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# Effect of pre-treatments and drying methods on dehydration of shatavari

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**Abstract**
A study was undertaken to develop the pre-treatments and drying methods for dehydration of shatavari in factorial completely randomised design with three factors *viz*., types of roots, pre-treatments and drying methods. Observations on various physicochemical parameters were recorded. It was observed that, yellow roots recorded maximum recovery and reconstitution ratio (12.72% and 0.749, respectively) with minimum moisture content and water activity (11.08% and 0.414, respectively). While maximum *L* value, minimum *a** and *b** value (58.00, 5.39 and 23.05, respectively) were noticed in white root type. With respect to pre-treatments, steam blanching for five minutes recorded maximum recovery and reconstitution ratio (12.90% and 0.900, respectively) with minimum moisture content and water activity (10.77% and 0.415, respectively). Maximum *L* and *b** values were also noticed in steam blanching for five minutes (58.13 and 26.16, respectively). Further, among the different drying methods maximum recovery and reconstitution ratio (12.22% and 0.843, respectively), minimum moisture content and water activity (10.29% and 0.415, respectively) was found in electric drying. Higher *L* and *b** value while lower *a** value was also noticed in electric drying.

**Keywords:** Reconstitution, non-enzymatic browning, dehydration, water activity, L value

## Introduction
Shatavari (*Asparagus racemosus* Willd.) an important medicinal plant belonging to family Asparagaceae is regarded as 'Rasayana', that increases the cellular vitality and resistance in the Ayurvedic System of Medicine (Goyal *et al*., 2003; Bopana and Saxena, 2007) [4, 2]. Traditionally, the root has been used as a galactagogue which stimulates the secretion of breast milk (Kirtikar and Basu, 1918; Wani *et al*., 2011) [5, 8] and considered both a general tonic and a female reproductive tonic (Saxena *et al*., 2010) [7]. The major bioactive compound shatavari is steroidal saponins known as Shatavarins (I to X). Roots are the richest source of steroidal saponins. The tuberous roots of *A. racemosus* are highly hygroscopic in nature and absorb moisture when exposed to air resulting in degradation of saponin. Peeling is very cumbersome process which requires lot of labour. Hence, the study was conducted to determine the suitable pre-treatment for easy peeling and drying methods for dehydration of roots.

## Material and Methods
The experiment was conducted at Department of Postharvest Technology, KRC College of Horticulture, Arabhavi (UHS Bagalkot) in factorial completely randomised design with three factors consisting of type of roots (white type and yellow type), pre-treatments (water blanching for 2.50 and 5.00 minutes; steam blanching for 2.50 and 5.00 minutes) and drying methods (sun drying, solar tunnel drying and electric drying) with two replications.
Fresh, cleaned roots of both white and yellow types were blanched in boiling water and steam for two min. 30 sec and five minutes. After blanching, roots were peeled manually with help of a sharp knife/ peeler, spread in a single layer on trays and kept for drying under open sunlight, solar tunnel drying and electric drying. Drying was continued till the constant weight of dried roots was obtained. Dried roots were brought to normal temperature and packed in 150-gauge polyethylene bags, sealed and stored in a cool, dry place under ambient conditions. The observations on below mentioned parameters were recorded.

Recovery percentage was calculated by using the following formula

$$\text{Recovery (\%)} = \frac{\text{Weight of the dried roots (g)}}{\text{Weight of the fresh roots (g)}} \times 100$$

Moisture content of the dried roots was measured using a Moisture analyser and expressed in percentage.
The water activity of dried roots was measured using a digital water activity meter.
The reconstitution ratio was calculated by using the following formula

$$\text{Reconstitution ratio} = \frac{\text{Rehydration ratio}}{\text{Dehydration ratio}}$$

The colour of the dried roots was measured using a Lovibond colour meter and colour was expressed in Lovibond units *L** (lightness/darkness), *a** (redness / greenness) and *b** (yellowness / blueness).
The non-enzymatic browning (NEB) analysis of dried roots was analysed using a spectrophotometer. Five grams of dried root samples were soaked in 100 ml of 60 per cent alcohol for 12 hours. Then the solution was filtered using What man No. 44 filter paper and the absorbance of filtrate was measured at 440 nm against blank (60% ethyl alcohol) for non-enzymatic browning. The readings displayed in the spectrophotometer were noted and expressed as optical density value (Ranganna, 2003) [6].

**Results and discussion**

The results showed that there was significant difference between the factors for recovery, moisture content, water activity, reconstitution ratio, colour values and non-enzymatic browning. Among the two types of roots, maximum recovery (12.72 %) and reconstitution ratio (0.749) were observed in yellow root type ($C_2$). Yellow shatavari roots have slightly thicker peel than white type, which enhances the peeling operation without causing damage to roots. Hence, the recovery was higher in the yellow root. The reconstitution ratio was found higher in yellow root (0.749) compared to white root (0.650). This might be due to the minimum cell disruption in yellow root which regained the original shape of the root.
Maximum *L*: minimum *a** and *b** value was recorded in $C_1$ (white root type) whereas, the minimum *L*; maximum *a** and *b** value was recorded in $C_2$-yellow type. This might be due to varietal character, the white root has a higher lightness and the yellow root as the name says, are yellow in colour. Hence, the *b** value, an indicator of yellowness is high yellow root. White roots ($C_1$) recorded lower NEB whereas, yellow roots ($C_2$) recorded higher. Lower NEB in white roots is due to a faster drying process compared to yellow roots.
Among the different pre-treatments, higher recovery of 12.90 per cent was observed in steam blanching for five minutes followed by water blanching for five minutes. Higher cover observed in steam blanching is mainly attributed to the easier peeling of roots without causing any damage to roots. Minimum moisture content (10.77 %) and water activity (0.415) were observed in steam blanching for five minutes followed by water blanching for five minutes. Loss of moisture in steam blanching was due to increased cell permeability to moisture escape during the drying process. The results confirm with Chaudhary and Kumar (2020) in beetroot. Reconstitution ratio (0.90) was also maximum in steam blanching for five minutes followed by water blanching for five minutes. This might be due to the minimum cell disruption in yellow root which regained the original shape of the root. Maximum *L* value (58.13) and *b** value (26.16) was also found in steam blanching for five minutes. Non-enzymatic browning was also found minimum in steam and water blanching for five minutes (0.063 each).
There is significant difference among the drying methods for all the parameters observed. Maximum recovery (12.22%), reconstitution ratio (0.843), *L* value (60.76), *b** value (27.14) was found in electric drying with minimum moisture content (10.29 %), water activity (0.398), *a** value (5.35) and non-enzymatic browning (0.028). Higher recovery in electric drying was due to higher drying rate and uniform drying efficiency of electric drier. Electric drying helped in faster drying than other two methods which further helped to maintain all the quality parameters. The results are in accordance with Al-Amin *et al*. (2015) [1].
Among the interaction, non-significant difference was observed for recovery, moisture content and water activity. Higher reconstitution ratio was found in $C_2P_4D_3$ (1.073) which was on par with $C_1P_4D_3$ (0.991) with lower non-enzymatic browning. Maximum lightness (*L* value) was found in $C_1P_4D_3$ (66.70) followed by $C_2P_3D_3$ (63.26). This phenomenon was mostly due to the fact that the inactivation of peroxidase (POD), which caused the deterioration of the product colour (Xiao *et al*., 2012) [9].
Recovery percentage and reconstitution ratio are directly proportional to each other. Wherever the rehydration ratio was higher, the reconstitution ratio was also higher. Reconstitution ratio indicates the quality of product which was found higher in steam blanching and water blanching for 5 minutes. Cellular and structural disruption during blanching might have contributed to increase the rehydration rate in turn reconstitution ratio of dehydrated product (Al-Amin *et al*., 2015) [1] and reconstitution ratio was also found higher in electric drying which might be due to faster rate of drying (Al-Amin *et al*., 2015) [1].

**Table 1:** Influence of pre-treatments and drying methods on recovery and quality of shatavari roots

| Treatments | Recovery (%) | Moisture content (%) | Water activity | Reconstitution ratio | *L* Value | *a** Value | *b** Value | NEB |
|---|---|---|---|---|---|---|---|---|
| $C_1$ | 9.63 | 11.23 | 0.429 | 0.650 | 58.00 | 5.39 | 23.05 | 0.045 |
| $C_2$ | 12.72 | 11.08 | 0.414 | 0.749 | 54.86 | 6.97 | 27.33 | 0.098 |
| SEM± | 0.11 | 0.03 | 0.002 | 0.008 | 0.04 | 0.01 | 0.01 | 0.001 |
| CD @ 1 % | 0.45 | 0.13 | 0.006 | 0.030 | 0.15 | 0.04 | 0.05 | 0.004 |
| | | | | | | | | |
| $P_1$ | 10.32 | 11.70 | 0.430 | 0.511 | 55.60 | 6.31 | 24.74 | 0.093 |
| $P_2$ | 11.14 | 11.15 | 0.417 | 0.706 | 55.74 | 6.00 | 24.24 | 0.063 |
| $P_3$ | 10.35 | 11.01 | 0.423 | 0.681 | 56.26 | 6.36 | 25.63 | 0.065 |
| $P_4$ | 12.90 | 10.77 | 0.415 | 0.900 | 58.13 | 6.06 | 26.16 | 0.063 |
| SEM± | 0.16 | 0.05 | 0.002 | 0.011 | 0.05 | 0.02 | 0.02 | 0.001 |
| CD @ 1 % | 0.64 | 0.18 | 0.009 | 0.042 | 0.21 | 0.06 | 0.07 | 0.005 |
| $D_1$ | 10.20 | 11.91 | 0.430 | 0.599 | 56.41 | 6.19 | 25.17 | 0.063 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $D_2$ | 11.11 | 11.27 | 0.436 | 0.657 | 52.13 | 7.00 | 23.26 | 0.122 |
| $D_3$ | 12.22 | 10.29 | 0.398 | 0.843 | 60.76 | 5.35 | 27.14 | 0.028 |
| SEM± | 0.14 | 0.04 | 0.002 | 0.009 | 0.05 | 0.01 | 0.01 | 0.001 |
| CD @ 1 % | 0.55 | 0.16 | 0.008 | 0.037 | 0.18 | 0.05 | 0.06 | 0.005 |
| $C_1P_1D_1$ | 5.87 | 12.60 | 0.433 | 0.174 | 59.29 | 5.84 | 22.14 | 0.069 |
| $C_1P_1D_2$ | 8.47 | 11.88 | 0.481 | 0.466 | 48.30 | 6.69 | 23.18 | 0.024 |
| $C_1P_1D_3$ | 10.00 | 10.27 | 0.398 | 0.760 | 59.78 | 4.26 | 24.02 | 0.035 |
| $C_1P_2D_1$ | 8.42 | 12.04 | 0.429 | 0.529 | 56.60 | 5.75 | 22.97 | 0.061 |
| $C_1P_2D_2$ | 9.34 | 11.52 | 0.427 | 0.593 | 55.40 | 5.42 | 21.82 | 0.057 |
| $C_1P_2D_3$ | 10.24 | 10.07 | 0.388 | 0.751 | 62.12 | 4.62 | 23.26 | 0.015 |
| $C_1P_3D_1$ | 8.40 | 12.15 | 0.452 | 0.594 | 55.91 | 6.52 | 23.35 | 0.044 |
| $C_1P_3D_2$ | 9.27 | 11.20 | 0.449 | 0.571 | 54.28 | 4.93 | 20.20 | 0.047 |
| $C_1P_3D_3$ | 10.49 | 10.17 | 0.411 | 0.745 | 62.82 | 4.59 | 24.58 | 0.022 |
| $C_1P_4D_1$ | 10.43 | 11.90 | 0.440 | 0.782 | 61.69 | 4.96 | 23.49 | 0.070 |
| $C_1P_4D_2$ | 11.90 | 10.93 | 0.436 | 0.839 | 53.20 | 6.86 | 20.91 | 0.063 |
| $C_1P_4D_3$ | 12.75 | 10.04 | 0.403 | 0.991 | 66.70 | 4.34 | 26.74 | 0.031 |
| $C_2P_1D_1$ | 11.20 | 12.53 | 0.422 | 0.372 | 56.40 | 6.77 | 24.86 | 0.146 |
| $C_2P_1D_2$ | 12.75 | 12.19 | 0.447 | 0.620 | 53.27 | 8.20 | 21.82 | 0.243 |
| $C_2P_1D_3$ | 13.65 | 10.71 | 0.402 | 0.674 | 56.57 | 6.10 | 32.46 | 0.041 |
| $C_2P_2D_1$ | 13.03 | 11.58 | 0.423 | 0.737 | 51.72 | 6.40 | 24.67 | 0.043 |
| $C_2P_2D_2$ | 12.62 | 11.00 | 0.431 | 0.689 | 54.18 | 7.90 | 26.13 | 0.164 |
| $C_2P_2D_3$ | 13.22 | 10.69 | 0.403 | 0.934 | 54.46 | 5.91 | 26.61 | 0.042 |
| $C_2P_3D_1$ | 11.35 | 11.32 | 0.411 | 0.704 | 52.45 | 7.09 | 29.68 | 0.047 |
| $C_2P_3D_2$ | 11.01 | 10.97 | 0.424 | 0.661 | 48.88 | 8.22 | 27.24 | 0.211 |
| $C_2P_3D_3$ | 11.57 | 10.26 | 0.393 | 0.814 | 63.26 | 6.82 | 28.74 | 0.023 |
| $C_2P_4D_1$ | 12.92 | 11.17 | 0.432 | 0.896 | 57.21 | 6.24 | 30.23 | 0.029 |
| $C_2P_4D_2$ | 13.50 | 10.49 | 0.399 | 0.816 | 49.55 | 7.79 | 24.84 | 0.168 |
| $C_2P_4D_3$ | 15.87 | 10.12 | 0.385 | 1.073 | 60.42 | 6.21 | 30.76 | 0.018 |
| Mean | 11.18 | 11.16 | 0.421 | 0.70 | 56.43 | 6.18 | 25.19 | 0.071 |
| SEM± | 0.40 | 0.11 | 0.006 | 0.026 | 0.131 | 0.04 | 0.04 | 0.003 |
| CD @ 1 % | NS | NS | NS | 0.104 | 0.520 | 0.15 | 0.16 | 0.013 |

## Conclusion

Among all the treatments steam blanching for five minutes followed by water blanching for five minutes and electric drying was considered better with retention of all physicochemical parameters where higher recovery, minimum moisture content, water activity and minimum colour change was noticed.

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