

Pusa Shobha: Onion for Dehydration

Onion is a rich source of iodine and contains catechol and allyl propyl disulfide which is responsible for the antifungal properties and pungency of onion respectively. These compounds are responsible for their antioxidant, antibacterial, anticancer, antidiabetic, and other health-benefiting effects. Pusa Shobha is a new variety of onion having high dry matter (15.24 g/100g), pungency (4.61 μ mole/100g), antioxidant (2.53 μ mole TE/g), total phenol (18.11 mg/100g), and total soluble solid (16.41°B). The dehydrated onion has large scope of market in domestic as well as foreign market, therefore the study discusses the mechanism of dehydrated onion.

ONION (*Allium cepa* L.) is an economically important vegetable. It generates the largest foreign exchange around 77% among the vegetables. It is consumed as a fresh, salad, cooked or processed and widely used as a potent source of bioactive compounds carotenoids, flavonoids, polyphenols, anthocyanins, etc. Onion (*Allium cepa* L.) is an important vegetable crop, commercially grown in different parts of the country for domestic consumption as well as export markets. Onion is known for its flavour, pungency, and medicinal value. It is used as salad, and cooked in various ways like curries, soup, vinegar, and preserved pickles. In India, onion is grown in an area of 1.91 million ha with a total production of 31.27 million MT and productivity of 16.40 T/ha (NHB 2021-2022). India is the second largest producer of onion in the world after China. Maharashtra has the highest share both in area (24.73%) and production (27.72%). A nationwide study conducted by the NABARD Consultancy Service (NABCONS) revealed significant overall post-harvest losses of 7.26 % was found in onion.

The value of dehydrated onions becomes particularly evident in instances of excess onion production. Dehydration effectively lowers the moisture content to safe levels without compromising the colour, flavour, or nutritional value of the onions. This process is carried out under strictly controlled conditions. Dehydrating onions leads to a significant reduction in both weight and volume, translating into substantially lower transportation and storage costs and extended shelf life. Consequently, dehydration emerges as a viable solution for preserving excess onion produce and mitigating market price fluctuations during both glut and dearth periods. The low calorie, high nutrient dehydrated onion is a good source of potassium, vitamin B, as well as vitamin C (Table 1). Dehydrated onion packed in pouches/containers prolongs the flavour retention and retains very little moisture helps to avoid the growth of moulds.

Table 1. Chemical composition of dehydrated onion slices (nutritive value/ 100 g)

Nutrient	Value
Moisture (%)	4.60-5.50
Protein (g)	10.00-12.5
Fat (g)	0.80-1.00
Mineral (g)	3.50-4.50
Carbohydrate (g)	70-75.34
Calcium (g)	300-350
Phosphorus (g)	280-320
Iron (mg)	2.00-3.00
Vitamin C (mg)	120-150

Suitability of onion variety for dehydration

Onion bulbs suitable for dehydration possess specific characteristics that ensure optimal quality and yield (Table 2). A high Total Soluble Solids (TSS) content of 15-20% or more is essential for achieving the desired flavour and dry matter (15-18%) texture. Additionally, a high insoluble solid content, not less than 1%, contributes to the structural integrity of the dehydrated onion. White flesh onions are preferred due to their resistance to discolouration and bitterness during dehydration. A low ratio of reducing to non-reducing sugars minimizes the risk of browning and caramelization. Medium-sized onions with thick necks are ideal for dehydration, as they retain their shape better during the drying process. Onions with high pungency levels, indicated by pyruvic acid content, are preferred for flavour retention. Disease and pest resistance is crucial for maintaining the quality and yield of dehydrated onions. Finally, a small root zone simplifies harvesting and handling during dehydration.

Table 2. List of suitable varieties for dehydration

Name of Variety	Name of the University/Institute which developed the variety	Season	TSS (°B)	Dry matter (%)
Pusa Shobha	ICAR-IARI, New Delhi	Rabi	16-18	15-18
Pusa White Flat	ICAR-IARI, New Delhi	Rabi	13-15	14-16
Pusa White Round	ICAR-IARI, New Delhi	Rabi	12-15	13-15
Agrifound White	NHRDF, Nashik	Rabi	15-16	12-14
Punjab-48	PAU, Ludhiana	Rabi	14-15	13-16
Arka Yojith	IIHR, Bengaluru	Rabi	18-20	15-20

Table 3. Differences between drying and dehydration

Drying	Dehydration
Removal of water by the use of non-conventional energy sources like sun and wind	Process of removal of water from the food by the application of artificial heat under controlled conditions of heat, RH, and airflow
Sun drying is not possible in cloudy weather	Dehydration is not weather dependent process
The colour of the sun-dried product might not be uniform	The colour of dehydrated products is uniform
Food might be contaminated by dust and other contaminants	Dehydration is done under hygienic conditions and products are safe
Sun drying requires more space and time	Dehydration requires less floor area and time
Low and uneven moisture removal	Higher and uniform moisture removal

Mechanism of dehydration

Onions are typically sliced thinly and then dried in the sun or in a cabinet dehydrator. However, dehydration is a more effective method of preserving onions because it removes more moisture and therefore extends the shelf life of the onions (Table 3). During dehydration, the onion slices are placed between heated plates in a food chamber, facilitating heat transfer from the heat source to the food. This initiates a moisture diffusion process, where moisture escapes from the food. This phenomenon is known as heat and mass transfer. Initially, moisture loss occurs from the outer surface of the food, leading to the formation of a dried, thick layer. This layer acts as an insulating barrier, slowing down the rate of heat transfer into the food. This, in turn, establishes a moisture gradient, further reducing the drying rate. As the dehydration process progresses, the food reaches its normal equilibrium relative humidity (ERH), where heat and mass transfer rates diminish significantly. At this point, no further weight or moisture loss occurs unless the atmospheric conditions surrounding the food are altered.

Pusa Shobha

Pusa Shobha, a variety developed at the Division of Vegetable Science, ICAR-IARI, New Delhi, stands out with its distinctive brown skin and white flesh. These onions feature a compact, flat globe shape and a brown colour, making them well-suited for storage, drying, processing, and export. The bulbs typically have a diameter ranging from 4.5 to 6.0 cm, with a polar diameter between 4.8 and 6.5 cm. The weight of a single bulb falls within the range of 70.0 to 100.0 grams. Pusa Shobha's white flesh exhibits a high TSS content of approximately 16±2 degrees Brix, dry matter (16.18%) making it particularly suitable for processing purposes (Table 2).

Pretreatment and drying condition

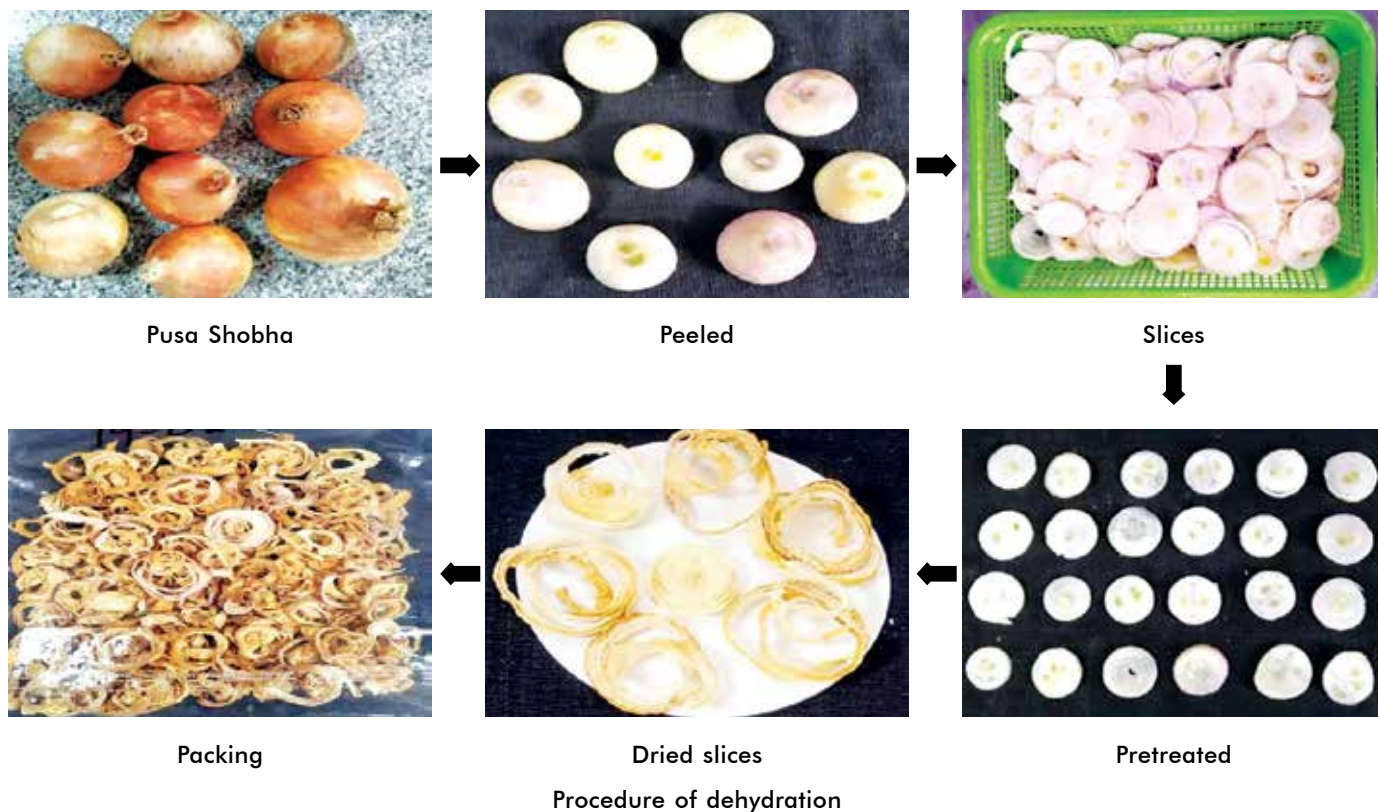
The pre-treatment of onion slices with a 5% NaCl solution yielded the best results in terms of retaining antioxidant activity, total phenols, pungency, and achieving a better rehydration ratio. This treatment also resulted in lower levels of non-enzymatic browning and moisture content in the final product when compared to other treatments. Regarding the drying process, onion slices were subjected to three different temperatures: 50°C, 55°C, and 60°C in a cabinet dryer. Among these, 60°C was identified as the most suitable temperature for dehydrating onion slices. This temperature retained comparatively less moisture in the product, preserved higher levels of nutritional quality, and required less time for bulk drying of the product.

Packaging and storage

The storage of dehydrated onion slices 200-gauge high-density polyethylene (HDPE) pouches was found to be good as it retains better retention of pungency, ascorbic acid, antioxidant activity, and rehydration ratio, sensory characteristics with low moisture, sugars, and non-enzymatic browning during the storage up to three months compared to 200 g LDPE (low-density polyethylene) pouches. However, the sample stored at low temperature retained a high content of antioxidant activity, total phenols, pungency, and ascorbic acid with better sensory characteristics in dehydrated onion slices as compared to ambient temperature during storage.

Advantages of dehydration

- Increase in concentration of nutrients due to loss of moisture.
- Protein, fat, and carbohydrate is present in larger amounts per unit mass of dried food.



- It improves quality in terms of colour, flavour, and texture.
- Reduction of packaging and distribution costs.
- It also retains nutrients longer duration during storage.
- Less affected by pests and diseases due to low moisture content.

Limitations of dehydration

- Loss of vitamin content, water-soluble vitamins can be partially oxidized during blanching and enzyme inactivation.
- Ascorbic acid, thiamine, and carotene are damaged by oxidative processes.
- Prolonged exposure to high temperature leads to non-enzymatic browning.

CONCLUSION

Pusa Shobha is a recently developed onion variety specifically designed for dehydration. This variety boasts white-coloured flesh that exhibits significantly reduced

browning during the dehydration process compared to other onion varieties. Pusa Shobha outshines its counterparts with higher TSS, dry matter content, and pungency levels. Dehydration is widely recognized as one of the most effective methods for preserving onions while simultaneously minimizing waste caused by sprouting, pests, and diseases during storage. Additionally, it contributes to stabilizing market prices, particularly during the dearth period. These attributes make Pusa Shobha a valuable addition to onion cultivation, especially for those seeking to enhance preservation and promote market stability.

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Tomato Hybrid Kashi Adbhut (VRNTH-18283) for high temperature: Suitable for high day temperature of $38\pm 2^{\circ}\text{C}$ and night temperature of $32\pm 2^{\circ}\text{C}$. Semi-indeterminate plants, fruit weight 60-30 g with yield potential of 520 q/ha, having TSS 3.7° Brix and acidity 0.25%. Crop duration February to June under north Indian plains. Availability of fruits up to 2nd week of June. Identified by Institute Technology Identification Committee. Proposal for release and notification submitted to U.P. State Government in April 2022.

Tomato Hybrid Kashi Tapas (VRNTH-19095) for high temperature: Suitable for very high day temperature of $38\pm 2^{\circ}\text{C}$ and night temperature of $32\pm 2^{\circ}\text{C}$. Semi-indeterminate plants. TSS 5.4° Brix & acidity 0.38%. Yield potential is 448 q/ha. Fruit weight is 45-40 g. Crop duration February to June under north Indian plains. Availability of fruits up to 1st week of June. Identified by Institute Technology Identification Committee. Proposal for release and notification submitted to U.P. State Government in April 2022.

Source: ICAR-Annual Report 2022-23