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Influence of osmotic pretreatment and drying methods on the moisture content of dehydrated onion

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Abstract

The present study was carried out in the laboratory of the Department of Vegetable Science, IGKV, Raipur, (C.G.), during the two consecutive years 2022-23 and 2023-24 with the objective of studying the effect of osmotic pretreatments on the moisture content of dehydrated onion. In the preparation of dehydrated onion, eight pretreatments viz., 15 °brix salt, 20 °brix salt, 40 °brix sugar, 60 °brix sugar, 40:15 °brix sugar+ salt, 40:20 °brix sugar+ salt, 60:15 °brix sugar+ salt and 60:20 °brix sugar+ salt with two onion viz., white and red onion were used. The experiment was conducted in a Factorial Completely Randomised Design (FCRD) with the above two factors and replicated thrice.

Keywords: Onion, pretreatments, moisture content, dehydrated onion

Introduction

Fruits and vegetables are highly perishable and seasonal commodities, and dehydration is an effective method for extending their shelf life and availability. It reduces moisture content, restricts microbial growth, and decreases the weight and volume of the product, thereby lowering packaging, storage and transportation costs. Onion (*Allium cepa* L.), commonly known as bulb or common onion, is one of the most widely cultivated *Allium* species and belongs to the family Alliaceae. It is nutritionally valuable, containing considerable amounts of moisture, carbohydrates, sugars, protein, fibre, vitamin C and minerals (Dev *et al.*, 2006; Adarsh *et al.*, 2014) ^[3,2]. Onion has been used since ancient times as a food, seasoning and medicinal ingredient and continues to be an important component of various cuisines. It is consumed both fresh and in processed forms, while dried onion is commercially available as flakes, minced, chopped and powdered products.

Drying is an important preservation technique that enhances shelf life, reduces packaging and transportation costs, and facilitates the availability of onion products beyond the harvest season. However, the drying process may adversely affect desirable characteristics such as flavour, taste, colour and nutritional quality. Therefore, the major challenge is to achieve the desired moisture reduction while retaining the quality attributes of the final product. Pretreatments such as osmotic dehydration can facilitate moisture removal and improve the efficiency of subsequent drying. The selection and proper control of drying conditions are essential for maintaining product quality and meeting consumer expectations regarding sensory quality, safety and nutritional value. Thus, appropriate pretreatment and drying methods are important for producing high-quality dehydrated onion with improved storage stability.

Materials and Methods

The hot air oven method was used to measure the moisture content of both fresh and dehydrated onions (AOAC, 2005) ^[1]. A portion of an onion slice weighing about ten grams was placed in a moisture box that had been previously weighed, dried for 24 hours at 105 degrees, and then chilled in a desiccator. The dried sample was weighed and the result was noted. Using the following formula, the sample's moisture content was determined as a percentage (w.b.). Three measurements of the samples' moisture content were taken, and the average result was used to determine the moisture content of both fresh and dried onions.

$$\text{Moisture content (\%)} = \frac{W1 - W2}{W1} \times 100$$

Where,

W1 = Initial weight of the sample, g

W2 = Final weight of the sample, g

Results and Discussion

The data on the moisture content of dehydrated onion as influenced by different osmotic pre-treatments and drying methods are presented in Table 1. and graphically illustrated in Figure 1.

The moisture content of fresh white onion and red onion were considerably higher than that of the dehydrated samples. A marked reduction in moisture content was observed after osmotic pre-treatment and drying in both onion varieties. The reduction in moisture content may be attributed to water loss during osmotic dehydration followed by moisture removal during drying. The data obtained were analysed statistically and the interactions were found to be significant.

Under open yard sun drying the moisture content of dehydrated onion ranged from 6.97 to 8.80%. Among the white onion treatments, V₁P₁ (White onion + 15°Brix salt) recorded the highest moisture content (8.80%) and the lowest moisture content (7.20%) was recorded in V₁P₈ (White onion + 60°Brix sugar + 20°Brix salt). In red onion, V₂P₁ (Red onion + 15°Brix salt) recorded the highest moisture content (8.60%) and the lowest moisture content (6.97%) was observed in V₂P₈ (Red onion + 60°Brix sugar + 20°Brix salt).

In shade drying, the moisture content varied from 6.48 to 8.30%. Among the white onion treatments, V₁P₁ (White onion + 15°Brix salt) recorded the highest moisture content (8.30%) and V₁P₈ (White onion + 60°Brix sugar + 20°Brix salt) recorded the lowest moisture content (6.70%). Similarly, in red onion, V₂P₁ (Red onion + 15°Brix salt) recorded the highest moisture content (8.10%) and V₂P₈ (Red onion + 60°Brix sugar + 20°Brix salt) recorded the lowest moisture content (6.48%).

The moisture content values recorded under air drying ranged from 6.00 to 7.80%. Among the white onion treatments, V₁P₁ (White onion + 15°Brix salt) recorded the highest moisture content (7.80%) and V₁P₈ (White onion + 60°Brix sugar + 20°Brix salt) recorded the lowest moisture content (6.20%). In red

onion, V₂P₁ (Red onion + 15°Brix salt) recorded the highest moisture content (7.60%), and the lowest moisture content (6.00%) was observed in V₂P₈ (Red onion + 60°Brix sugar + 20°Brix salt).

During tray drying, the moisture content ranged from 5.13 to 6.90%. Among the white onion treatments, V₁P₁ (White onion + 15°Brix salt) recorded the highest moisture content (6.90%), and V₁P₈ (White onion + 60°Brix sugar + 20°Brix salt) recorded the lowest moisture content (5.40%). Similarly, in red onion, V₂P₁ (Red onion + 15°Brix salt) recorded the highest moisture content (6.80%), and V₂P₈ (Red onion + 60°Brix sugar + 20°Brix salt) recorded the lowest moisture content (5.13%).

In hot air drying the moisture content varied from 5.50 to 7.13%. Among the white onion treatments, V₁P₁ (White onion + 15°Brix salt) recorded the highest moisture content (7.13%) and V₁P₈ (White onion + 60°Brix sugar + 20°Brix salt) recorded the lowest moisture content (5.70%). In red onion, V₂P₁ (Red onion + 15°Brix salt) recorded the highest moisture content (7.10%) and V₂P₈ (Red onion + 60°Brix sugar + 20°Brix salt) recorded the lowest moisture content (5.50%).

The mean moisture content of different drying methods indicated significant variation Open yard sun drying (T₁) recorded the highest mean moisture content (7.82%), followed by shade drying (T₂) (7.32%), air drying (T₃) (6.81%) and hot air drying (T₅) (6.31%), whereas tray drying (T₄) recorded the lowest mean moisture content (6.01%). The lower moisture content under tray drying may be attributed to rapid and uniform heat transfer, which facilitated efficient moisture removal.

Across all drying methods, V₁P₁ (White onion + 15°Brix salt) and V₂P₁ (Red onion + 15°Brix salt) consistently recorded the highest moisture content, whereas V₁P₈ (White onion + 60°Brix sugar + 20°Brix salt) and V₂P₈ (Red onion + 60°Brix sugar + 20°Brix salt) consistently recorded the lowest moisture content. Increasing the concentration of sugar and combined sugar-salt osmotic pre-treatments resulted in a gradual decrease in moisture content in both onion varieties due to greater osmotic water loss before drying and improved dehydration efficiency.

The effects of onion variety (V), pre-treatment (P) and their interaction (V × P) were significant under all drying methods, indicating that both factors significantly influenced the moisture content of dehydrated onion. These findings are in agreement with Masalkar *et al.* (2010)^[4] and Seifu *et al.* (2018)^[5] found that the moisture content of dried onion ranged from 4.9 to 6.6%.

Table 1: Effect of different pre-treatments and drying methods on moisture content of dehydrated onion

Treatments	Moisture content (%)									
	Open yard sun drying		Shade drying		Air drying		Tray drying		Hot air drying	
V ₁ P ₁ (White onion+15 ⁰ brix salt)	8.80		8.30		7.80		6.90		7.13	
V ₁ P ₂ (White onion+20 ⁰ brix salt)	8.50		8.00		7.50		6.70		7.00	
V ₁ P ₃ (White onion+40 ⁰ brix sugar)	7.90		7.40		6.90		6.10		6.40	
V ₁ P ₄ (White onion+60 ⁰ brix sugar)	7.40		6.90		6.40		5.60		5.90	
V ₁ P ₅ (White onion+40:15 ⁰ brix sugar+ salt)	8.10		7.60		7.10		6.30		6.60	
V ₁ P ₆ (White onion+40:20 ⁰ brix sugar+ salt)	7.90		7.40		6.80		6.10		6.40	
V ₁ P ₇ (White onion+ 60:15 ⁰ brix sugar+ salt)	7.60		7.10		6.60		5.80		6.10	
V ₁ P ₈ (White onion+60:20 ⁰ brix sugar+ salt)	7.20		6.70		6.20		5.40		5.70	
V ₂ P ₁ (Red onion+15 ⁰ brix salt)	8.60		8.10		7.60		6.80		7.10	
V ₂ P ₂ (Red onion+20 ⁰ brix salt)	8.30		7.80		7.30		6.50		6.80	
V ₂ P ₃ (Red onion+40 ⁰ brix sugar)	7.70		7.20		6.70		5.90		6.20	
V ₂ P ₄ (Red onion+60 ⁰ brix sugar)	7.20		6.70		6.20		5.40		5.70	
V ₂ P ₅ (Red onion+40:15 ⁰ brix sugar+ salt)	7.90		7.40		6.90		6.10		6.40	
V ₂ P ₆ (Red onion+40:20 ⁰ brix sugar+ salt)	7.70		7.20		6.70		5.90		6.20	
V ₂ P ₇ (Red onion+ 60:15 ⁰ brix sugar+ salt)	7.40		6.90		6.37		5.60		5.90	
V ₂ P ₈ (Red onion+60:20 ⁰ brix sugar+ salt)	6.97		6.48		6.00		5.13		5.50	
Mean	7.82		7.32		6.81		6.01		6.31	
	SE (m)±	CD@5%	SE (m)±	CD@5%	SE (m)±	CD@5%	SE (m)±	CD@5%	SE (m)±	CD@5%
V	0.003	0.007	0.001	0.004	0.003	0.007	0.005	0.015	0.005	0.015
P	0.004	0.010	0.002	0.006	0.004	0.010	0.007	0.021	0.007	0.021
VXP	0.006	0.017	0.003	0.009	0.006	0.017	0.012	0.034	0.012	0.034

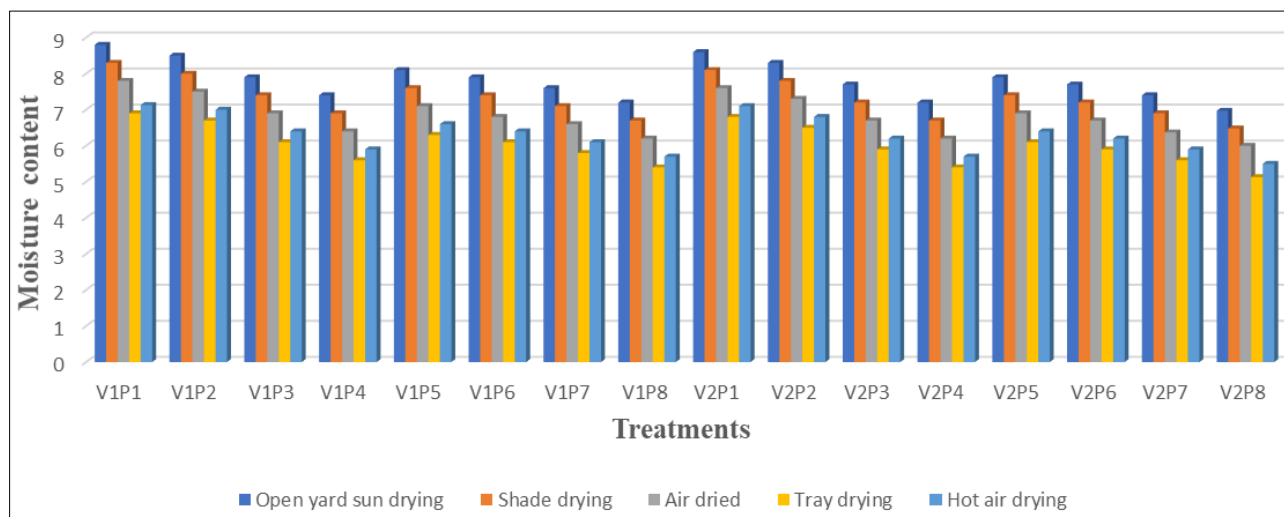


Fig 1: Effect of different pre-treatments and drying methods on moisture content of dehydrated onion

Conclusion

The moisture content of dehydrated onion was significantly influenced by onion variety, osmotic pretreatment, drying method and their interaction. Osmotic pre-treatment followed by drying resulted in a substantial reduction in moisture content compared with fresh onion. Among the pre-treatments, V₁P₈ (White onion + 60°Brix sugar + 20°Brix salt) and V₂P₈ (Red onion + 60°Brix sugar + 20°Brix salt) consistently recorded the lowest moisture content, indicating greater osmotic water loss and improved dehydration efficiency. In contrast, V₁P₁ and V₂P₁ (15°Brix salt) recorded the highest moisture content across the drying methods. Among the drying methods, tray drying recorded the lowest mean moisture content (6.01%), followed by hot air drying (6.31%), air drying (6.81%), shade drying (7.32%) and open yard sun drying (7.82%). Thus, tray drying in combination with higher concentration sugar-salt osmotic pre-treatment was found to be most effective in achieving greater moisture removal and producing dehydrated onion with lower residual moisture content.

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