



Effect of blanching treatments and dehydration methods on rehydration quality of khejri (*Prosopis cineraria*) pods

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ABSTRACT

The khejri (*Prosopis cineraria* L. Druce), is a multipurpose leguminous tree of hot arid desert. Its tender pods are utilized for culinary purpose both in fresh and dehydrated conditions without ascertaining its quality aspect. Therefore, the present investigation was carried out to find out the effect of blanching treatments and dehydration methods on rehydration quality of khejri pods. The experiment consists of three methods of drying and six blanching treatments replicated thrice under completely randomised design (CRD). Both tender pods (harvested within 20 days of fruit set at green stage) and mature pods (harvested after 25 days of fruit set at colour turning stage) were taken for the study. Among various methods of drying; sun drying took minimum time (11 hours) while other methods took comparatively longer period for drying. Moreover, recovery per cent of pods did not vary significantly within the drying methods and blanching treatments. In general, tender pods recovery was less compared to matured pods. The rehydration ratio was maximum in pods blanched in hot water (5 min.) followed by control. Among different methods, the rehydration ratio was maximum in shade drying followed by sun drying and the least in tray drier. The storage life of dehydrated pods was more than 52 weeks in blanching treatment than only about 8 weeks in control (un-blanching pods). The appearance of sun dried pods was not good as brownish and grayish colour pods were observed. Whereas in case of pods dried in shade and tray drier were green in colour. The protein content was also higher in pods dehydrated either in shade or in tray drier but the differences among the blanching treatments were non-significant. Thus, it can be concluded that the tender pods dried after blanching in 2 per cent salt solution (5 min.) or blanched in 2 per cent salt solution (5 min.) + 0.1 per cent KMS (potassium metabisulphite) either in shade or in tray drier have overall good acceptability because of retention of green colour, higher protein content, good storage life, better appearance after rehydration, good culinary taste, overall higher hedonic rating and more hygienic conditions than open sun drying.

Key words: Blanching, Dehydration, Hedonic rating, Rehydration, *Prosopis cineraria*

The khejri (*Prosopis cineraria* L. Druce), is a medium to big size tree, evergreen or nearby so, with lighter foliage and thorny branches. Thar Desert is considered as home of khejri. It is distributed from Afghanistan, Arabia, Iran and Pakistan to India. In India, it is found in Rajasthan, Haryana, Punjab, Gujarat, Delhi, Madhya Pradesh, Maharashtra and north Karnataka as a constituent of desert thorn forest. In general, *Prosopis cineraria* is growing extensively under natural conditions in arid and semiarid regions of the country. *Prosopis cineraria* is a multipurpose tree and of great economic importance for the farmers of arid region, as every part of the tree is utilized in one or the other form (Srivastava and Hetherington (1991) and Saroj *et al.* (2002), Saroj and Nagaraja 2006). The tender pods are eaten green or dried after boiling locally called *sangri* and also used in

the preparation of curries and pickles (Khasgival *et al.* 1969, Nagaraja *et al.* 2003). The pods contain protein (12-16%), calcium (1.5-1.7%), potassium (1.40-1.65%) and sodium (0.70-0.82%) (Nagaraja 2002). Ripe pods are sweet, which contain 9-14% crude protein, 6-16% sugar (Bhiyama *et al.* 1964, Bhandari *et al.* 1979, Nagaraja 2003), 1.0-3.4% reducing sugars (Gupta *et al.* 1984) and 45-55 % carbohydrate (Jastra and Paroda 1981). The pods are also used as feed for animals and leaves (used both green and dry) are considered as excellent quality fodder in the desert. Pruned branches are used as fuel wood and fencing material. Hard and durable wood is used for making furniture, tool handles, boat frame etc. The bark provides tanning material. The bark, inflorescence and gum have various medicinal properties.

In spite of multiple uses and extremely hardy to various biotic and abiotic stresses; least attention has been given to utilize the potential of this valuable plant. Even today, there is hardly any block plantation of khejri with vegetatively propagated planting materials. The natural regeneration under rainfed condition is common in arid region but such

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plants exhibit wide range of variability in vigour, gestation period (8-20 years), thorniness, fruiting and quality attributes etc. (Saroj 2002). Moreover, no sincere efforts have been made to ascertain optimum stage of maturity, method of harvesting, sorting and grading of *khejri* pods for further processing like; dehydration and preparation of products like., vegetable, pickles, panchkuta etc. Farmers are collecting unripe pods from the mixed forest areas or farmland and after drying in the sun, using during off seasons. The collecting unripe pods without knowledge of maturity standard, sun drying without proper cleaning and grading possess a lot of impurity persists, owing to poor quality of dehydrated product with less storage life. Therefore, this experiment was undertaken with the objective to find out suitable blanching treatment and drying method for better quality of dehydrated *khejri* pods.

MATERIALS AND METHODS

The investigation was carried out in the Post Harvest Technology Laboratory at Central Institute for Arid Horticulture, Bikaner (Rajasthan) during 2008 and 2009. For this purpose, the *khejri* pods were collected at two stage of maturity from the identified clone, growing under uniform management conditions. In the first stage, i.e. tender green pods before seed formation, were harvested within 20 days of fruit set while in second stage, i.e. immature green pods with soft seed formation were harvested after 25 days of fruit setting. After proper cleaning, only uniform size of 500 g pods per treatment in both the stages were taken for imposing various treatments.

The treatments comprised of five blanching treatments, i.e. T₁ blanching in hot water (5 min.), T₂ blanching in hot water (5 min.)+0.1% potassium metabisulphide (KMS), T₃ blanching in 2% salt solution (5 min.), T₄ blanching in 2% salt solution (5 min.)+0.1% KMS, T₅ blanching in 2% salt solution (10 min.), T₆-Control and three methods of dehydration, i.e. (i) direct sun drying the pods by placing in open sun after the moisture is drained, (ii) under shade by spreading pods in thin layer under shade, i.e in the room at ambient temperature after the moisture is drained, (iii) tray drier method, i.e. uniform spreading of pods in a thin layer

in aluminum tray and kept inside the cabinet at a temperature of 45±2°C. The treatments were replicated thrice under completely randomised design (CRD) with factorial approach. After proper dehydration when pods attained almost constant weight; the observation on number of hours taken for drying was recorded, recovery percent were calculated by final weight divided by initial weight multiplied by 100, rehydration ratio was calculated by final weight after immersing the pods in water for 24 hours divided by initial weight and hedonic rating of dehydrated and rehydrated pods using 10 point scale for different parameters. The hedonic scoring was done by 10 experts and average value was mentioned for each character. The protein content was also determined by using standard procedure (AOAC 1990). The data were analyzed using with MSTAT statistical package on pooled basis.

RESULTS AND DISCUSSION

Time taken for dehydration

The data given in Table 1 to assess the time taken for dehydration of *khejri* pods both tender and mature under different drying methods and blanching treatments, it is obvious that tender pods dehydrated early than mature pods. Among drying methods, both types of pods dried within 11-14 hours under sun while 15-17 hours under trays and longest time was taken under shade drying, i.e. 48-50 hours. The early dehydration under sun drying was due to high solar intensity and low atmospheric humidity during May-June under open conditions of western Rajasthan. Whereas, the same conditions were reversed under shade drying, thus took longer time for dehydration. Among blanching treatments, no significant differences were recorded with respect to time taken for dehydration but more time was when pods were un-blanching, as blanching soften the tissues. Moreover, the interaction effect between method of dehydration and blanching treatments were found to be significant.

Recovery of dehydrated pods

The recovery percentage was worked out after

Table 1 Time taken (hours) in dehydration of *khejri* pods under various treatments

Treatment	Methods of drying					
	Tender pods			Mature pods		
	Sun	Shade	Tray drier	Sun	Shade	Tray drier
T ₁ Blanched in hot water (5 min.)	11	46	14	13	48	16
T ₂ Blanched in hot water (5 min.) + 0.1% KMS	11	46	14	13	48	16
T ₃ Blanched in 2% salt solution (5 min.)	11	46	14	13	48	16
T ₄ Blanched in 2% salt solution (5min) + 0.1% KMS	11	46	14	13	48	16
T ₅ Blanched in 2% salt solution (10 min.)	11	46	14	13	48	16
T ₆ Control	12	48	15	14	50	17
	Method	Treatment	Method × Treatment	Method	Treatment	Method × Treatment
SEm (±)	0.13	0.19	0.33	0.17	0.25	0.42
CD(P=0.05)	0.38	0.54	0.93	0.49	0.721.20	

Table 2 Per cent recovery of dehydrated khejri pods under various treatments

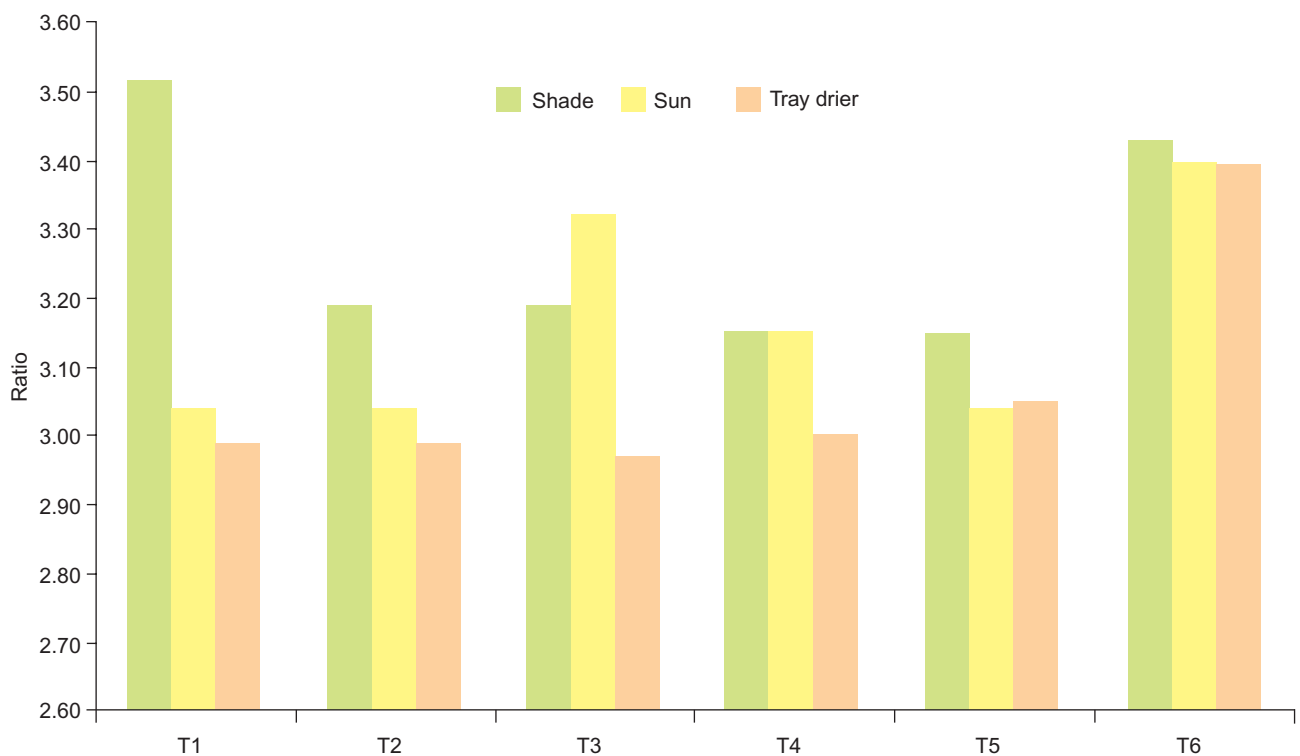
Treatment	Methods of drying					
	Tender pods			Mature pods		
	Sun	Shade	Tray drier	Sun	Shade	Tray drier
T ₁ Blanched in hot water (5 min.)	24.92	25.13	24.85	28.05	28.07	28.18
T ₂ Blanched in hot water (5 min.) + 0.1% KMS	25.00	24.91	25.12	28.06	28.01	28.08
T ₃ Blanched in 2% salt solution (5 min.)	24.92	24.95	25.08	28.22	28.02	28.13
T ₄ Blanched in 2% salt solution (5 min.) + 0.1% KMS	24.99	24.99	25.07	28.07	27.99	28.02
T ₅ Blanched in 2% salt solution (10 min.)	24.93	24.95	25.09	28.13	28.03	28.03
T ₆ Control	24.94	25.14	25.26	28.07	27.93	28.21
	Method	Treatment	Method × Treatment	Method	Treatment	Method × Treatment
SEm (±)	0.33	0.41	0.57	0.23	0.46	0.60
CD(P=0.05)	0.91	1.23	1.64	0.69	1.60	1.75

dehydration of weighed quantity of fresh tender and mature pods. The data given in Table 2 indicate that the recovery in tender pods varied between 24.85 to 25.26 per cent while in mature pods it varied from 28.01-28.21 per cent. In general, the per cent recovery of mature pods were more than tender pods, as mature pods were more fibrous and having higher dry matter content than those of tender pods. In fact recovery per cent mainly depend upon the loss of moisture content during dehydration process as well as dry matter content of pods harvested at particular maturity stage. Regarding method of drying and blanching treatments, no significant differences were recorded with respect to recovery

percentage of dehydrated pods. Similar findings have been also reported by Vishal Nath (2000) while working with utilization of khejri pods.

Rehydration ratio

The dehydrated pods of khejri are used for culinary preparations only after rehydration in fresh water. In this investigation, the rehydration ratio was worked out by final weight after immersing the pods in water for 24 hours divided by initial weight of dehydrated pods. The data depicted in Fig 1 indicate that there was meager variation in rehydration ratio under various blanching treatments, as



Treatments T₁=Blanched in hot water (5 min.), T₂ = Blanched in hot water (5 min.) + 0.1% KMS, T₃ = Blanched in 2% salt solution (5 min.), T₄=Blanched in salt solution (5 min) + 0.1% KMS, T₅=Blanched in 2% salt solution (10 min.), T₆=Control

Fig 1 Effect of various treatments on rehydration ratio of khejri tender pods

it varied from 2.95 to 3.51 only. However, the rehydration ratio was higher in almost all blanching treatments under shade drying except T₃ {blanching in 2% salt solution (5min)}, where it was more under sun drying. Though, the un-blanching (control) dehydrated pods given relatively higher values of rehydration under all method of drying except shade drying and blanching in hot water (5 min). The investigation indicate that there was some influence of method of drying and blanching treatments but exact correlation and scientific explanation are yet to be worked out.

Storage life of dehydrated pods

The data on storage life of dehydrated pods of khejri both tender and mature are given in Table 3. The results reveal that storage life of khejri pods varied significantly both under drying methods and blanching treatments. The interaction effect between method of drying and blanching treatment was also found to be significant. In drying methods, storage life was better under shade drying than those of tray method and open sun drying. The slow drying under shade had better impact on storage life of dehydrated khejri pods than quick drying. Thus, there was universon correlation between time taken for dehydration and storage life of dehydrated pods. Among blanching treatments, blanching in 2 per cent salt solution (5 min) had given better storage life followed by blanching in 2 per cent salt solution (5 min)+ 0.1 percent KMS. The minimum storage life was observed under control (without blanching) where dehydrated pods can be stored not more than 8.50 weeks. This indicated that blanching is essential for better storage life. The maximum storage life (53.20 weeks) was observed under shade drying of tender pods blanching in 2 percent salt solution (5 min) followed by tray drying (52.50 weeks) and sun drying (52.00 weeks). The trend was same with mature pods also under same blanching treatments but marginally lesser storage life than tender pods. The findings are inconformity with Nagaraja (2002) where he has suggested the need of blanching of khejri pods.

Culinary quality and protein content

The culinary quality was judged by fibreness and taste of dehydrated pods after rehydration (Table 4). There was no fibreness and normal taste was found in tender pods while slight fibreness and acrid taste was found with mature pods under all drying methods and blanching treatments. The results indicate that stage of harvesting is more important for culinary quality than method of drying and blanching treatments, as fibreness and acrid taste is not liked in culinary products. This fibreness and acrid taste in mature pods was probably due to advanced stage of harvesting, owing to more stiffness of tissues and increased level of phenols and tannins.

The total protein content of dehydrated pods was also analyzed to see the variation among different drying methods and blanching treatments. There were significant variations were observed with respect to protein content among different drying methods and blanching treatments. The interaction effect was also found to be significant. In general, better retention of protein content was recorded under tray drying than shade and open sun drying. The highest protein content, i.e. 19.12 per cent and 18.75 per cent was recorded in tender and mature pods respectively in tray method of drying when blanching in 2 per cent salt solution (10 min). There was slightly loss of protein content when drying was done under open sun. The minimum protein content was 14.00 per cent in tender pods after blanching in 2 per cent salt solution (5 min.) and 16.88 percent in mature pods after blanching in 2 per cent salt solution (5 min.)+ 0.1 per cent KMS under open sun drying. It indicates that controlled and gradual drying methods are better than quick drying with respect to protein retention.

Visual assessment and hedonic rating

Even after higher protein content in mature pods, the culinary quality of tender pods was better than mature pods, thus for visual assessment and hedonic rating only tender pods were considered (Table 5). The colour of pods after rehydration should be green and it was observed only in

Table 3 Storage life (Weeks) of dehydrated pods of khejri under various treatments.

Treatment	Methods of drying					
	Tender pods			Mature pods		
	Sun	Shade	Tray drier	Sun	Shade	Tray drier
T ₁ Blanched in hot water (5 min.)	28.50	29.50	29.20	24.50	25.00	27.21
T ₂ Blanched in hot water (5 min.) + 0.1% KMS	36.25	37.23	36.50	34.25	35.40	34.50
T ₃ Blanched in 2% salt solution (5 min.)	52.00	53.20	52.50	50.00	51.13	50.25
T ₄ Blanched in 2% salt solution (5min) + 0.1% KMS	42.00	42.50	42.17	37.18	38.24	37.50
T ₅ Blanched in 2% salt solution (10 min.)	40.20	41.15	40.00	38.25	39.45	38.15
T ₆ Control	8.00	8.50	8.16	7.25	7.50	7.00
	Method	Treatment	Method × Treatment	Method	Treatment	Method × Treatment
SEm (±)	0.21	0.30	0.50	0.17	0.25	0.43
CD(P=0.05)	0.59	0.83	1.40	0.50	0.70	1.22

Table 4 Culinary quality and protein content in dehydrated pods under various treatments.

Treatment		Methods of drying										
		Tender pods						Mature pods				
		Culinary quality		Protein content (%)			Culinary quality		Protein content (%)			
		Fibre-ness	Taste	Sun	Shade	Tray Drier	Fibre-ness	Taste	Sun	Shade	Tray Drier	
T ₁	Blanched in hot water (5min.)	No	Normal	15.46	15.48	18.25	Slight	Slight acrid	17.03	17.06	18.31	
T ₂	Blanched in hot water (5min.) +0.1%KMS	No	Normal	15.51	15.63	17.50	Slight	Slight acrid	17.88	17.69	18.56	
T ₃	Blanched in 2% salt solution (5min)	No	Normal	14.00	15.75	17.44	Slight	Slight acrid	17.31	18.50	17.44	
T ₄	Blanched in 2% salt solution (5min) +0.1% KMS	No	Normal	14.94	16.63	18.06	Slight	Slight acrid	16.88	17.88	18.38	
T ₅	Blanched in 2% salt solution (10 min.)	No	Normal	14.50	15.31	18.75	Slight	Slight acrid	17.06	18.37	19.12	
T ₆	Control	No	Normal	15.81	15.31	17.88	Slight	Slight acrid	16.44	16.88	17.19	
	CV (%)			3.80	5.20	3.50			4.12	4.55	5.67	
	SEm±			1.42	1.40	2.04			0.98	2.15	1.64	
	CD(P=0.05)			0.63	0.63	0.86			0.48	1.00	0.79	

Table 5 Visual assessment and hedonic rating of dehydrated and rehydrated tender pods under various treatments

Treatment	Colour of pods		Rating				Over all acceptance
	Dehydrated	Rehydrated	Dehydrated pods		Rehydrated pods		
			Colour	Appearance	Colour	Appearance	
<i>Sun</i>							
T ₁	Black	Brown	5.2	5.7	4.5	5.1	5.1
T ₂	Black	Brownish green	5.9	6.2	5.4	5.8	5.8
T ₃	Grey	Greenish yellow	7.0	6.7	7.1	7.0	6.8
T ₄	Dark Brown	Light brown -greenish	5.3	5.4	6.7	7.0	6.2
T ₅	Black	Light brown -greenish	5.9	5.6	4.7	5.6	5.5
T ₆	Ash	Reddish brown	5.7	5.8	6.1	6.0	5.9
Mean			5.85	5.92	5.77	6.1	5.88
<i>Shade</i>							
T ₁	Light brown	Green	6.0	5.9	7.1	7.0	6.8
T ₂	Light brown	Green	6.5	6.7	7.5	7.4	6.9
T ₃	Light brown	Green	7.2	7.4	7.6	7.6	7.5
T ₄	Light brown	Green	7.0	7.0	7.3	7.3	7.2
T ₅	Light brown	Green	6.0	6.7	6.4	6.8	6.5
T ₆	Light brown	Green	5.5	5.5	5.5	5.6	5.5
Mean			6.37	6.50	6.90	6.95	6.73
<i>Tray drier</i>							
T ₁	Light brown	Green	6.4	6.3	7.0	7.0	6.7
T ₂	Light brown	Green	7.0	6.9	7.0	7.0	7.0
T ₃	Light brown	Green	6.9	7.8	7.9	7.6	7.8
T ₄	Light brown	Green	7.0	7.0	7.2	7.3	7.2
T ₅	Light brown	Green	5.9	6.0	6.7	6.6	6.3
T ₆	Ash	Light brown	5.9	5.7	6.0	5.9	5.9
Mean			6.52	6.62	6.97	6.90	6.82
	CV(%)						2.16
	SEm±						0.07
	CD (P=0.05)						0.19

shade and tray methods of drying. Whereas, no desired green colour was observed under open sun drying. In general, the colour of rehydrated pods under open sun drying was either faded light green colour or brownish green colour. The highest hedonic rating (7.8) at 10 point scale was recorded under tray drying method blanched in 2 per cent salt solution (5 min.) followed by 7.5 under shade in same blanching treatment. The second best rating was scored by blanching in 2 per cent salt solution (5 min.)+ 0.1 per cent KMS. The overall acceptability of open sun drying was significantly low (5.88) on hedonic rating.

CONCLUSION

The experimental results of the study concluded that the pods blanched in 2% salt solution (5 min) and blanched in 2 per cent salt solution (5 min)+0.1 per cent KMS were found good with respect to storage life and culinary quality. The tender pods dried under shade and trays have better quality, retains green colour of pods after rehydration, better hygienic conditions and overall better acceptability at hedonic rating. The future research agenda can be set in the area of freeze drying for retaining green colour and to avoid loss of nutrient through blanching.

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