Research Article

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Effect of harvesting stage on drying, rehydration and sensory characteristics of *khejri* (*Prosopis cineraria*) pods

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ABSTRACT

Dehydrated tender green pods of *khejri* (*Prosopis cineraria*) are utilized as premium vegetable in north-west part of country. Looking into the economic importance of *khejri* pods (*sangri*), an experiment was conducted to investigate the effect of pod harvesting stage on drying, rehydration and sensory properties of dried pods during year 2021-22. The maximum dry product recovery (28.22%) was recorded in 13 days maturity closely followed by 16 days (28.08%) maturity pods. Significantly high rehydration capacity was noticed in early harvest (10, 13 and 16 day's maturity) pods as compared to late harvest (19, 22 and 25 maturity) pods. Desirable sensory properties were also observed in10 to 16 days maturity pods. Based on study, it is concluded that *khejri* variety *Thar Shobha* pods should be harvested in 2-3 pickings between 10-16 days after fruiting for getting good quality dried product.

Introduction

Khejri (*Prosopis cineraria*) is a leguminous tree grows naturally under resource poor arid edapho-climatic conditions of north-west part of country. This tree is a life-line tree of Thar Desert because it provides food, fodder, fuel, shelter to local inhabitants and also supports eco-restoration through augmenting soil fertility and checking erosion (Samadia, 2016). It is the most important component of the traditional farming systems and tolerates extreme edapho-climatic conditions with lush-green foliage and bears fruits that too during the driest period (Pareek, 2002). Its nutritious leaf (*loong*) utilized as fodder for livestock and tender pods locally known as *sangri* consume extensively for vegetable and pickle purpose. *Sangri* is sold in fresh and dehydrated form at premium prices, and it is the main constituent of *Panchkutta* vegetable culinary. *Sangri* is high valued and sold at remunerative prices *i.e.*, Rs. 100-150 and 500-800 per kg both in fresh and dehydrated form, respectively. *Sangri* is rich in minerals such as potassium, magnesium, calcium, zinc, iron and in addition a good source of protein and dietary fiber. It also contains high antioxidants, phenols, flavonoids and saponins, which help in boosting the immunity and reduce bad cholesterol in the blood.

ICAR-CIAH, Bikaner has developed an improved variety of *khejri* named as *Thar Shobha* which has many ideal horticultural attributes such as dwarf plant stature, thornlessness, regular bearer, uniform quality pods and high yield of good quality fodder. In recent times, farmers are showing much interest in commercial orcharding of *Thar Shobha* and cultivation area of this variety is rapidly increasing in arid and semi-arid regions of Rajasthan, Gujarat and Haryana state. Farmers are cultivating it for nutritious tender fresh green pods and leaf-fodder. Fresh green pods are

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available for very short period *i.e.* 10-15 days during second fortnight of April. Farmers and rural women process these green pods into dry pods locally known as *sangri*, which is the high value product of *khejri*. A single spike of *khejri* bears variable maturity pods due to asynchronous bearing habit. In traditional practice, farmers usually harvest whole produce in single picking which includes immature and over mature pods too. Further dehydration of these pods yields non-uniform quality *sangri* that fetch lesser price in the market. To obtain uniform premium quality dried *sangri*, green pods required to be harvest at specific maturity. So far, maturity indices for harvesting of green pods for dehydration purpose have not been standardized. Therefore, the present study was carried to determine the right maturity stage for getting premium quality dried product and also to know the pod maturity level effect on drying rehydration and sensory attributes.

Material and Methods

The experiment was carried out in *Thar Shobha* variety in year 2021-22. Panicles were tagged and pod setting date was mentioned in tag during March month. First harvest was conducted after 10 days of pod setting. Later on, harvesting was carried out at 13, 16, 19, 22 and 25 days after pod setting. Immediately after harvesting pods were brought to post harvest laboratory, washed, blanched for 5 minutes, dried in tunnel type solar dryer and packed in food grade plastic boxes for further observations.

Drying yield (%): Drying yield was determined by the following formula

$$\text{Drying yield} = \frac{\text{Weight of dried pods}}{\text{Weight of fresh pods}}$$

Determination of drying ratio: The drying ratio was calculated by the following formula:

$$\text{Drying ratio} = \frac{\text{Weight of fresh pods before drying}}{\text{Weight of dried pods } (sangri)}$$

Rehydration ratio: Rehydration means refreshing the dehydrated or dried products in water. Fifteen beakers (three for each maturity stage) of each 500 ml capacity were taken and 300 ml of boiling water and 20 g of dried sample were poured into each beaker and kept for 60 minutes for rehydration. Weight of rehydrated samples was measured at 10 minutes interval for 60 minutes period. Surface moisture from rehydrated samples was removed properly by applying tissue paper before measuring weight. The rehydration ratio was calculated by following formula-

$$\text{Rehydration ratio} = \frac{\text{Weight of rehydrated pods}}{\text{Weight of dried pods}}$$

Rehydration kinetics: Drying kinetics was determined by measuring sample weight by digital balance at regular interval (1 hr) during drying and plotting graph of weight loss against time. Same way rehydration kinetics was determined by plotting curve of weight gain against time period (10 minutes interval) during rehydration process (Ismail *et al.*, 2016).

Sensory evaluation: Sensory evaluation of rehydrated *sangri* of different maturity stages was carried out on the basis of hedonic scale by group of scientists, experts and SRFs at ICAR-CIAH, Bikaner.

Statistical analysis: Data was collected in triplicate; the mean values with standard deviations were reported. Significant mean difference at 95% confidence level (α=0.05) was identified through use of WASP 2.0 software developed by ICAR-Central Coastal Agricultural Research Institute, Goa.

Results and Discussion

Effect of harvesting stage on dry product yield (%):

Dry product yield was significantly affected by the harvesting stage of green pods. Pods harvested after 10 days of setting demonstrated minimum dry product yield *i.e.* 25.86%, however as the maturity progressed yield was considerably enhanced and observed 28.19 and 28.05% in pod harvested after 13 and 16 days of setting, respectively. In later maturity stages, dry product yield was continuously decreased significantly and found 27.37, 26.99 and 26.34% of fresh weight in pods harvested after 19, 22 and 25 days after pod setting (Fig. 1). Low dry product yield in early harvested pods is may be due to presence of high moisture content during initial stage of development. The rationale behind the maximum dry product yield in pods harvested after 13 and 16 days of setting is increase in dry matter content due to deposition of fiber, cellulose and lignin in pods during later stages of development.

At the stage of 19, 22 and 25 days of harvest significant reduction in dry product recovery (%) were observed. It may be due to initiation of seed development in pods which augment the fresh weight but dry matter content do not enhanced because seed is having high water content during early developmental stage. Similar results were obtained in vegetable type cluster bean pods dehydration where dry product yield from beans were reduced at the inception of seed development stage (Gurjar *et al.*, 2023). These observations were also in an agreement with the results previously reported by Ismail *et al.* (2016) in green bean (*Phaseolus vulgaris*) during open sun drying.

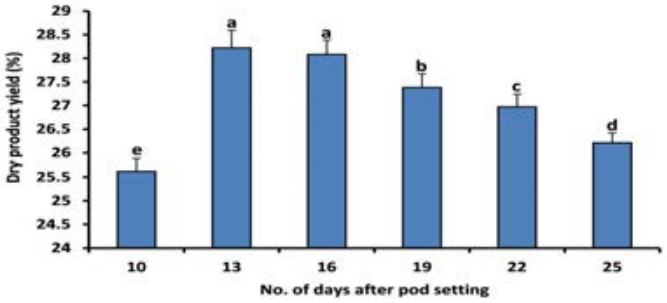

Fig. 1. Effect of pod harvesting stage on dry product yield (%) of *sangri*

Effect of harvesting stage on rehydration ratio of dried pods: Rehydration ratio (RR) is the ratio of the mass of rehydrated and drained food to the mass of the original material (dried product). Rehydration capacity is one of the important properties used to measure the quality of dried food materials (Lewicki, 1998). A high value of rehydration ratio means the dried product has ability to convert near to original color, texture and shape through absorption of water after soaking. In present study, significant variation was noticed in rehydration ratio of *sangri* harvested at different maturity stages.

The maximum rehydration ratio (2.95) was recorded in pods harvested after 10 days of setting while significant diminish in RR was observed in 13 and 16 days maturity pods. However, difference in rehydration value was non-significant between 13 and 16 days maturity pods (Fig. 2). As the pod maturity progressed, continuous significant decline in RR was observed and minimum (1.94) was found in pods harvested after 25 days of setting. According to results presented above RR is inversely proportional to the number days after pod setting. The high RR in early maturity stage (10, 13 and 16 days maturity) pods was due to porous structure of cell wall owing to less deposition of fiber, cellulose and lignin which allow water to enter unhindered in dried product. In case of later stages of pods maturity (19, 22 and 25 day's maturity), porosity and elasticity of cell wall was declined because of more concentration of fiber and lignin in peel. The similar results were reported in okra during rehydration of dried flakes harvested at different fruit maturity stages (Tufekci and Ozkal, 2017).

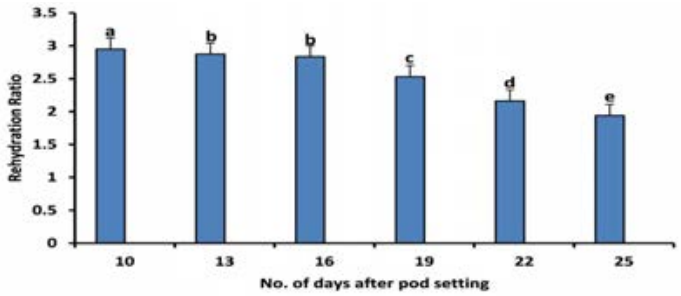

Fig. 2. Rehydration ratio of dried pods harvested at different maturity stages

Effect of harvesting stage on rehydration kinetics of dried sangri: Rehydration rate is considered as one of the important parameters for assessing dried product quality. Rehydration curves of the dried *sangri* of different maturity stages versus rehydration time were plotted in Fig. 3. It was witnessed that high rehydration rates were noticed in all samples for the first 30 minutes and then rehydration rates start to slow down. However, in case of late harvest *i.e.* 19, 22 and 25 days maturity pods rehydration rate was comparatively sluggish as compared to the early harvest pods right throughout the rehydration period. It might be due to the fact that early harvest pods possess higher porosity that facilitates quicker diffusion of water into the material.

The rapid rehydration rate in the initial period in all samples was because of high water activity gradient between the sample and surrounding media (water) and as time passes, this difference reduced with consequent lower rate of rehydration. The decline in rehydration rates at later stages is related to the lower water absorption presumably because of the filling of water in free capillaries and intercellular spaces present in tissues of dehydrated pods. Similar rehydration patterns for a variety of legumes have been reported previously (Berrios *et al*., 1999; Ulloa *et al*., 2013).

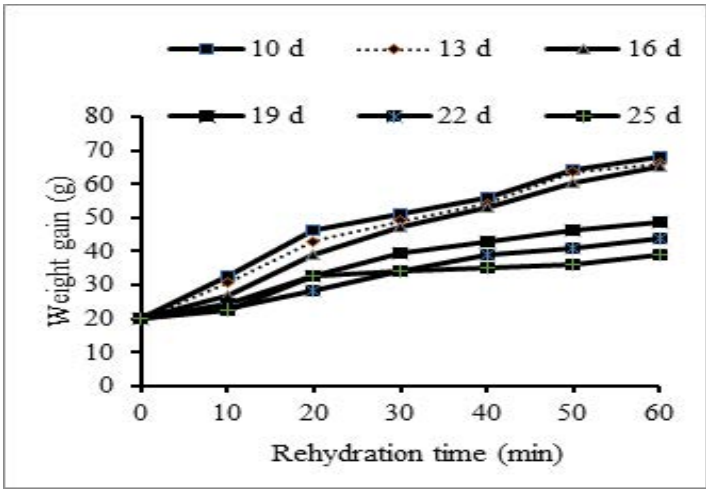

Fig. 3. Rehydration kinetics dried pods harvested at different maturity stages

Sensory evaluation of rehydrated pods: Sensory evaluation revealed that early harvest pods showed higher sensory score as compared to late harvest pods (Fig. 4). The pods harvested after 10, 13 and 16 days of setting received more than 8 score for taste, texture and color from the experts while late harvested pods showed significantly lower score. No significant difference was observed for sensory score between 10, 13 and 16 days maturity pods. Initiation of seed development, color change and peel hardness are responsible for decline in sensory score of 19, 22 and 25 days maturity pods.

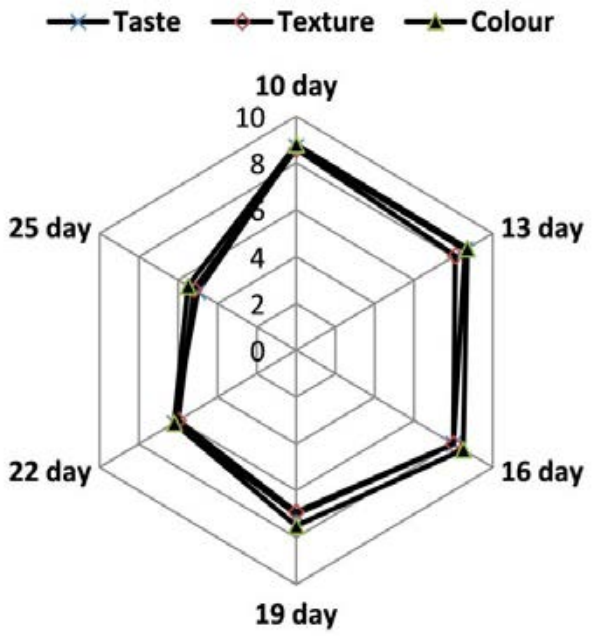

Fig. 4. Evaluation of sensory attributes of dried pods harvested at different maturity stages

Conclusion

It is concluded from the study that harvesting stage of green pods is significantly influence the drying, rehydration and sensory properties of dried pods. Pods harvested between 10 and 16 days of fruiting showed desirable drying, rehydration and sensory attributes. Late harvest, 19, 22 and 25 days maturity pods showed significant decline in all desirable attributes. Therefore, *khejri* variety *Thar Shobha* pods should be harvested in 2-3 pickings between 10-16 days of fruiting for getting good quality dried product.

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Conflict of Interest

The authors have no conflict of interest.

Data Sharing

All relevant data are within the manuscript.

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