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Adoption of indigenous and modern techniques of preservation and storage of fruits and vegetables in Ladakh

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Abstract

The study was conducted to explore the indigenous practices of preservation and storage of fruits and vegetables which have a special significance in the cold arid region of Ladakh, as it remains cut off from the rest of the country for almost six months due to harsh weather conditions. A sample of 200 farmers was randomly selected from 20 villages in four blocks of Leh district with 10 respondent farmers from each selected village during 2020 and 2021. The results revealed that the adoption of farmers' underground pits/holes for storing vegetables was observed highest followed by underground structures (Vegetable Cellar). Finally, it was observed that there is still large scope for the adoption of indigenous methods of preservation and storage of vegetables and fruits for winter consumption as it is also reducing the post-harvest losses up to a maximum extent. Moreover, indigenous practices of preservation of fruits and vegetables helped in increasing the livelihood of farmers in the cold arid region of Ladakh.

Keywords: Indigenous, practices, adoption, preservation, storage, fruits, vegetables, and Ladakh

Introduction

Ladakh is situated in trans-Himalayas and it comprises Leh and Kargil districts. Leh district is situated between 32°N to 36° N latitude and 75°E to 80°E longitude at an altitude ranging from 2900-5900m above mean sea level (Anonymous, 2009) [2]. The temperature varies between -35 to +35 degrees Celsius. The area is known for its rugged terrain and harsh climatic condition. The inhabitants living in this area are adapted to these climates but during winter nutritional security is an issue as the region is completely out of stock and merely anything grows for almost 5-6 months. Food preservation has become a part and parcel of the life of a common man in the present scenario. Food preservation is inevitable owing to many reasons. Some foods such as fruits and vegetables are available in specific seasons and not in others, while other foods are more abundantly available in some seasons than in others. In some places, there is a surplus production of a food product, whereas in other places there is an inadequate supply. Foods can also be perishable (likely to decay or go bad quickly) and semi-perishable including juicy fruits, vegetables, mangoes, tomatoes, and many more, which very quickly get spoilt. Consequently, farmers adopted certain techniques to preserve such seasonal foods intact for later use (Krishnan, et. 2014) [6]. Today, food preservation is very important in fulfilling the food supply needs of a developing country like India. India's global ranking in fruit and vegetable production is second after China. The significance of adequate consumption of fruits and vegetables to human health and nutrition has received great attention globally. This is large because of their high contents of micronutrients and bioactive compounds that are essential for nutrition and health (Arimond *et al.*, 2018; Sivakumar *et al.*, 2018) [4, 10].

Vegetables and fruits are essential in the human diet as they contain compounds of nutritional importance, iron, calcium, and vitamins that are not synthesized by the human body. The lean period is very difficult to survive and locals have come up with age-old practices to adhere to their nutrition and wellness. These indigenous practices were used in the preservation and storage of fruits and vegetables for winter consumption. During winter, locals consume dried fruits and vegetables preserved indigenously to meet their nutritional security. This traditional way of processing fruit products carried out by the farm women and self-help groups (SHGs) also helps to generate income and employment for the rural youth in the region. Keeping in view the above facts, the study was carried out to document the traditional techniques of

preservation and storage *via a vis* knowledge-wise adoption of new techniques. It has been designed with the objective to understand and assess the adoption of traditional processing methods of fruits and vegetables by the farmers, the adoption of traditional dryers for fruits and vegetables by the farmers, the adoption of modern techniques drying for fruits and vegetables by the farmers and response of younger generation towards traditional methods for storage of vegetables, fruits,

and processed fruit products.

Research Methodology

The present study was conducted in 2020 and 2021 in the Leh district of the Ladakh region. Four blocks were purposively selected for the study which includes Khaltsi, Leh, Nubra, and Nyoma, and 20 villages were randomly selected from these blocks with 5 villages from each block. The details are mentioned below in Table 1 (Anonymous, 2018)^[3].

Table 1: Twenty selected villages from four blocks of the Leh district

S. No.	Block: Nubra	Block: Nyoma	Block: Khalsi	Block: Leh
1	Hunder	Liktsey	Saspol	Stakna
2	Diskit	Chumathang	Nimu	Chuchot
3	Panamic	Nyoma	Basgo	Saboo
4	Sumoor	Mudh	Nurla	Choglamsar
5	Partap-pur	Tukla	Khalsi	Stok

A total sample of 50 farmers was selected from each of the four blocks and 10 respondent farmers were selected from the selected villages by using the multistage-stratified random sampling technique. Thus, a sample of 200 farmers including farm women and rural youth was undertaken for the study. The data regarding the adoption of farmers' indigenous storage practices of fruits and vegetables for winter consumption was collected with the help of a pre-structured interview schedule. The extent of adoption of farmers' perception about storage practices was measured on the basis of a three-point continuum i.e., 'Agree', 'Partially Agree', and 'Disagree', with a score of 3, 2, and 1, respectively. The response of farmers regarding the use of new techniques of drying in the form of solar dryers and the response of the younger generation towards traditional methods of storage of vegetables and processing of fruit products have been assigned marks and '1' mark each was assigned for 'Yes'

correct reply and '0' mark each for 'No' reply, respectively. Then, the frequency and percentage of respondents in each statement were calculated. The extent of adoption was measured on the basis of the mean percent score obtained for each statement.

Results and Discussion

Preservation of foodstuffs such as vegetables and fruits has very important significance in the hilly region of Ladakh. There is a huge variation in climatic conditions during the year and the region remains cut off from the outside due to harsh weather conditions. So, there is a tremendous need for the preservation of fruits and vegetables, and locals in this region are habitual in practicing different indigenous methods of preservation which have a hidden scientific background to cater to the need in the ensuing winter. The results of the study are presented and discussed as under:

Table 2: Adoption of traditional methods of vegetable storage by the farmers.

(n=200)

S. No.	Traditional storage methods of vegetables	Local name	Percentage of Respondents			Mean Score
			Agree	Partially Agree	Disagree	
1	Underground pit/hole for storing vegetables	Sadong	48.50	30.00	21.50	22.70
2	Underground structure for vegetable Cellar	Tsothbang	47.50	35.50	17.00	23.05
3	A glass room where vegetables are stored	Shelkang	42.50	25.00	32.50	21.00
4	Onion storage hanging process	Charches	37.50	10.00	52.50	18.50
5	Vegetable pickle Storage in glass bottle	Shel	47.50	27.50	25.00	22.25
6	Leafy vegetables stored in between dried alfa-alfa grass	Oal tsodma	30.00	30.00	40.00	19.00

The result presented in (Table 2) depicts the traditional methods of storage of vegetables by the farmers in the Leh region with their local names and their extent of adoption. An almost similar extent of adoption was observed amongst respondent farmers for these practices as revealed by the mean score recorded during the study. The data revealed that the highest mean score of 23.05 percent was recorded in the case of the vegetable Cellar (Local name: Tsothbang) storage structure in which 47.50% of farmer respondents agreed, 35.50% partially agreed and the lowest 17% disagreed with the adoption of this practice. The lowest mean score of 18.50 percent was recorded in the case of indigenous onion storage practice (Local name: Charches) in which 37.50 percent of farmers agreed, 10 percent partially agreed and 52.50 percent

disagreed with adoption. However, a mean score of 22.70 percent was recorded in the case of the underground pit/hole (Local name: Sadong) method in which 48.50 percent of respondents agreed while 30 percent of respondents farmers partially agreed and 21.50 percent of respondents disagreed with the adoption of this method. A similar trend was observed in the case of the use of a glass room for storage of vegetables (Local name: Shelkang) with a mean score of 21.00% in which 42.50% of respondents agreed, 25% partially agreed and 32.50 percent disagreed for adoption. The other indigenous practices also followed a similar trend as observed in Table 2. Similar findings were observed by Ali *et al.* (2012)^[1] who studied the methods for storage of vegetables in the cold arid region of Ladakh

Table 3: Adoption of traditional methods of fruit storage by the farmers.

(n=200)

S. No.	Traditional storage methods for fruits	Local name	Percentage of Respondents			Mean Score
			Agree	Partially agree	Disagree	
1	Apple stored in boxes	Tsato	42.50	32.50	25.00	21.75
2	Apricot oil stored in bottles	Bottle	42.50	27.50	30.00	21.25
3	A glass room where fruits are stored	Shel kang	36.50	41.00	22.50	21.40
4	Fruit Storage in Muslin Cloth	Fhatcha	34.00	36.00	30.00	20.40
5	Apricot Jam stored in Glass containers	Shel Bung	27.50	25.00	47.50	1.80

The results presented in (Table 3) depict the traditional methods of storage of fruits and their by-products by the farmers in the Leh region which include fruit storage in boxes, glass rooms, and in muslin cloth and storage of apricot oil and fruit jam in glass bottles. The data revealed that a maximum mean score of 21.75 percent was recorded in the case of storage of fruits in boxes (Local name: Tsato) in which 42.50 percent of respondents agreed, 32.50 percent partially agreed and only 25.00 percent disagreed with the adoption of the practice. The lowest mean score of 1.80 percent was recorded in the case of storage of apricot jam in glass bottles (Local name: Shel) in which 27 percent of

farmers agreed, 25% partially agreed and a maximum of 47.50 percent of respondents disagreed for the adoption of it. A similar trend was observed in the case of the adoption of other indigenous practices for the storage of fruits and their by-products like storage of apricot oil in glass bottles, fruit storage in glass rooms or in muslin cloth which the majority of the respondent's farmers agreed, and the lesser number of respondent farmers disagreed for the adoption of the said practices as presented in Table 3. The results were in agreement with the findings of Reddy (1987)^[7], Sumathi (2008)^[8] Singh (2010)^[9], and Mansuri (2015)^[10], who studied the adoption of different indigenous practices fruits.

Table 4: Adoption of traditional processing methods of fruit products by women farmers.

(n=64)

S. No.	Processing methods of Fruit products	Local name	Percentage of Respondents			Mean Score
			Adoption	Less Adoption	Not Adoption	
1	Apricot Jam	Chuli Jam	31.25	15.62	53.13	17.81
2	Apricot Flour	Chuli Phey	21.87	25.00	53.13	16.87
3	Dried Apricot	Chuli Skampo	62.50	23.44	14.06	24.84
4	Apple Juice	Kushu Juice	37.50	40.63	21.87	21.56
5	Apple Jam	Kushu Jam	15.62	23.44	60.94	15.46
6	Dried Apple	Kushu Skampo	62.50	20.31	17.19	24.53
7	Sea-buckthorn Jam	Tsestalulu Jam	6.25	7.81	85.94	12.03
8	Sea-buckthorn Juice	Tsestalulu Juice	10.93	4.69	84.38	12.66
9	Grape wine	Gunchang	4.69	1.56	93.75	11.09
10	Walnut oil	Starga Mar	12.50	15.63	71.87	14.06
11	Apricot oil	Tsigu Mar	53.12	15.63	31.25	17.81
12	Apricot Juice	Chuli Juice	31.25	23.44	45.31	18.59

The extent of adoption of traditional methods of making fruit products by the farm women such as Apricot Jam, Apricot floor, Dried apricot, Apple Juice, Apple Jam, Dried apple, Sea-buckthorn Jam, Sea-buckthorn juice, Grape wine, Walnut oil, Apricot oil, and Apricot juice is presented in (Table 4). The data revealed that the highest mean score of 24.84 percent was recorded in the case of the indigenous practice of drying apricots for which 62.50 percent of farm women agreed, 23.44 percent partially agreed and only 14.06 percent disagreed with the adoption of it. Similarly mean score of 24.53 percent was recorded in the case of the indigenous practice of drying apples for which 62.50 percent of farm women agreed, 20.31 percent partially agreed and 17.19 percent disagreed with adopting it. The lowest mean score of

11.09 percent was recorded in the case of processing grape wine for which only 4.69% of respondents agreed, 1.56 percent partially agreed and 93.75 percent of farm women disagreed with adopting it. A similar trend was observed in the case adoption of other indigenous practices of processing fruit products like apple juice, apricot juice, apricot jam, apricot oil, apricot flour, apple jam, walnut oil, sea-buckthorn juice, and sea-buckthorn jam, with mean scores of 21.56, 18.59, 17.81, 17.81, 16.87, 15.46, 14.06 12.66 and 12.03, respectively as presented in Table 4. The lowest mean scores reflected in the trend revealed that the majority of the farm women disagreed with adopting the practice and the highest mean score obtained observed that the majority of the farmers agreed to adopt the practice.

Table 5: Adoption of traditional dryers for fruits and vegetables by the farmers.

(n=200)

S. No.	Adoption of traditional dryers	Response	Frequency (f)	Percentage (%)
1	Fruits and Vegetables dried on Rock Stones	Yes	85	42.50
2	Fruits and Vegetables Dried in a glass room	Yes	135	67.50
3	Fruits and Vegetables dried on the terrace during sun-shine	Yes	148	74.00
4	Fruits and Vegetables dried from wood-fired oven	Yes	45	22.50
5	Fruits and Vegetables dried by hanging methods	Yes	105	52.50

The results presented in (Table 6) depict the adoption level of farmers for the traditional drying practices of fruits and vegetables. The results revealed that the adoption level of drying practice on terraces during sunshine was highest (74.00 percent) followed by drying in a glass room (67.50

percent), hanging methods (52.50 percent), and drying on rock stones (42.50 percent). But drying in a wood-fired oven was observed least (22.50 percent) adopted by farmers in the region

Table 6: Adoption of modern techniques of dryers for fruits and vegetables by the farmers.

(n=200)

S. No.	Adoption of modern techniques for dryers	Response	Frequency (f)	Percentage (%)
1	Solar Dryer	Yes	20	10
2	Tent Dryer	Yes	80	40
3	Solar Cabinet Dryer	Yes	10	5
4	Solar greenhouse Dryer	Yes	12	6
5	Sun best solar Dryer	Yes	16	8
6	Planters' energy network solar Dryer	Yes	11	5.5
7	Solar tunnel Dryer	Yes	10	5
8	Any other Dryers	Yes	40	20

The results presented in (Table 6) represent the modern techniques of drying fruits and vegetables, by using different types of dryers such as solar dryers, tent dryers, solar cabinet dryers, solar polyhouse dryers, sun best solar dryer, planters' energy network solar dryer, and solar tunnel dryer and their adoption level by the farmers. The highest adoption rate of 40 percent was recorded in case of tent dryer followed by a solar dryer (10 percent), sun best solar dryer (8 percent), solar

greenhouse dryer (6 percent), planters' energy network solar dryer (5.5 percent), solar cabinet dryer (5 percent) and solar polyhouse dryer (5percent). Similarly, 40 percent of farmers used other dryers for the preservation of fruits and vegetables. Similar findings were observed by Hussain *et al.* (2012) ^[5] who studied apricot drying, and preservation techniques currently practiced in Ladakh.

Table 7: Adoption of traditional methods as a business for storage of vegetables, fruits, and processing by the unemployed youth farmers of Leh district.

(n=60)

S. No.	Statements for the younger generation	Response	Frequency (f)	Percentage (%)
1	Adopt traditional methods as a business	Yes	31	52.00
2	Earn capital from traditional methods	Yes	30	50.00
3	Generate self-employment	Yes	33	55.00
4	Is it profitable	Yes	35	58.33

The results presented in Table 6 revealed the response of the younger generation about the traditional methods of storage of vegetables, fruits, and processing methods of fruit products in the Leh district. Majority of the younger generation have responded positively that traditional methods are presently acting as a profitable business and generate employment for the rural youth and farm women in the district.

Conclusion

Food preservation and storage in this region has been and continues to be a vital part of the life of common people. In this study, the traditional food preservation techniques prevalent in the region have been explored to estimate the inevitability of food preservation in this region where such large climatic variations persist. There was also a good scope to study these food preservation techniques so that they can be modified and the food can remain healthy and nutritious for a long time without deteriorating its quality. The results of the present study revealed that the indigenous practices of preservation and storage of vegetables together with the processing of fruit products have a remarkable significance in this hilly region. This is due to the fact that during winter nutritional security is a very important concern for the whole region as it remains cut off from the rest of the world for almost 5-6 months. The people of Ladakh are not only following the traditional method of preserving and storing vegetables and fruits for winter consumption but are also

using modern techniques of drying and processing fruits and vegetables. The present studies also revealed a high adoption level of these indigenous practices by farmers of the Leh district. These traditional methods are not only effective for food and nutritional security but have also attained the status of profitable business activity in the region. These indigenous practices have also been observed to generate employment for the rural youth and have a great scope for the overall development of the food technology industry in the region. However, these traditional methods can be modified by introducing technological interventions wherever possible which will be beneficial not only for the common people and government but also for future generations. The administration of the union territory of Ladakh is promoting the 'Horticulture-Mission' for the farmers in the region to reduce their dependence on importing vegetables and fruit crops from other regions.

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