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## Harnessing the underutilized fruit & vegetable of arid and semi arid region: *Kachri*, *Ker* and *Sangri*

Nisha Choudhary and Vimla Dunkwal

### Abstract

To assess the knowledge regarding underutilized foods, a survey was done in seven *panchayat samities* i.e. *Bikaner*, *Kolayat*, *Nokha*, *Sridungargarh*, *Lunkaransar*, *khajuwala* and *Panchu* in Bikaner district of Rajasthan. Out of these comprising one village from each *panchayat samiti* was selected randomly. A total of seven hundred women aged more than 40 years were include in the study. The products of *kachri*, *ker*, *sangri* commonly consumed in the community were standardized in the laboratory using sensory evaluation technique. All the products were acceptable by the judges but few of the products such as *kachri* (Sweet-sour veg -  $8.9 \pm 0.16$ ), *ker* (*kadhi* with freshly processed *ker*  $8.8 \pm 0.42$ ), *sangri* (*kadhi* prepared with *sangri* -  $8.9 \pm 0.31$ ) more acceptable by the panelist.

**Keywords:** Underutilized foods, sensory evaluation, product development

### Introduction

Today, it is essential to provide people access to a safe, healthy and nourishing food supply, especially in low-income and undernourished communities. The world population (7.8 billion) is predicted to reach 9.6 billion people in 2050, rising at a rate of 1.03 per cent annually. India, which has a population of 1.38 billion, makes up 17.5 per cent of the global population. The greatest challenge of today is to provide this burgeoning population with stable, safe and nutritious quality food (UN, 2021) <sup>[20]</sup>. Due to their bioactive components, nutritional value and medicinal significance, underutilized plants are recognized as a sustainable and long-term infusion (Peduruhewa *et al.*, 2021) <sup>[13]</sup>. There are shards of evidence of neglected wild food plants with significant nutritional content. *Ayurveda*, *unani* and other indigenous healthcare systems have used a variety of underutilized indigenous fruit crops for ages due to their therapeutic properties. Wild fruit crops are also used to make well-known processed goods like jam, RTS, fruit drinks, chutneys, candies, pickles, squashes, concentrate, etc. Fruit crops are high in vitamin C, which has been proved to benefit skin by brightening it and protecting it from free radicals. Additionally, it can be used as a cooling agent to lessen the adverse effects of strokes and treat a variety of illnesses, including scurvy, constipation, haemorrhage, leucorrhoea, anemia, stomach discomfort and others. Underused crops can adjust to reducing excess agricultural input. Additional research and development on these crops will definitely drastically enhance nutrition and food security (Kamboj *et al.*, 2020) <sup>[5]</sup>. To mitigate the negative consequences of hunger and malnutrition, it is critical to research the possibility of utilizing novel plant resources with the potential for use as food, medicine, fodder, energy and other commercial uses. Some underutilized plants with high nutritional and therapeutic potential and low input needs have been identified as a potential remedy for this concern (Dansi *et al.*, 2012) <sup>[3]</sup>. Underutilized edible plant species are being exploited all over the world to make popularized new products and value-added commodities such as heat-processed goods (jam, jelly, candy, sauce and dehydrated goods), dried fruits or vegetables, fruit juice, confectionaries, preserved goods, glazed goods, wine, pickles, frozen puree and canned goods. The primary goals of processing underused food plants are to maintain nutritional content, decrease post-harvest loss, eliminate waste, reduce seasonality and improve quality. (Ravani *et al.*, 2014) <sup>[14]</sup>. Furthermore, *bael*, *karonda*, *ker*, *phalsa*, tamarind, custard apple species are used for the production of frozen puree (Dahanayake *et al.*, 2015) <sup>[2]</sup>. Most of the underutilized foods are often available only in the local markets and are practically unknown in other parts of the world and in today's world, people's consciousness towards health and their tendency to avoid chemicals & synthetic foods have driven them towards preferences for nutrition through natural resources (Gajanana *et al.*, 2010) <sup>[4]</sup>.

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Hence, increasing the market potentialities of underutilized products. However, these underutilized fruits are not very popular and are sold at very low prices in the local markets because of the lack of people's awareness of their nutritive values, consumption habits, limited research and developmental policies by the government agencies for their potential exploitation (Meena *et al.*, 2022) <sup>[9]</sup>. Underutilized arid fruits and vegetables have been used by people all over the world as a part of their folk custom and are employed in a variety of value-added goods in addition to having several therapeutic benefits.

In hot, dry regions of India, *kachri* (*Cucumis melo* var. *callosus*), a monoecious cucurbitaceous vegetable, is produced for its sweet, acidic fruits in the *kharif* and spring summer months. Since the majority of farmers utilise their own seeds, there is a huge range in fruit size and colour. (Samadia *et al.*, 2018) <sup>[19]</sup>. After peeling, the entire fruit, including seeds, is consumed. The role of *kachri* fruits is to provide better taste with sourness and are typically used in combination with other vegetables such as cluster bean pods, radish leaves, and Acacia senegal seeds. If the fruit is obtained at the matured unripened stage, it is have a very long shelf life (20-30 days) under ambient conditions. Locally, the fruits are peeled, sliced into transverse sections, and sun dried for storage up to a year at room temperature and use during the off season. Before dehydrating in an electric dryer, chopped pieces of *kachri* could be pretreated with sulphur dioxide fumes for three hours to produce a better-quality dried product (Meghwal, 2008) <sup>[11]</sup>. The dried fruits are processed into a powder and used to make bread and biscuits. *Ker* is a shrub that belongs to the *Capparaceae* family, which has 600 species and nearly 30 genera. It is found in tropical and warm temperate regions (Vyas *et al.*, 2009) <sup>[21]</sup>. In addition to growing along farm boundaries, *ker* can also be found in *orans*, *gochar*, and wasteland. Rich variation in plant kinds, canopy, flowering and fruiting has been seen in the natural population in-situ, and efforts have been made to sustain the acquired variability ex-situ (Mahla and Singh, 2013) <sup>[8]</sup>. It has a high soil binding capacity, a moderate resistance to salinity and alkalinity, and can assist to increase soil fertility. Due to its xerophytic characteristics, it is suited for large-scale cultivation, particularly to prevent soil and wind erosion on sand dunes and sandy wastelands. In addition to socioeconomic and environmental benefits, it has multiple medical capabilities as its various plant components contain pharmacological activities such as hypercholesterolemic, anti-inflammatory, analgesic, anti-diabetic, anti-microbial, antiplaquer, hypertension, antihelminthic, and purgative actions (Satyanarayan *et al.*, 2008) <sup>[17]</sup>. The tiny fruits of this plant are making it economically significant. The green immature fruits are treasured for use in pickling and vegetable preparation, either alone or in combination with *khejri* pods and other ingredients. The fruits are, however, astringent at this stage because of the tannins and other phenolic compounds present, which can be eliminated using a specific procedure (Meghwal and Azam, 2007) <sup>[10]</sup>. *Prosopis cineraria* (L.) Druce, often known as *khejri* or *shami*, is a deep-rooted leguminous multifunctional tree native to the scorching Indian desert but also found in Arabia's dry regions. It is the most crucial part of a rainfed desert farming system because it increases the production and growth of companion crops while also providing nourishing feed, fuelwood, tiny timber, gums, and tannins. Camels and small ruminants enjoy eating its foliage.

*Khejri* is one of the rare tree species that develops and thrives in the face of extreme climatic conditions, as indicated by the fact that it produces new leaves, flowers, and fruits during the driest months of the year (March-June). It is feasible due to its innate capabilities for resisting dryness, deep root system, and tiny leaves. *Khejri* pods that are still immature are used as high-quality vegetables in both fresh and dehydrated forms, while ripe dried pods with 9–14 per cent crude protein and 6–16 per cent sugar can be powdered and used to make baked goods. In India, Pakistan, Bangladesh, the United Arab Emirates, Saudi Arabia, and Iran, various plant parts are used to cure a variety of illnesses, including leprosy, leucoderma, dysentery, asthma, bronchitis, piles, jaundice, and muscular tremors (Meghwal *et al.*, 2021) <sup>[12]</sup>.

## Materials and Methods

### Locale of the study

The study was conducted in seven *panchayat samities* of Bikaner district i.e. Bikaner, *Kolayat*, *Nokha*, *Sridungargarh*, *Lunkaransar*, *Khajuwala* and *Panchu*. One village from each *panchayat samiti* was selected randomly viz. *Beechwal*, *Kodemdesar*, *Nokha gaavn*, *Seruna*, *Jagdevwala*, *Karnisar bhatiyar* and *Bhamatsar*. A survey was conducted for seven hundred individuals on their cooking practices and method for preparing different food items using various underutilized foods in their area. A pre-prepared questionnaire was used to identify the methods adopted by the subjects in cooking. Panel of experts were contacted and interacted at their place of work for the evaluation of developed website. Products were developed and standardized in the Department of Food and Nutrition, College of Community Science, SKRAU, Bikaner.

### Selection of subjects

Hundred subjects were taken from each selected village of *panchayat samities* through random method. Simple random sampling is the basic sampling technique through which a group of subjects (a sample) was selected for study from a population. Each individual was chosen entirely by chance and each member of the population got equal chance of being included in the sample (Simkus, 2022) <sup>[18]</sup>. Further, a list of subjects attaining more than 40 years of age was prepared. Subjects aged 40 years and above were purposively selected for the present study because they had experience and were near to the traditions so the chances of getting reliable information about indigenous knowledge regarding underutilized food from this group. Thus, a total of seven hundred respondents were constituted as sample size.

### Information on processing methods from the subjects

A survey was conducted in seven *panchayat samities* of Bikaner district. Hundred subjects were taken from each *panchayat samiti* and in-depth information regarding seven hundred subjects comprised of females, their cooking practices, methods for preparing different food items and domestic as well as therapeutic use of underutilized foods was collected. An organized interview schedule was used to address the subjects which consisted two sections i.e. general and specific.

**General information:** Information regarding general and personal profiles which include:

**Age:** It has been operationalized as the number of years that respondent had completed at the time of investigation. It was recorded in years in response to an open-ended question and the same number has been considered as the score of this variable (Arya and Rathore, 2017) [1].

**Education:** Level of education of each respondent was assessed in terms of literate, illiterate middle class, secondary, higher secondary, graduate & above. (Kuppuswamy, 1976) [7].

**Occupation:** The type of occupation helps in gathering information regarding the source of income. Six categories viz. housewife, agriculture, labour, business, government service & any other were considered while collecting the information.

**Religion:** Religion of the respondents were asked to know whether they are Hindu, Muslim, Sikh, Jain or of any other religion.

**Type of family:** The selected respondents were categorized according to their family type i.e. nuclear and joint (Rayagoudar, 2009) [15].

- 1. Nuclear family:** A family consisting of husband, wife, their children & any other member of the family who is/are dependent on this unit and living together.
- 2. Joint family:** Collection of more than one primary unit on the basis of close blood relations and common residence.

**Number of members:** It was assessed by total members in a family.

**Monthly income:** The income of subjects was identified in terms of low income group (LIG), middle income group (MIG) & high income group (HIG). (Rajasthan Housing Board, Jaipur, 2014).

**Specific Information:** Information regarding processing and utilization of underutilized foods was collected:

#### Information about underutilized foods

Information about consumption, frequency, form of consumption of underutilized food was fore gathering a comfortable environment and their response was marked.

#### Recipe details and method of preparation

Information regarding the name of recipe, method of preparation, ingredients & quantities for the preparation using underutilized foods were documented.

#### Development and standardization of products

Product development is not a novel concept but on the eve of 21<sup>st</sup> century, it has taken on a new meaning in the agricultural sector of developing countries and there are many reasons for this. Perhaps, the most basic is product development - a general concept which is often associated with manufactured goods, the use of high technology and marketing in developed countries (Kotler, 1986) [6]. Standardization is the process of implementing and developing technical standards. It can help in maximizing compatibility, interoperability, safety, repeatability and quality (Roday, 2007) [16]. Various products of *kachri* (chutney, vegetable and *churan*), *ker* (pickle, *kadhi*

and vegetable), *sangri* (vegetable and pickle), *phog* (*kadhi*, *raita* and *paratha*), *kheep* (vegetable, *raita* and pickle) were prepared and organoleptically evaluated for their colour, appearance, texture, flavour, taste and overall acceptability.

#### Result and Discussion

General information such as age, educational status, occupation, religion, type of family, number of members and income status of all the subjects were collected using a structured interview schedule. Out of 700 subjects, majority of the participants (76.28%) were from 40-50 years and rest of them (23.71%) belonging to 51-60 years. It was observed that more than half (51.28%) of the subjects were illiterate followed by up to middle (27.0%), secondary (10.85%), higher secondary (5.0%) and few (1.57%) were educated up to graduate level. Percentage of homemakers (44.14%) was higher and 32.71 per cent were farmers, 17.57 per cent belonging to labours, 4 per cent and 1.57 per cent were self and government-employed in terms of occupation.

**Table 1:** Percentage distribution of subjects on the basis of their general information (N=700)

S. No.	General Information		Percentage of the subjects
1.	Age(Years)	40-50	534(76.28)
		51-60	166(23.71)
2.	Education	Middle class	189(27.0)
		Secondary class	76(10.85)
		Higher secondary class	35(5.0)
		Graduate	11(1.57)
		Illiterate	359(51.28)
3.	Occupation	House Wife	309(44.14)
		Labour	123(17.57)
		Farmer	229(32.71)
		Self-employed	28(4.0)
		Government employee	11(1.57)
4.	Religion	Hindu	449(64.14)
		Muslim	206(28)
		Sikh	5(0.71)
		Jain	35(5.0)
		Others	5(0.71)
5.	Type of family	Nuclear	120(17.14)
		Joint	580(82.85)
6.	Size of family	Small(1-4member)	69(9.85)
		Medium(5-8 members)	342(48.85)
		Large(9 and above)	289(41.28)
7.	Income status	HIG	9(1.28)
		MIG	372(53.14)
		LIG	319(45.57)

Note: Figure in parentheses indicate percentage  
HIG= High Income Group; MIG= Middle Income Group; LIG= Low Income Group

Majority of the subjects (82.85%) were from joint family and 17.14 per cent were from nuclear family. Most of the subjects (48.85%) had medium family size followed by large families (41.28%), Only 9.85 per cent belonged to small families. Among the subjects, Most of them (64.14%) were from Hindu families whereas 28.0 per cent of Muslim, 0.71 per cent of Sikh, 5.0 per cent of Jain and 0.71 per cent of them were from other religions including Christians. Out of total subjects (N=700), majority (53.14%) belonged to middle income group, 45.57 per cent belonged to low income group and 1.28 per cent belonged to high income group.

The *kachri* products commonly consumed in the community

were standardized in the laboratory using sensory evaluation technique result of sensory evaluation for *kachri* products indicated that sweet-sour *kachri* vegetable was found to be most acceptable and scored  $8.9 \pm 0.16$  on nine point scale as compared to other vegetable i.e. simple ( $8.4 \pm 0.13$ ) and

combined with cluster beans ( $8.4 \pm 0.17$ ). The *chutney* prepared with dried *kachri* powder scored maximum ( $8.3 \pm 0.27$ ) on nine point scale followed by *chutney* prepared with fresh *kachri* ( $7.9 \pm 0.37$ ). *Churan* was prepared from drying *kachri* powder and acceptable ( $7.2 \pm 0.22$ ) by judges.

**Table 2:** Mean scores obtained by *kachri* products

Kachri products	Scores of sensory characteristics on nine point hedonic scale					
	Colour	Flavour	Texture	Taste	Appearance	Overall acceptability
<b>Vegetable</b>						
Simple	8.0±0.11	7.7±0.9	8.2±0.11	7.9±0.25	7.8±0.35	8.4±0.13
Sweet-sour	8.7±0.15	8.9±0.15	8.6±0.19	8.8±0.13	8.9±0.6	8.9±0.16
With cluster beans	8.4±0.21	8.6±0.17	8.6±0.22	8.6±0.31	8.0±0.11	8.4±0.17
<b>Chutney</b>						
Fresh <i>kachri</i>	8.1±0.19	8.2±0.25	8.0±0.32	8.3±0.17	7.6±0.29	7.9±0.37
Dried <i>kachri</i>	8.3±0.21	8.0±0.32	8.6±0.16	8.6±0.11	8.1±0.16	8.3±0.27
<i>Churan</i>	7.0±0.10	7.1±0.11	7.8±0.14	7.4±0.28	7.5±0.37	7.2±0.22

± SD scores,

The *ker* products generally consumed in the community were standardized in the laboratory. It was observed that the freshly processed *ker* vegetable scored higher ( $8.7 \pm 0.12$ ) than the processed dry vegetable ( $6.9 \pm 0.56$ ). The *kadhi* made with freshly processed *ker* was recorded higher acceptability

( $8.8 \pm 0.42$ ) than dried *ker* ( $7.0 \pm 0.47$ ). The panelist like the pickle made with only *ker* gained  $8.7 \pm 0.48$ , followed by *ker* with green mango scored  $7.0 \pm 0.36$ . Significant variances at 5 per cent level of significance were perceived.

**Table 3:** Mean score obtained by vegetable of *ker*

Ker Vegetable	Scores of sensory characteristics on nine point hedonic scale					
	Colour	Flavour	Texture	Taste	Appearance	Overall acceptability
Freshly processed <i>ker</i>	8.8±0.42	8.9±0.33	8.7±0.47	8.6±0.41	8.7±0.48	8.7±0.12
Processed dried <i>ker</i>	7.2±0.42	7.2±0.63	7.3±0.67	6.8±0.13	7.1±0.31	6.9±0.56
t-value	8.48*	7.27*	4.43*	6.97*	8.76*	7.63*
<b>Ker kadhi</b>						
With freshly processed <i>ker</i>	8.7±0.48	8.8±0.34	8.6±0.51	8.8±0.42	8.7±0.48	8.8±0.42
Processed dried <i>ker</i>	7.4±0.49	7.5±0.52	7.3±0.82	7.2±0.63	7.2±0.63	7.0±0.47
t-value	5.7*	6.5*	4.23*	6.65*	5.74*	9.0*
With <i>ker</i>	8.8±0.34	8.7±0.54	8.6±0.47	8.7±0.48	8.8±0.42	8.7±0.48
<i>Ker</i> and green mango	7.3±0.47	6.9±0.43	7.5±0.47	7.1±0.39	7.2±0.33	7.0±0.36
t-value	7.7*	7.4*	5.5*	8.1*	9.6*	9.1*

\*( $p < 0.05$ ) Significant

The *sangri* products generally consumed in the community (Plain vegetable, *pachkuta* vegetable, plain *sangri* pickle, *sangri* pickle with *ker*, *sangri* pickle with green mango and *kadhi*) were standardized in the laboratory using sensory

evaluation, indicated that medium spiced vegetable ( $8.7 \pm 0.42$ ) found to be most acceptable than its other variation. Similarly medium spiced pickle ( $8.7 \pm 0.29$ ) was most acceptable.

**Table 4:** Mean scores obtained by the variation of spices in *sangri* vegetable and pickle

Spices variation in <i>sangri</i> vegetable	Scores of sensory characteristics on nine point hedonic scale					
	Colour	Flavour	Texture	Taste	Appearance	Overall acceptability
Mild spiced	7.1±0.31	6.7±0.67	7.1±0.31	6.6±0.51	6.9±0.31	7.1±0.31
Medium spiced	8.7±0.48	8.9±0.31	8.8±0.42	8.7±0.48	8.8±0.42	8.7±0.42
Highly spiced	6.9±0.56	6.7±0.48	6.8±0.32	6.7±0.23	6.8±0.19	6.8±0.25
F- value	44.54*	61.35*	72.91*	57.14*	78.84	72.97*
C.D.	0.12*	0.26*	0.21*	0.25*	0.21*	0.21*
<b>Spices variation in <i>sangri</i> pickle</b>						
Mild spiced	7.1±0.31	6.7±0.67	7.1±0.30	6.6±0.51	6.9±0.23	7.1±0.31
Medium spiced	8.7±0.39	8.9±0.28	8.8±0.42	8.7±0.48	8.8±0.17	8.7±0.29
Highly spiced	6.9±0.18	6.7±0.28	6.7±0.32	6.8±0.23	7.0±0.19	6.9±0.25
F- value	28.9*	38.21*	29.89*	30.04*	36.55*	37.30*
C.D.	0.26*	0.24*	0.24*	0.27*	0.22	0.23*

\*( $p < 0.05$ ) Significant

**Table 5:** Mean scores obtained by different combination of *sangri* pickle

Combination of <i>sangri</i> pickle	Scores of sensory characteristics on nine point hedonic scale					
	Colour	Flavour	Texture	Taste	Appearance	Overall acceptability
Plain <i>sangri</i> pickle	8.7±0.39	8.9±0.28	8.8±0.42	8.7±0.48	8.8±0.17	8.7±0.29
<i>Sangri</i> pickle with green mango						
a) 1:1	8.8±0.42	8.9±0.31	8.8±0.42	8.7±0.28	8.8±0.29	8.8±0.21
b) 1:½	6.5±0.40	6.3±0.18	6.7±0.25	6.4±0.17	6.6±0.31	6.8±0.32
<i>Sangri</i> pickle with <i>ker</i>						
a) 1:1	7.1±.57	6.8±.17	7.2±.33	7.0±.41	7.2±.41	7.4±.50
b) 1:½	6.8±0.38	6.8±0.18	7.0±0.25	6.8±0.15	7.2±0.31	6.7±0.33
F value	41.84*	67.6*	39.01*	44.25*	33.5*	29.45*
CD	0.25*	0.22*	0.24*	0.25*	0.24*	0.23*

\* $(p<0.05)$  Significant

Among three types of *sangri* pickle, the pickle prepared with green mango gained maximum (8.8±0.21) scored. *Sangri* in *panchkuta* vegetable with medium spices (8.8±0.42) was most acceptable score. *Kadhi* prepared with *sangri* was highly

acceptable (8.9±0.31) than that of *kadhi* without *sangri* (6.8±0.42). All the products like vegetable, pickle and *kadhi* have significance difference of 5 per cent.

**Table 6:** Mean scores obtained by the variation of spices in *panchkuta* vegetable

Spices variation in <i>panchkuta</i> vegetable	Scores of sensory characteristics on nine point hedonic scale					
	Colour	Flavour	Texture	Taste	Appearance	Overall acceptability
Mild spiced	6.8±0.31	6.9±0.31	7.1±0.31	6.8±0.42	6.9±0.31	6.9±0.21
Medium spiced	8.7±0.48	8.9±0.31	8.8±0.42	8.9±0.32	8.5±0.52	8.8±0.42
Highly spiced	6.5±0.52	6.7±0.48	6.7±0.32	6.5±0.23	6.7±0.48	6.5±0.25
F- value	61.98*	53.81*	42.46*	57.14*	47.78*	59.18*
C.D.	0.25*	0.21*	0.20*	0.22*	0.23*	0.22*
<b><i>Kadhi</i></b>						
With <i>sangri</i>	8.8±0.42	8.9±0.31	8.9±0.42	8.8±0.31	8.9±0.52	8.9±0.31
Without <i>sangri</i>	6.7±0.48	6.7±0.38	6.9±0.32	6.8±0.23	6.7±0.48	6.8±0.42
t- value	10.35*	12.04*	10.60*	11.02*	12.04*	12.6*

 $(p<0.05)$  Significant

## Conclusion

It can be concluded that various products of underutilized foods were prepared and acceptable by the judges but mainly but few of them liked very much by the panelists i.e. *kachri* (Sweet-sour veg - 8.9±0.16), *ker* (*kadhi* with freshly processed *ker* 8.8±0.42), *sangri* (*kadhi* prepared with *sangri* - 8.9±0.31).

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