

STUDYING THE EFFECT OF DIFFERENT FRUIT AND SEED DRYING METHODS ON SEED QUALITY OF TWO DIFFERENT GENOTYPES OF CHILLI (*Capsicum annuum* L.)

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Abstract: The effect of seed drying methods on physiological quality of chilli seeds of fruits harvested at physiological maturity was studied in Randomized block design (RBD) in four replications with four treatments like sun-drying, shade drying, freeze drying of fruits and hand extracted seeds on the day of harvest followed by shade drying in two varieties released from OUAT, Bhubaneswar viz. Utkal Rashmi and Utkal Ava. Seeds were stored for 10 months and observations were recorded on germination percentage, vigour index, root length, shoot length and root-shoot ratio in a regular interval of 2 months. Results revealed that maximum germination percentage and vigour index were recorded in seeds extracted from fruits just before testing with shade drying for both the varieties at all the 5 durations of storage. Seeds extracted immediately after harvest at physiological maturity stage maintained higher germination till 2 months of storage and was at par with shade drying in Utkal Ava. However shade drying was significantly better than other methods of drying for Utkal Rashmi at all durations. Vigour index of hand extracted seeds is significantly better than other drying methods in both varieties. In Utkal Rashmi, the vigour index of shade drying was at par with the hand extracted seeds which was significantly better than other drying methods. Hence both shade drying and hand extracted seeds on the day of harvesting is recommended for drying of chilli seeds.

Keywords: Chilli (*Capsicum annuum* L.); Fruit and seed drying methods; Germination percentage; Vigour index;

INTRODUCTION

Chilli (*Capsicum annuum* L.; 2N=24) is a member of the Solanaceae family. Nearly 30 species were identified under the genus *Capsicum*. Out of it, only five species *C. annuum* L., *C. baccatum* L.; *C. chinense* Jacq.; *C. frutescens* L. and *C. pubescens* Ruiz & Pavonand are mostly cultivated and are recognized by International Bureau of Plant Genetic Resources (Bosland and Votava, 2000; Wang and Bosland, 2006). Among all, *C. annuum* L. is the

widely cultivated and most explored species. It is an indispensable spice essentially used in every Indian cuisine due to its pungency, taste, appealing colour and flavour. Pungency of chilli is due to a crystalline acrid volatile alkaloid called 'capsaicin', present in the placenta of fruit which has diverse prophylactic and therapeutic uses in allopathic and ayurvedic medicine. Chilli seeds exhibit peculiar behavior in storage requirement. These seeds loose germination quickly after removing from fruit. Seeds maintain viability for a longer period when they are in fruits than the seeds extracted and stored. Seeds reported to maintain a higher germination value up to 6 months, when retained in fruits and stored under ambient conditions. (Murthy & Murthy, 1961, Radhe Sham *et al.*, 1996, Nagaraja *et al.*, 1998b, Sahoo, 2014). The quality of chilli seeds are maintained for a long period by adopting different drying methods and also extraction methods. Chilli, unlike brinjal and tomato, the other members of Solanaceae family where seeds are mostly extracted at ripened stage using fermentation method, chilli seed extraction is mostly done after drying of the ripened fruits. However it is reported that chilli seeds express maximum vigour at physiological maturity stage (Vasudevan *et al.* 2008, Sahoo, 2014). Hence chilli drying is very crucial from seed viability and vigour point of view, as seeds extracted from fruits at physiological maturity is supposed to express maximum vigour. So for understanding the viability and vigour of chilli seeds both inside the fruit and extracted at the day of harvest for the entire storage period is a matter of study. Keeping these propositions in mind, the present experiment was designed to evaluate the drying methods like shade drying, sun-drying, freeze drying of chilli with fruits harvested at physiological maturity and hand extraction of seeds on the day of harvest followed by shade drying for identifying suitable drying methods.

MATERIALS AND METHODS

The present investigation was undertaken with a view to evaluate different drying methods of chilli for seed extraction and its effect on storage response of seeds for different storage durations in two varieties of chilli (*Capsicum annuum* L.) released from OUAT, Bhubaneswar viz. Utkal Ava and Utkal Rashmi. Chilli fruits were harvested at red mature stage, grown in central Research Station of Orissa University of Agriculture and Technology, Bhubaneswar, Odisha during Rabi 2013-14. After harvesting, fruits were subjected to different drying methods like shade drying, sun-drying, freeze drying. In one treatment, seeds were extracted manually from the fruits on the day of harvest, washed thoroughly and dried in shade. Sufficient quantity of fruits of the two varieties were dried and stored at ambient storage condition for a maximum period of 10 months. During this period, regular seed

quality parameters were recorded at 2 months interval to record the rate of deterioration in viability and vigour using germination test and seed vigour index (Abdul Baki and Anderson, 1973). The experimental results were analyzed in complete randomized block design using ANOVA.

RESULTS AND DISCUSSION

Germination percentage

The seed quality parameters like germination, vigour were tested for the seeds before storing and found to be above the standard in both varieties. Results of experiment revealed that seeds of variety Utkal Ava retained maximum germination percentage for hand extracted seeds (86.5%) followed by shade drying (84.25%) at 2 months of storage which were statistical at par (Table 1). However in subsequent storage periods i.e. 4, 6, 8 and 10 months of storage, seeds in shade dried fruits performed better than hand extracted seeds though they were not significantly different except for 4 months of storage. When considered sundried and germination in freeze drying methods the shade dried and hand extracted methods were significantly better than others for all durations of storage. Likewise in Utkal Rashmi, both hand extracted seeds (87%) and shade dried seed (84.25%) had similar performance till 2 months of storage and performance of shade dried seeds were significantly better than other methods, which did not have any significant difference among themselves for all durations of storage except for 4 months. Lowest germination was recorded in freeze drying method for all durations followed by seeds of sundried fruits in both the varieties, Utkal Ava and Utkal Rashmi (Figure 1).

Vigour Index

The initial vigour index was 1048 for Utkal Ava and 1246 for Utkal Rashmi. For Utkal Ava, vigour index of seeds dried in different methods and stored for 2 and 8 months were significantly different. For other durations, vigour index of shade dried and hand extracted seeds were at par and both were significantly higher than sun dried and freeze dried methods for all durations. Sun dried seeds performed significantly better in terms of vigour index for all durations of storage than freeze dried seeds. It was highest for hand extracted seeds (1002) followed by shade drying (810) at 2 months duration of storage (Table 1). In Utkal Rashmi, vigour index of seeds dried in different methods and stored for different durations were significantly different from each other except hand extracted and sun dried methods at 2 months. At 6 months and 8 months of storage, hand extracted and shade dried seeds were statistically at par with sun dried and freeze dried seeds at 10 months of storage. Shade dried

seeds performed best in terms of vigour index for all durations of storage. It was highest for shade dried seeds (1030) followed by hand extracted seeds (725) at 2 months duration of storage. Unlike variety Utkal Ava, where vigour of sundried seeds was very less, herein variety Utkal Rashmi, sundried seeds had maintained satisfactory level of vigour which was at par with hand extracted seeds. Vigour index was consistently lowest for freeze dried seeds for all durations of storage in both the varieties (Figure 2).

Table 1: Seed germination percentage and Vigour index of chilli (*Capsicum annuum* L.) dried under different conditions in ambient storage.

| Sl. No | Treatment | Germination | | Vigour Index | |
|--------|---------------------------------|----------------|----------------|----------------|----------------|
| | | V ₁ | V ₂ | V ₁ | V ₂ |
| 1 | M ₀ D ₀ * | 90.00 | 91.00 | 1048.15 | 1246.63 |
| 2 | M1D1 | 84.25 | 84.25 | 810.28 | 1029.83 |
| 3 | M1D2 | 74.50 | 78.25 | 802.58 | 987.63 |
| 4 | M1D3 | 66.00 | 65.25 | 666.63 | 807.50 |
| 5 | M1D4 | 46.00 | 55.00 | 361.13 | 590.70 |
| 6 | M1D5 | 30.00 | 32.50 | 250.53 | 284.83 |
| 7 | M2D1 | 86.50 | 87.00 | 1002.95 | 724.70 |
| 8 | M2D2 | 71.00 | 77.50 | 816.50 | 777.18 |
| 9 | M2D3 | 64.50 | 68.50 | 637.25 | 723.85 |
| 10 | M2D4 | 52.50 | 56.00 | 439.00 | 575.90 |
| 11 | M2D5 | 31.00 | 39.50 | 219.45 | 236.13 |
| 12 | M3D1 | 61.00 | 71.00 | 541.00 | 707.65 |
| 13 | M3D2 | 55.25 | 71.00 | 491.68 | 613.15 |
| 14 | M3D3 | 42.50 | 57.50 | 345.45 | 565.70 |
| 15 | M3D4 | 36.50 | 36.00 | 262.35 | 285.23 |
| 16 | M3D5 | 17.50 | 25.00 | 97.95 | 135.85 |
| 17 | M4D1 | 55.25 | 62.50 | 457.25 | 457.25 |
| 18 | M4D2 | 50.00 | 51.50 | 317.98 | 426.78 |
| 19 | M4D3 | 43.50 | 42.25 | 322.25 | 318.10 |
| 20 | M4D4 | 23.00 | 25.00 | 125.55 | 162.23 |
| 21 | M4D5 | 8.75 | 12.00 | 32.40 | 65.00 |

| | | | | |
|---------|-------|-------|--------|--------|
| Mean | 51.88 | 56.60 | 478.49 | 558.18 |
| SEM (±) | 1.60 | 2.23 | 35.13 | 68.25 |
| CD 5% | 3.19 | 4.46 | 70.26 | 136.51 |
| CD 1% | 4.25 | 5.93 | 93.44 | 181.56 |

| | | |
|---------------------|----------------------|------------------|
| *Methods of Drying | Durations of Storage | Variety |
| M1 : Shade Drying | D1 : 2 Months | V1- Utkal Ava |
| M2 : Hand Extracted | D2 : 4 Months | V2- Utkal Rashmi |
| M3 : Sundried | D3 : 6 Months | |
| M4 : Freeze Drying | D4 : 8 Months | |
| | D5 : 10 Months | |

Fig 1. Seed germination percentage of chilli (*Capsicum annuum* L.) dried under different conditions in ambient storage

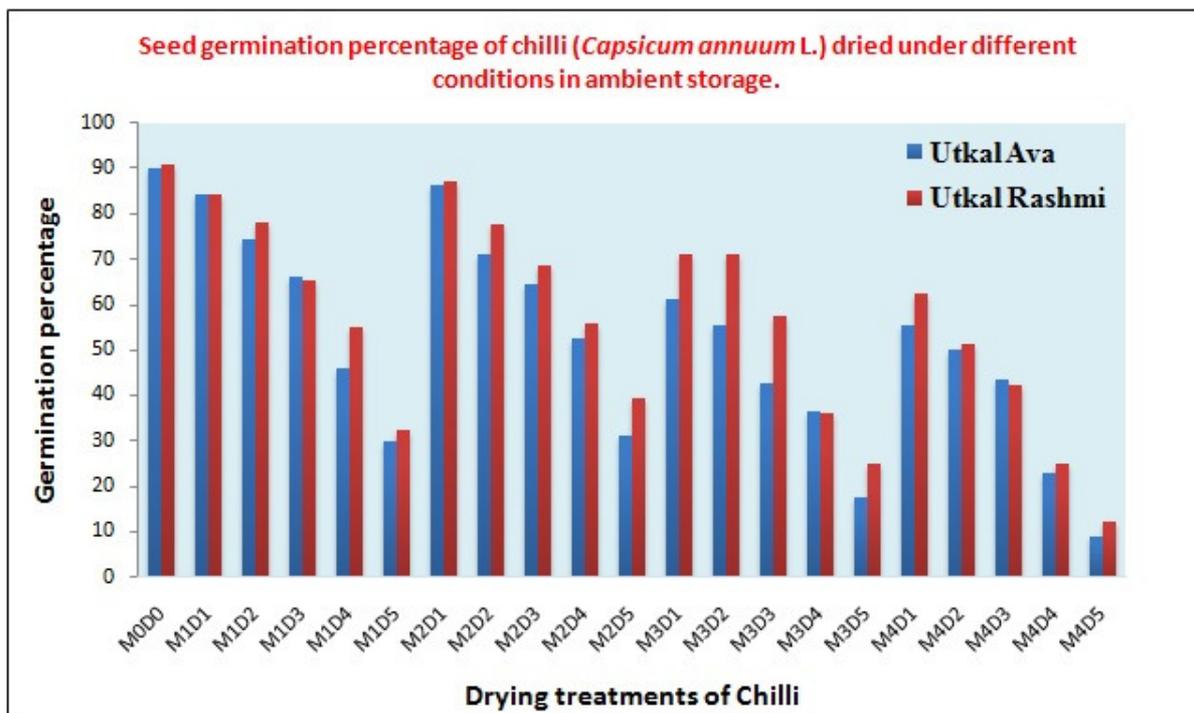
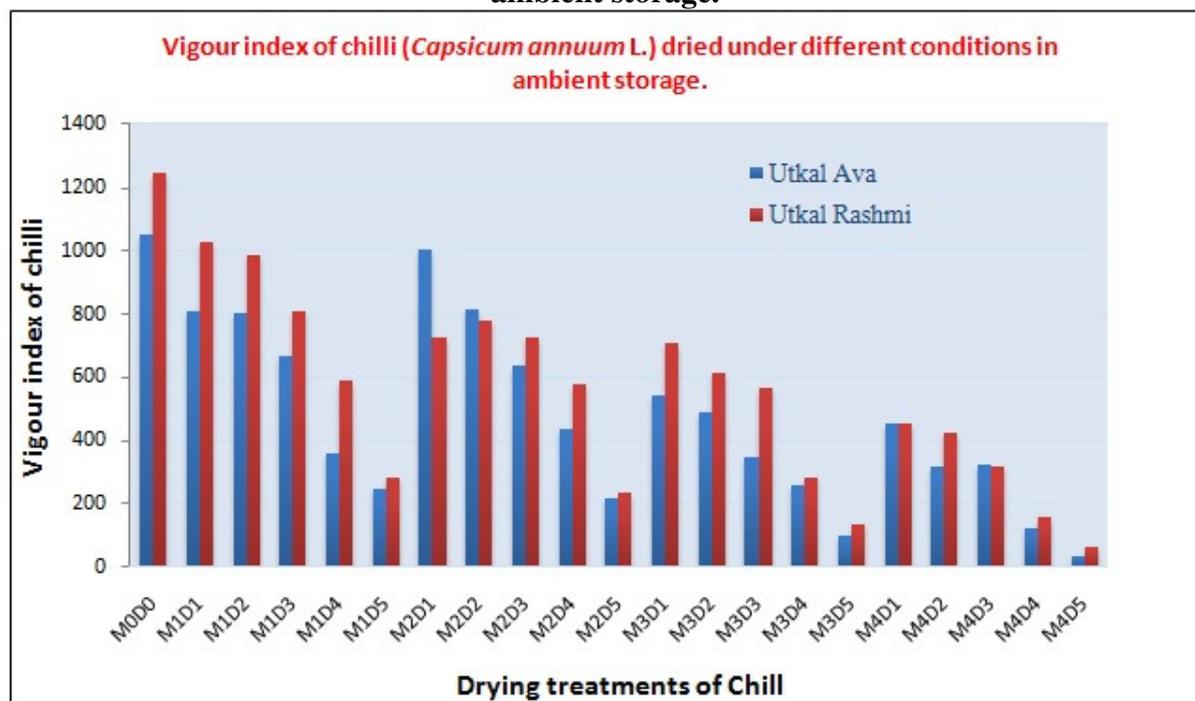


Fig 2. Vigour index of chilli (*Capsicum annuum* L.) dried under different conditions in ambient storage.



Root-Shoot Length and Root-Shoot Ratio

In most of the storage durations root length of variety Utkal Rashmi was higher than variety Utkal Ava. So variations in root length were more prominent in Utkal Rashmi than Utkal Ava. In Utkal Rashmi shade dried seeds showed significantly longer root length than other drying methods (8.35 cm at 4 months of storage). But in Utkal Ava, root lengths of all treatments were mostly similar except freeze dried seeds. Shoot length of Utkal Ava and Utkal Rashmi did not exhibit much difference. However in both varieties shade dried seeds had longer shoots than other treatments. Sun dried seeds though exhibited very less germination and vigour compared to shade dried and hand extracted seeds, they had good root and shoot length indicating its usefulness as a drying method for chilli in case of humid climates. Variety Utkal Rashmi had higher (1.63) mean root shoot ratio than Utkal Ava (1.48) as it had longer roots (Table 2). Root shoot ratio for all treatments and all durations were statistically at par without any significant variations. Drying methods played very important role in seed quality in the present experiment. Results can be better interpreted by understanding the fact that, chilli seed attains physiological and functional maturity at high seed moisture content of 39-40% and the rate of moisture migration from center to surface of the seed is influenced by temperature, pericarp thickness, chemical composition of seed and seed coat permeability. The rate of moisture removal from the surface of seed is influenced

by degree of surface saturation, relative humidity and temperature of drying air. If evaporation from the seed surface occurs too rapidly it can damage the embryo, therefore seed should be dried carefully to arrest stress damage due to heat (Philpot, 1976). In contrast, if moisture elimination takes place too slowly it may favour invasion of pathogens (Harrington, 1972). In the present experiment shade drying of chilli fruits harvested at red maturity or physiological maturity was found to be the most effective method of drying. Seeds extracted and shade dried on the day of harvest was also effective for a certain period in both the varieties. Sun drying was less effective for seed purpose. Similar results were reported by Thiagarajan (1983) in chillies. These results are in agreement with the findings of Dhanelappagol *et al.* (1988) in chillies, Javaregowda *et al.* (1990) in tomato and Shivahre *et al.* (1995) in chillies. Heat tolerance of seed varies with the species. For drying of vegetable seed, temperature not exceeding 35⁰C has been advocated by Harrington (1972). This variation in seed quality parameters between the two varieties may be due to existence of variability and genetic makeup of the variety. Such variations among the species in Solanaceous crops are reported by Javaregowda *et al.* (1990) particularly in tomato and brinjal. The higher seed quality parameters observed in both the varieties of fruits dried under shade drying and hand extraction method over sun drying is attributed to the optimal condition of drying for protection of seed, seed coat membrane, maintenance of intact embryo and avoiding fungal invasion, whereas the red ripe fruits dried under sun might have infected by fungi, rupturing of seed coat, damaging embryo and endosperm resulting in poor seed quality parameters. The results are in agreement with Shivhare *et al.* (1995), Philpot (1976), Vinod kumar (1998) and Bellad (1997) in chillies.

Table 2: Seedling root- shoot length and root shoot ratio of chilli (*Capsicum annuum* L.) dried under different conditions in ambient storage

| Sl. No | Treatment | Seedling Root Length | | Seedling Shoot Length | | Seedling Root-Shoot Ratio | |
|--------|---|----------------------|----------------|-----------------------|----------------|---------------------------|----------------|
| | | V ₁ | V ₂ | V ₁ | V ₂ | V ₁ | V ₂ |
| 1 | M ₀ D ₀ ^{**} | 6.65 | 8.65 | 5.00 | 5.05 | 1.36 | 1.73 |
| 2 | M1D1 | 5.75 | 7.60 | 3.88 | 4.63 | 1.49 | 1.65 |
| 3 | M1D2 | 6.08 | 8.35 | 4.70 | 4.25 | 1.31 | 1.98 |
| 4 | M1D3 | 5.53 | 8.03 | 4.58 | 4.38 | 1.23 | 1.89 |
| 5 | M1D4 | 4.33 | 6.43 | 3.50 | 4.33 | 1.23 | 1.77 |
| 6 | M1D5 | 4.85 | 5.53 | 3.50 | 3.30 | 1.41 | 1.84 |
| 7 | M2D1 | 6.88 | 4.88 | 4.73 | 3.45 | 1.50 | 1.37 |

| | | | | | | | |
|---------------|------|------|------|------|------|------|------|
| 8 | M2D2 | 6.58 | 5.73 | 4.93 | 4.33 | 1.36 | 1.35 |
| 9 | M2D3 | 5.23 | 6.80 | 4.65 | 3.75 | 1.20 | 1.86 |
| 10 | M2D4 | 4.98 | 6.18 | 3.38 | 4.15 | 1.63 | 1.54 |
| 11 | M2D5 | 4.43 | 3.58 | 2.65 | 2.38 | 1.68 | 1.57 |
| 12 | M3D1 | 5.38 | 6.45 | 3.50 | 3.48 | 1.56 | 1.87 |
| 13 | M3D2 | 5.73 | 5.30 | 3.18 | 3.40 | 1.88 | 1.92 |
| 14 | M3D3 | 5.10 | 6.38 | 3.00 | 3.45 | 1.78 | 1.90 |
| 15 | M3D4 | 4.58 | 5.25 | 2.63 | 2.60 | 1.81 | 2.01 |
| 16 | M3D5 | 3.38 | 3.20 | 2.28 | 2.28 | 1.54 | 1.49 |
| 17 | M4D1 | 5.25 | 4.53 | 3.03 | 2.88 | 1.74 | 1.60 |
| 18 | M4D2 | 3.20 | 4.65 | 3.18 | 3.63 | 1.04 | 1.29 |
| 19 | M4D3 | 4.40 | 4.20 | 3.10 | 3.30 | 1.70 | 1.31 |
| 20 | M4D4 | 2.95 | 3.55 | 2.40 | 3.03 | 1.39 | 1.23 |
| 21 | M4D5 | 1.88 | 2.78 | 1.95 | 2.75 | 1.16 | 1.05 |
| Mean | | 4.91 | 5.62 | 3.51 | 3.56 | 1.48 | 1.63 |
| SEM (\pm) | | 0.40 | 0.77 | 0.47 | 0.61 | 0.32 | 0.36 |
| CD 5% | | 0.81 | 1.54 | 0.95 | 1.22 | 0.64 | 0.72 |
| CD 1% | | 1.08 | 2.05 | 1.26 | 1.62 | 0.85 | 0.96 |

**Methods of Drying

Durations of Storage

Variety

M1 : Shade Drying

D1 : 2 Months

V₁- Utkal Ava

M2 : Hand Extracted

D2 : 4 Months

V₂- Utkal Rashmi

M3 : Sundried

D3 : 6 Months

M4 : Freeze Drying

D4 : 8 Months

D5 : 10 Months

CONCLUSION

Drying requirements of chilli seed was found to be very peculiar. Time of harvesting, method, temperature and duration of drying was very crucial. The present experiment evaluated all these aspects and revealed that shade drying of chilli fruits harvested at physiological maturity or seeds extracted on the same day of harvest followed by shade drying are useful for maintaining seed viability and vigour.

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