorbic acid for samples cured without foliage was decreasing continuously during curing. No initial increase was recorded because foliage was removed initially and hence neglected any chance of transfer of ascorbic acid from foliage. That was also the reason for significant lesser values of ascorbic acid in samples without foliage when compared with samples with foliage. The maximum value recorded for ascorbic acid was 5.98 ± 0.49 mg/100 g for samples cured without foliage in modular ventilated structure as shown in figure 3.4.2

3.5Quercetin Content

As per literature the Quercetin content for big onion is 60 ± 5 mg/100g for completely cured samples. From figure 3.5.1 and 3.5.2, the maximum quercetincontent recorded was 78.12 ± 5.44mg/100 g and 69. 14 ± 4.77 mg/100 g for samples cured with and without foliage in modular ventilated structure respectively. The minimum value recorded was 58.23 ± 4.21 mg/100 g and 50.21 ± 4.97 mg/100 g for samples cured inside tunnel drier with and without of foliage respectively. From both figures of quercetin content it can be concluded that quercetin content of big onion increase with increase in curing period and with proper curing the maximum querctin content can be reached. Reason for increase in quercetin content during curing with and without foliage can be decrease in moisture content in bulb. From statistical analysis it can be concluded that curing with foliage in each method are having higher values than without foliage at 5 per cent level of significance.

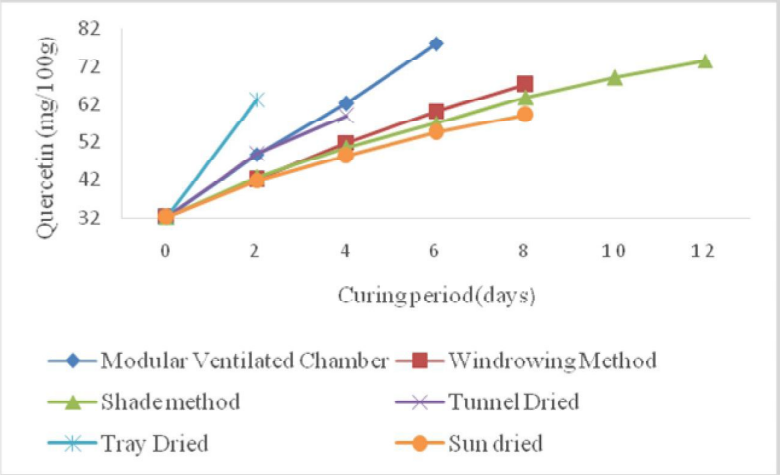

Fig 3.5.1:Quercetin Value of Big Onion with Foliage

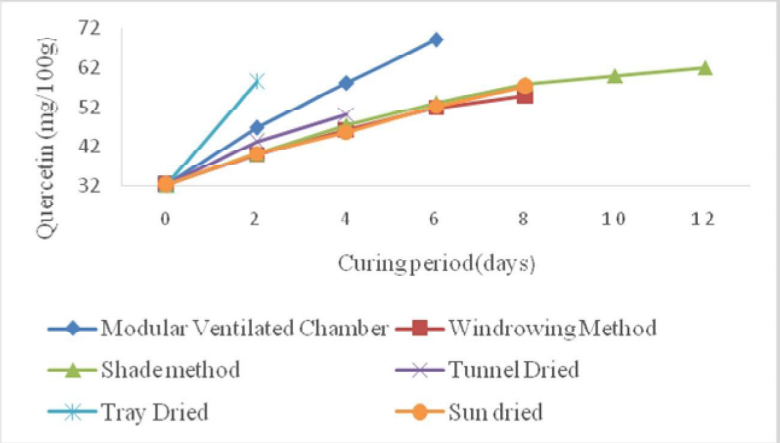

Fig. 3.5.2: Quercetin Value of Big Onion without Foliage

3.6 Pyruvate Content

In big onion the trend was similar to that of small onion for pyruvate content. The pyruvate content was increasing from their initial value of 116.5 µmol g^{-1} in all samples. Pyruvate content of samples cured in modular ventilated structure, shade method and tray drier was significantly higher than the other samples in both treatments with and without foliage, average values were 278.5µmol g^{-1}, 249µmol g^{-1}, and 217.5µmol g^{-1} in samples with foliage and 218 µmolg^{-1}, 199.5µmol g^{-1} and 196.5 µmol g^{-1} for samples cured without foliage respectively.

IV. CONCLUSION

In this curing studies, the observations were carried out on the duration, temperature, relative humidity, weight loss, color values, pyruvate content, total soluble solids, querecitincontent and ascorbic acid during curing. The quality of the cured bulbs were determined based on the colour and pungency parameters. Since uncured onion bulbs found

perished fully within 10 days storage under ambient conditions.Curing was found to be compulsory operation prior to storage of onion bulbs in bulk.The curing of onion in bulk can be done in modular ventilated structure and also by artificial curing methods can be done to overcome difficulties due to climatic condition like raining, poor handling (windrowing method, shade method and sun drying method).The bulbs is ready to market or for storage within 4-5 days in modular ventilated curing, where as it is 1-2 days for artificial curing and 8-10 days by traditional curing methods.The physical properties of onion bulbs changed significantly during curing. The surface area, size and volume of bulbs decreased; on the other hand bulk density, hardness of bulbs increased after curing.Chemical properties like ascorbic acid were decreasing during curing period and pyruvate content, and querecitin content were increasing during curing period.

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