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

Er. Sandeep Singh Rana
Department of Food Process Engineering
National Institute of Technology, Rourkela, India

Kishan Prasad
Department of Food Process Engineering
National Institute of Technology, Rourkela, India

Er. Payel Ghosh
Department of Food Process Engineering
National Institute of Technology, Rourkela, India

Abstract- Onion (*Allium cepa L.*) is a 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 the volatile component allyl 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 to dry and may develop higher level of rots during storage. The curing practice is completely dependent on climatic conditions 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 on farm curing method, which helps to achieve a stable onion production and minimizes the post-harvest losses. So, a modular ventilated structure was developed with a 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 and 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 efficient gadget for on-farming curing of onions for big onions.

Keywords- Curing, postharvest-losses, harvesting, total soluble solids, Windrowing, and 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 onions depend upon the curing process. India is the second largest producer 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 on 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 outermost layers of onion. Curing reduces the incidence of neck rot, reduces water loss during storage, prevents microbial infection, and is desirable for development of good scale colour. At [resent, 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 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 for curing so that losses can be minimized during curing of onion and onion quality can be maintained. Therefor based on the needs of the farmers this research was carried out 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 brought 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

modulated 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 onions 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 for experimental purpose). For commercial purpose the capacity can be increased by adding up similar structures with same design. It's basically 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. Then 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 onions. The samples used of big onions were of Bellary variety, 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 and 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. RESULTS AND DISCUSSION

1.1 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 conditions 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.

1.2 COLOUR

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 significance. Colour values were increasing with increase in curing time. As curing is going on there is significant colour development in all samples wit and without foliage irrespective of

the method used for curing but significantly different when compared with the other treatments. The samples which are cured with foliage had gained more colour in comparison to the respective samples without foliage.

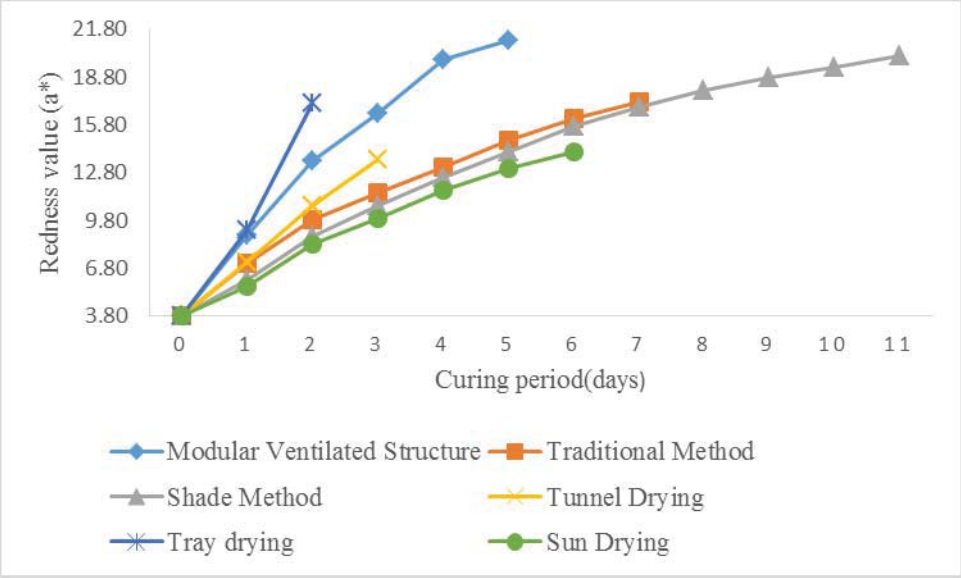

Fig. 3.2.1: Colour Value of Big Onion with Foliage

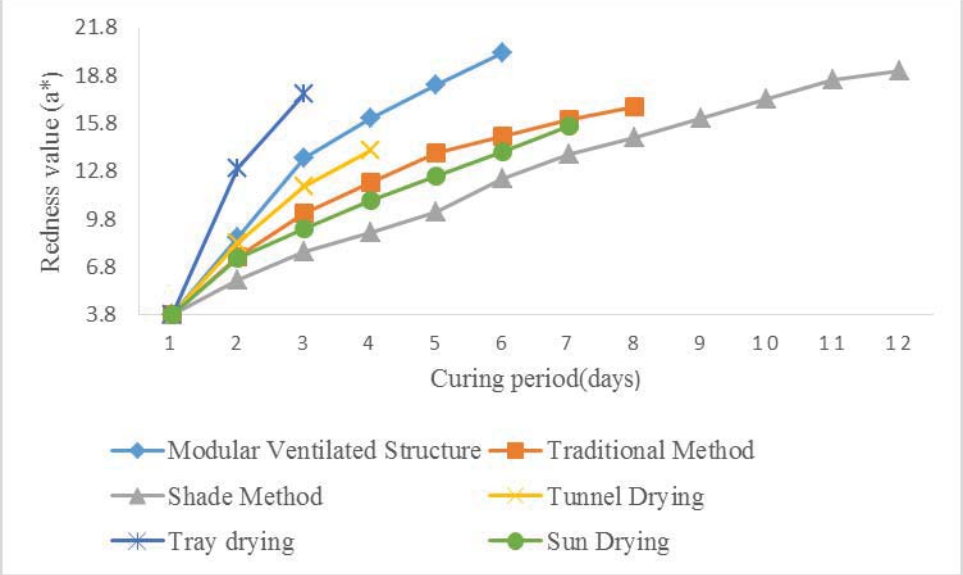

Fig 3.2.2: Colour Value of Big Onion without Foliage

1.3 *TOTAL SOLUBLE SOLIDS*

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

1.4 ASCORBIC ACID

An initial 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 maximum level there was decrease in ascorbic acid content in all samples. The maximum value 6.18 ± 0.55 mg/100 g for ascorbic acid was for samples with foliage and cured in modular ventilated structure.

Ascorbic acid for samples cured without foliage was decreasing continuously during curing. No initial decrease 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.

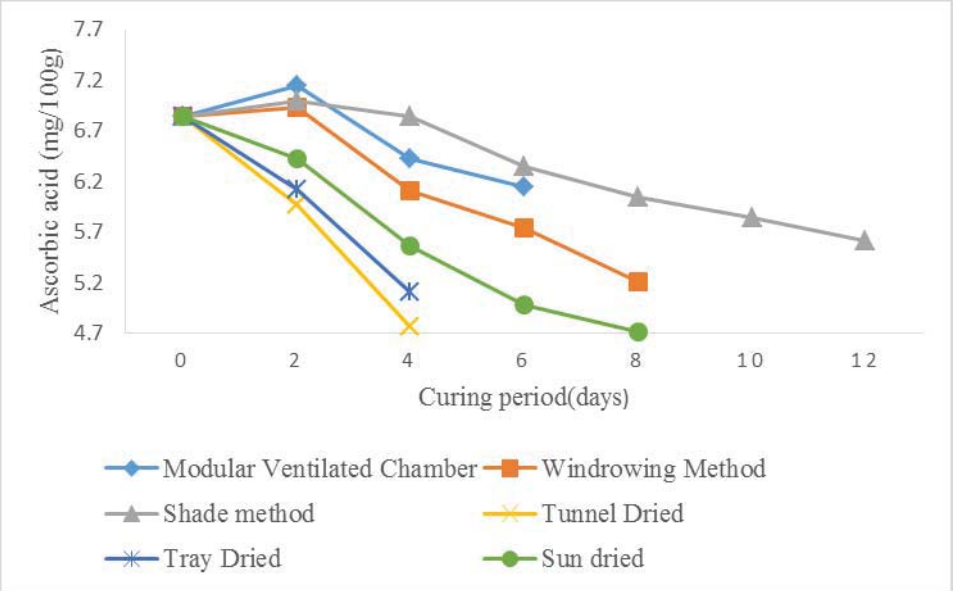

Fig. 3.4.1: Ascorbic Acid of Big Onion with Foliage

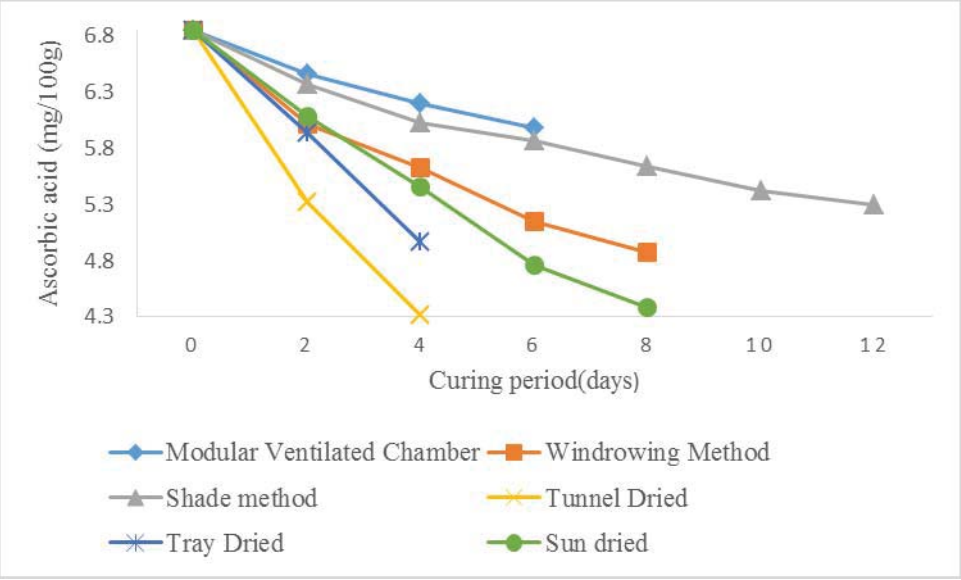

Fig. 3.4.2: Ascorbic Acid of Big Onion without Foliage

1.5 *QUERCETIN CONTENT*

As per literature the quercetin content for big onions is 60 ± 5 mg/100 g for completely crushed samples. From figure 3.5.1 and 3.5.2, the maximum quercetin content recorded was 78.12 ± 5.44 mg/100 g and 96.14 ± 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 quercetin can be reached. Reason for increase in quercetin content during curing with and without foliage can be due to 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.

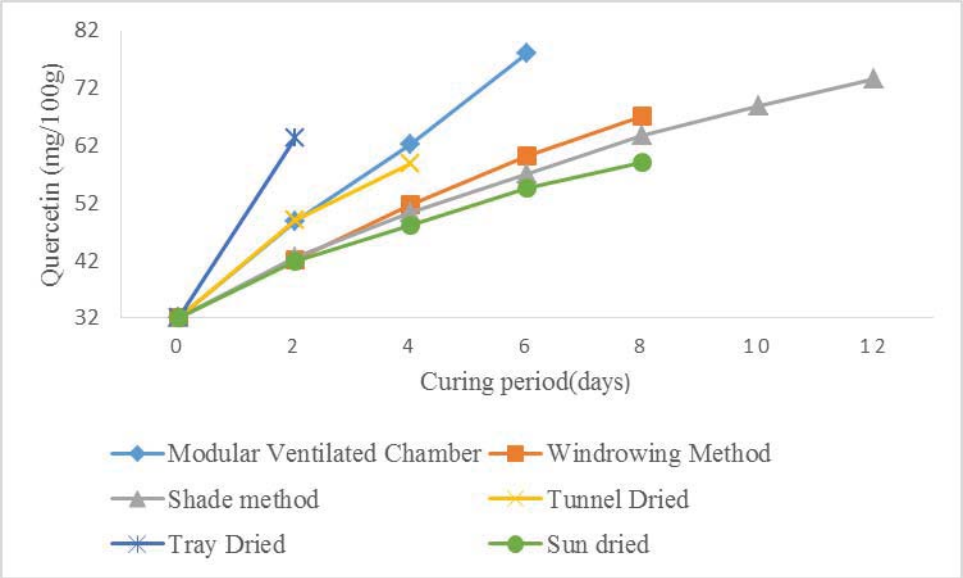

Fig 3.5.1: Quercetin Value of Big Onion with Foliage

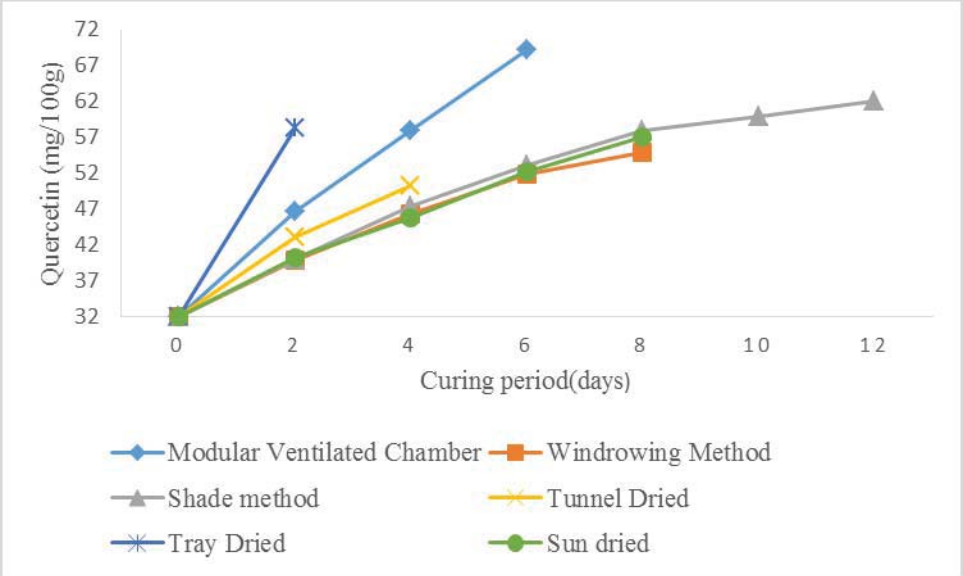

Fig. 3.5.2: Quercetin Value of Big Onion without Foliage

1.6 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 vale of 116.5 μmol g^{-1} in al samples. Pyruvate content for samples cured in modular ventilated structure, shade method and tray drier was significantly higher than the other samples in both treatments with or without foliage, average values were 278.5 μmol g^{-1}, 249 μmol $g^{-1}$and 217.5 μmol g^{-1} in samples with foliage and 218 μmol g^{-1}, 199.5 μmol g^{-1} and 196.5 μmol g^{-1} for samples cured without foliage respectively.

IV. CONCLUSION

In this curing studies, the observations were carried on the duration, temperature, relative humidity, weight loss, colour values, pyruvate content, total soluble solids, quercetin content 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 onions 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 the difficulties due to climatic conditions like raining, poor handling (windrowing method, shade method and sun drying method). The bulb is ready to market on for storage within 4-5 days in modular ventilated curing, whereas it is 1-2 days for artificial curing and 8-10 days by traditional 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 quercetin content were increasing during curing period.

REFERENCES

[1] Agic, r., gjorgjievska, m.c., martinovski, g., jevtic, s., tevtic, s. And lazic, B., 1997, dynamics of losses during bulb storage from semi-arid onion cultivars. *Acta Horticulturae*, 462: 565-570.

[2] ARC, Boyette, M. D.; D. C. Sanders, and E. A. Estes (2008). Maintaining the quality of North Carolina Fresh Produce. North Carolina Cooperative Extension Service. North Carolina State Univ., USA.

[3] Chauhan, k.p.s., singh, s.p. and chougule, a.b., 1995, studies on the effect of Windrow curing, neck cut and shade curing on export quality of onion bulbs during Storage. *National horticultural research and development foundation newsletter*, 15(4): 5-7.

[4] Gopalkrishnarao, k.d., 2007, studies on storage of vegetables - tomato, onion. *Annual Report,* indian institute of horticultural research, bangalore, p. 50.

[5] Jahanzab and G. Nabi. 2005. Onion marketing in Swat. Restructuring of horticulture research and development in NWFP. *Agric. Res*., Instt. Tarnab, Peshawar. pp. 18

[6] Hoyle, B. J. 1948. Onion curing − a comparison of storage losses from artificial, field and non−cured onions. *Proc. Amer. Soc. Hort. Sci.* 52(Nov.): 407−414.

[7] Lisa, K. and A.A. Kader (2004). Postharvest horticultural series No. 8. Small-Scale Postharvest Handling Practices: A Manual for Horticultural Crops (4th Edition). University of California - Davis, California.

[8] Magadum, s.b., 1981, genetic diversity in onion (*allium cepa* l.) Germplasm with special Reference to storage quality. *M.sc. (agri.) Thesis*, mahatma phule krishi vidyapeeth,Rahuri.

[9] Maw, B.W.; D.A.; Smittle and B.G. Mullinix (1997a). Artificially curing sweet onions. Applied-Engineering-in-Agriculture. 13: 4, 517-520.

[10] Mukeshkumar and kumar, m., 1991, effect of maleic hydrazide and curing on quality of *Kharif* onion (*allium cepa* l.) During storage. *Journal of interacademicia*, 4(3): 382- 385.

[11] Rao, s.n., rao, m.r. and krishnamurthy, g.g., 1967, increasing yields and reducing Storage losses of onion. *Indian farming*, 17: 14-16.

[12] Sandhu, j.s., thakur, j.c. and nandpuri, k.s., 1976, studies on the storage quality of Red and white onion (*allium cepa* l.) Varieties. *Journal of research*, 13(3): 279-282.

[13] Satish, s.v. and ranganna, b., 2002b, effect of curing on the physical and mechanical Properties of onion. *Mysore journal of agricultural sciences*, 36: 266-269.

[14] Singhal, s.c., 2000, export of onion – challenges and strategies. *Souvenir, national Symposium on onion and garlic production and post-harvest technology Management: challenges and strategies*, 19-21 november 2000, national research Centre for onion and garlic, rajgurunagar, nasik, pp. 49-64.

[15] Van doorn, A M. 1955: Control of onion neck rot by artificial curing. *Med. Dir. Tuinbouw. 18: 250-8.*

[16] Vaughan, E. K., M. G. Cropsey, and E. N. Hoffman. 1964. Effects of field curing practices, artificial drying and other factors in the control of neck rot. Technical Bulletin 77, Agricultural Experiment Stations. Corvallis, Oreg.: Oregon State University.

[17] Agricultural Research Center. (2003). Onion crop. National Program of Onion Research. Ministry of Agricultural and Land Reclamation. No. (852).

[18] Bahnasawy, A. H. (2000). Onion losses during storage as influenced by curing method. Misr J. Ag. Eng. 2001. Vol. 17 No (4): 209-225.

[19] Bajaj, k.l., gurdeep, k., singh, j. And gill, s.p.s., 1980, chemical evaluation of some important varieties of onion. *Plant foods for human nutrition*, 30: 117.