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Research Article

Quantitative Changes in Sugar and Protein Content during Maturation of Khejri Pods

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Non Timber Forest Products Discipline

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ABSTRACT

Prosopis cineraria (Khejri) is an important wild edible fruiting species occurring in arid zone of Rajasthan. It's pods locally known as sangri are rich in protein, carbohydrates and minerals and are an important ingredient of a popular vegetable curry. Leaves and flowers of khejri are used in traditional medicine to cure a wide range of diseases. During growth, development and maturity of fruits various physico-biochemical changes are found to occur which affect their quality. To study some of these changes during development and ripening of sangri, sugar and protein were evaluated in different categories of fruits. Initially as the fruit matured sugar content increased and then decreased but increased again in the ripened pods. Similar trend was observed in case of protein also. As these parameters are important determinants of eating quality, with their knowledge the rural inhabitants can enhance their livelihood by harvesting these fruits at proper time and selling them in the market.

Keywords: *Nutritional, Pods, Khejri, Morphological, Category.*

INTRODUCTION

Prosopis cineraria (L.) Druce (Syn. *Prosopis spicigera* L.) belonging to Family Fabaceae (Leguminosae) is an evergreen small to moderate size thorny tree. The species is indigenous inhabitant to dry and arid regions of Arabia and India (Afifi & Abu Al-rub, 2018) In India it is found in dry areas of Rajasthan, Gujarat, Haryana, Uttar Pradesh and Tamil Nadu. Khejri is a xerophytic tree and is well adapted to dry and arid environment. It's tap root penetrates vertically upto 20 m but can reach to a depth of 53 m or more. The tree is frost tolerant and can survive extremes of temperature. Density of khejri increases from the west to the east in the western Rajasthan. It's density is highest in areas with rainfall between 250-400 mm.

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But because of its capacity to absorb moisture from rains through foliage it can grow in extraordinary arid tract of as low as 10 mm rainfall. Tree grows on a variety of soils mainly in a mixture of sand and clay in low dune areas and sandy plains. P. cineraria can grow under highly saline and alkaline soils (Sandison & Harris, 1991; & Ramoliya et al., 2006).

The stem of the tree is straight and has a gray and rough exfoliated bark. The branches are slender, drooped giving the canopy a rounded appearance with short triangular spines (3–6 mm long) between leaf nodes. Leaves are ash green, alternate usually divided into two pinnae, each pinna has 7–14 pairs of oblong, oblique, apex leaflets. Flowering and fruiting varies with location and weather conditions and is generally very short from March to May. Flowers are small, creamy white, sessile slender pedunculated axillary spikes. Pods are long cylindrical, green turning yellow on ripening. Seeds are oblong or rhomboidal, brown, smooth with moderately hard testa. Pods mature in about a month and by the end of mid- May almost all the pods get ripened (Bhandari, 1990).

Prosopis cineraria is a multipurpose tree. It has been valued by different communities and cultures for versatility of its parts and often called as the kalpavriksha of the desert. Leaves, pods, seeds and bark have been used from time immemorial as food. Bark flour was mixed with other flour and eaten during famine (1899 – 1900). Bread is reported made from the ground bark, with or without the addition of other flour. Dried seeds and leaves were also ground and mixed with flour for making bread (Gupta & Kanodia, 1968; & Shankarnarayan & Saxena, 1988). Stem yields an edible gum. Green tender fruits also known as sangri are used as vegetable and pickled for future use. They form one of the important ingredient of the famous Rajasthan's dish Panchkuta along with ker, kumbat, kachri (Saxena, 1979). During fruiting season the green pods are sold locally at a rate of 100/- to 200 kg. The rate of dry pods in the market (Rs 400/--500/-depends on the thickness of the pods. Dried pods called khokha are used as animal feed. Leaves are known as loong and used as ruminant feed. Villagers traditionally lop their trees in winter and store the sun-dried leaves as fodder for dry season. A moderate sized tree may yield 35-45 kg of dry leaf fodder per year. (NAS 1980, & AFRI, 2020).

Prosopis cineraria has also been used in indigenous system of medicine as a folk therapy for various ailments. The bark is dry, acrid, bitter, with sharp taste; it is cooling, anthelmintic, tonic and known to cure leprosy, dysentery, asthma, leucoderma, piles, tremors of the muscles, wandering of the mind. The flowers are ground and mixed with sugar for use to safegaurd against miscarriage. The ashes of bark are used to remove hair by rubbing them over the skin .The smoke of the leaves is good for eye troubles. Fresh leaf juice mixed with lemon juice is used for dyspepsia; extract of crushed pods is used for earache, toothache, pain relief from fractured bones. Aqueous extract of bark and leaves applied externally to treat skin disease, disinfects wounds and promotes healing (Kirtikat & Basu, 1982; & Garg & Mittal, 2013).

Quality and storage life of fruits depends on various physico-biochemical changes, which occur during fruit growth, development and maturity. Harvesting at appropriate maturity is an important factor affecting fruit quality (Patel et al., 2014). Qualitative and quantitative distribution of sugar and protein in fruits and vegetables are often regarded as indication of fruit quality (Katona et al., 1999). They are useful to evaluate fruit maturity, ripeness, and storage conditions. Thus keeping in view the traditional importance of sangri fruits, and prominent quantitative changes in metabolites during maturation of pods, these were evaluated for their sugar and

protein content for two years in samples collected from Jodhpur, Rajasthan.

MATERIALS AND METHODS

All the chemicals and solvents used were of high purity (SIGMA and MERCK grade). UV-VIS readings were recorded using instrument SPEKOL 2000. Rotary evaporator (EYELA) was used for removal of solvents. Morphological data (length, width /diameter) was recorded using digital Vernier Callipers. Moisture content of fruits was determined using oven drying method. The experimental design was randomized with three replications each.

Study Site

Khejri is naturally found to occur in and around Jodhpur. Hence a suitable site in AFRI experimental field, Jodhpur, Rajasthan, containing reasonable number of khejri trees (about 25 years old trees) was selected in 2014. Jodhpur district is situated between 250 51'08" & 270 37'09" North Latitude and 710 48' 09" & 730 52'06" East Longitude covering geographical area of 22,250 sq. km and occupies 6.68 % of total part of state. The district comes under arid zone of the Rajasthan State and forms part of Great Thar Desert of Rajasthan. This zone is characterized by large diurnal and seasonal variations of temperature and low rainfall. Normal rainfall of Jodhpur is 314 mm. The average maximum temperature and the average minimum temperature during summer are reported to be 42.2°C, and 27.3°C respectively (GOI, 2017).

Healthy trees with height ranging from 490 cm to 860 cm, crown 265cm to 560 cm and girth ranging from 35 cm to 80 cm existing in Forest Ecology field, AFRI, Jodhpur, with coordinates N26o14.138', E 073o01.787'were marked for collection of fruits. Fruits were collected in April for two years, 2015 and 2017. There was severe infection due to gall formation in 2016 and yield of pods was very less so healthy pods were not available for analysis. Hence, only two year data has been presented here in this paper.

Grading and Sample Preparation

Collected khejri pods (sangri) were manually graded based on maturity /thickness. These were graded into four categories based on their thickness viz. immature (< 2mm), immature (02- 2.5 mm), mature (2.5- 3.5 mm) and ripe (3.5-5.5 mm) (Table 1).

Table 1: Grading of khejri pods

S.No.	Size (in mm)	Category/Maturity
1.	< 2mm	Category 1 (Immature)
2.	2-2.5 mm	Category 2 (Immature)
3.	2.5- 3.5 mm	Category 3 (Mature)
4.	3.5-5.5 mm	Category 4 (Ripe)

Determination of physical parameters and quality characteristics

Moisture, sugar and protein were analyzed as per Association of Official Analytical Chemists (AOAC) procedures. All analyses were performed in triplicate. The results were expressed in percentage. Crude protein content was obtained by multiplying total nitrogen content by the factor 6.25.

RESULTS AND DISCUSSION

Morphological data of fruits

Average length of sangri measured using vernier scale, varied from 8.68±1.37 cm. in Category 1, to 19.48±4.89 cm. in Category 4 and moisture content varied from 62.83±1.86 % (Category 1) to 63.09±2.85 % (Category 4) during the period of study (2015 & 2017) (Table 2).

Table 2: Morphological parameters of khejri pods

Year of collection	Category1		Category2		Category3		Category4	
	Avg. Length (cm.)	Moisture content (%)	Avg. Length (cm.)	Moisture content (%)	Avg. Length (cm.)	Moisture content (%)	Avg. Length (cm.)	Moisture content (%)
2015	10.61±0.39	60.22 ± 0.44	14.09±0.47	65.02 ± 0.44	25.92±0.78	70.07 ± 0.60	26.34±0.62	67.09 ± 0.82
2017	6.76±0.55	65.45 ± 0.84	9.92±0.69	69.91 ± 0.84	12.60±1.15	72.62 ± 0.61	12.63±0.67	59.10 ± 0.89
Mean ± SE	8.68±1.37	62.83±1.86	12.0±1.48	67.46±1.74	19.26±4.75	71.34±0.94	19.48±4.89	63.09±2.85

Quality evaluation of fruits

Sugar content is usually used as an index of ripening (Gomez et al., 2002). Genetic and environmental factors may affect the qualitative and quantitative composition of the sugar fractions by altering the activity of the enzymes involved in synthesis and breakdown processes (Linge & Dunlap, 1987).

The level of sugars of each tested fruit Category significantly changed alongwith the fruit development (Table 3). Sugar and protein content of sangri was determined in different categories viz. Category 1(Immature) < 2 mm, Category 2 (Immature) 2-2.5mm, Category 3 (Mature) 2.5-3.5 mm, Category. 4 (Ripe) 3.5-5.5 mm. The sugar content was found to increase from Category 1 (11.57 %) upto Category 3 (14.18 %) and then decreased in Category 4 (10.81%). It increased again in ripe pods (13.06%). Protein content increased upto Category 2 (12.24%) and then decreased in Category 3 and 4. However in both cases ripe pods were also analysed which showed an increase again of sugar (13.06± 2.44 %) and protein(9.62± 0.87 %) in these pods. Similar type of behaviour has also been observed in a study on effect of stage of maturity on concentration of sugars in other fruits (Brooks et al., 1993; & Sturm & Stampar, 1999).

Table 3 : Sugar & Protein content (%) in khejri pods

Parameter	Year	Category 1	Category 2	Category 3	Category 4
Sugar	2015	15.05± 0.02	16.3± 0.02	16.85± 0.02	12.15± 0.02
	2017	8.10± 0.01	9.17± 0.02	11.51± 0.03	9.47± 0.02
	Mean ±SE	11.57± 3.47	12.73± 3.56	14.18± 2.67	10.81± 1.34
Protein	2015	11.37± 0.02	13.1± 0.03	12.25± 0.02	10.5± 0.02
	2017	10.50± 0.01	11.38± 0.02	9.75± 0.02	8.38± 0.02
	Mean ±SE	10.93± 0.43	12.24± 0.86	11.00± 1.25	9.44± 1.06

CONCLUSION

P. cineraria often known as the lifeline of the desert people, has edible pods but very less is known about their harvesting period vis-à-vis nutritional value. The present study on variation sugar & protein during maturation of pods throws a light on the optimum harvesting time of the pods. The local people can use this information to get higher revenue by selling the pods of higher nutritional value. Marketing prospects of such pods needs to be researched upon. Apart from this khejri is a very slow growing species, development of fast growing variety needs to be emphasized. Khejri mortality is also a big concern hence conservation of the species is also of paramount importance.

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