

**ISTP (Group-7)**

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Study of traditional methods of food preservation, its scientific understanding and technological intervention



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## Ch 1: INTRODUCTION

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In the present scenario, food preservation has become a part and parcel of the life of a common man. 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 season 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, tomato, papaya and many more, which very quickly get spoilt. Consequently, civilized men adopted certain techniques to preserve such seasonal foods intact for later use. Today, food preservation is very important to fulfil the food supply needs of a developing country like India. It also ensures that the food is available and its supply is maintained at all times. Furthermore, problems like food shortage or famine can also be avoided.

Preservation of food stuffs, such as vegetables, fruits and grains has special significance in the hilly terrain of Himachal Pradesh. This northern state experiences huge variation in climate conditions during the year – from hot and humid tropical to cold and alpine. Some parts of the state are cut-off from the others due to harsh weather conditions and landslides (e.g. Spiti Valley) and remain inaccessible. Furthermore, in several regions of the state, cultivation happens only in selected months of the year. Due to these reasons, (i) a number of fruits and vegetables are seasonal with huge availability (and at cheaper costs) in certain months, with no availability in other months and (ii) there is a huge need for preservation and storage of food for later consumption.

Agriculture in Himachal Pradesh contributes nearly 45% to the net state domestic product. It is the main source of income as well as employment in the region. About 93% of the state population depends directly upon agriculture which provides direct employment to 71% of its people (Economic Survey, 2009-2010). It is therefore very important that the crops do not get spoilt due to weather conditions and are preserved using proper techniques for later use and a marketable supply of food products is maintained from Himachal Pradesh to other parts of India and the world.

Several age-old traditional methods of preservation of food exist, such as the familiar sun drying (to reduce water activity), and storage in vinegar (preservation under acidic condition to avoid attack by microbes), to name a few. In addition, there are also indigenous methods which were/are used by generations of villagers, which have hidden scientific knowledge, but are currently under decline.

In this project we aim to explore those traditional methods of food preservation along with its scientific understanding and suggest some technological interventions based on the extension of the obtained knowledge. To facilitate our research, we will visit villages in order to interact with residents, especially those belonging to older generations to get to know the traditional methods of preservation of seasonal fruits, vegetables, and cooked food. Of particular interest are the remote villages of Himachal state, which are generally cut-off during the winter months. Based on the obtained knowledge, further technological interventions for improvement can be suggested as well as suggestions for extending the preservation concept to other food stuffs.

## Ch 2: LITERATURE REVIEW

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The following chapter highlights some of the aspects of food preservation based on the literature survey conducted, in order to have a deeper insight into the project. We first try to understand the demographics and climatic conditions of our region and the agricultural pattern being followed in Himachal Pradesh. Then we take a deeper look at the actual stakeholders involved in our project and how are they affected. Further, we explore the background of our project which gives us an idea about types of food preservation techniques prevailing in India from ancient times. Finally we conclude the literature review by analysing a case study.

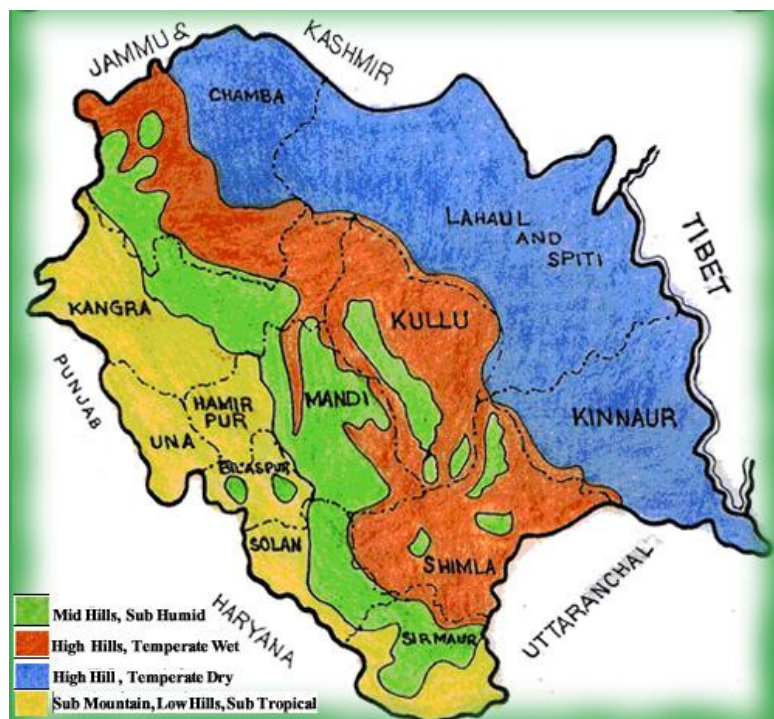
### 2.1 SITE DESCRIPTION

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India is the second most populated country in the world with approximately 1.237 billion<sup>[1]</sup> citizens with seventh largest geographical area of around 3,166,414 sq km<sup>[2]</sup>. To fulfil the basic food requirement of whole country thorough planning and management is required. Food preservation and processing plays an important role in fulfilling food requirement of the country. For this purpose Ministry of Food Processing Industries (MOFPI) was launched by the Government of India in the year 1988. The main goal of Ministry is to *“focus on policy issues relating to the promotion of food processing industries in the country which would result in reduction in post harvest losses, efficient storage & transportation, processing, increase in shelf life of food products, availability of fresh & processed products at reasonable prices to consumers and better income to the farmers.”*<sup>[3]</sup>

Food preservation plays an important role in our life. To understand the challenges of food preservation, we need to understand the varied topography and climate of the state. Himachal Pradesh is the seventeenth largest state in the India, and is situated in the lap of mountainous northwest Himalayan region. Total geographical area of Himachal Pradesh is 55,673 km<sup>2</sup>. State-elevation ranges from about 350 meters to 7,000 meters above the sea level. In Himachal Pradesh average winter temperature is 7 °C and in summer it is 28 °C. Within the state, these temperatures varies widely even within a few miles of each other. Average precipitation in Himachal Pradesh is 1,469 mm. Himachal Pradesh is a mostly mountainous area, surrounded by the Indian states of Jammu and Kashmir in the north,

Uttar Pradesh, Uttaranchal, Haryana and Punjab to the south, China and Tibet in the East. According to 2003 Forest Survey of India report, 66.52% of the total geographical area of Himachal Pradesh is covered with forest (see figure 1, below).<sup>[1]</sup>



**Figure 1:** Map depicting Agro Climatic Zones of Himachal Pradesh ([www.hpagriculture.com/agro.htm](http://www.hpagriculture.com/agro.htm))

In Himachal Pradesh main occupation of the people is agriculture. More than 70% of the state population directly depends upon agriculture for livelihood. According to the Economic Survey of Himachal Pradesh 2013-2014 done by Economics and Statics department of Government of Himachal Pradesh, *“The economy of Himachal Pradesh is predominantly dependent upon agriculture and in the absence of strong industrial base; any fluctuations in the agricultural or horticultural production cause some changes in economic growth also. During 2012-13 about 14.42 percent of state income has been contributed by agriculture sector alone.”*

#### ❖ Pattern of Agriculture in Himachal Pradesh:

Importance of agriculture for the state is huge as it is a major source of occupation for the most of the population. It contributes about 14% of the total state income.

The main crops grown in Himachal Pradesh are:

- Cereal crops: including maize, wheat and rice.
- Oilseed crops: including ground nut, sunflower, soya bean, mustard and toria.
- Pulse crops: including urd, bean, rajmash, moong and gram lentil.
- Fruits: including apple, pear, peach plum, mango and raisin grapes.

Food grain production has shown increasing growth over the last decade. The average contribution of Himachal Pradesh to the total food grain production over a last decade is 6.3%. Here are some statistics for food grain production from 2007 - 2011 (see tables 1-2, below).

**Table 1: Food grain production in Himachal Pradesh compared to India (Thousand Tonnes)**

Year	Himachal Pradesh	India	Share of Himachal Pradesh in India (%)
<b>FY 2007</b>	1.38	217.28	0.64
<b>FY 2008</b>	1.56	230.78	0.68
<b>FY 2009</b>	1.40	234.47	0.60
<b>FY 2010</b>	0.74	218.2	0.34
<b>FY 2011</b>	1.53	244.78	0.62

Source: PHD Research Bureau, compiled from RBI, Ministry of Agriculture

According to Himachal Pradesh Horticultural Produce Marketing and Processing Corporation Ltd.(a GOVT. undertaking), “The total area under fruit in HP is about 2.07 Lac hectares with a production of about 5.00 Lac MTs of all kinds of fruits. Apple is the major fruit accounting for more than 40% of total area under fruits and about 88% of total fruit production.”(Source: <http://hpmc.gov.in/himachal.htm> last updated on 26-may 2010)

**Table 2: Apple production in Himachal Pradesh compared to India (Thousand Tonnes)**

Year	Himachal Pradesh	India	Share of Himachal Pradesh in India (%)
<b>FY 2007</b>	268.4	1623.7	16.53
<b>FY 2008</b>	592.5	2001.5	29.60
<b>FY 2009</b>	510.1	1985.1	25.70
<b>FY 2010</b>	280.1	1777.2	15.76
<b>FY 2011</b>	892.1	2890.6	30.86

Source: PHD Research Bureau, compiled from RBI, Ministry of Agriculture

Here are some statistics for district wise food grain and commercial crop production in Himachal Pradesh for 2012-2013.

**Table 3: District wise agricultural production of Himachal Pradesh for 2012-13: Food grain**  
(Area in 000' Hectare and Prod. in 000'MT)

S.No.	District	Wheat		Barley		Gram		Pulses		Total	
		Area	Prod.	Area	Prod.	Area.	Prod.	Area.	Prod.	Area.	Prod.
1.	Bilaspur.	26.30	46.80	0.15	0.50	0.15	0.30	0.90	0.50	27.50	48.10
2.	Chamba.	21.40	38.00	3.75	5.70	-	-	-	-	25.15	43.70
3.	Hamirpur	33.40	59.55	0.10	0.30	0.10	0.15	0.90	0.50	34.50	60.50
4.	Kangra	94.40	168.00	3.30	5.20	0.40	0.60	1.55	1.10	99.65	174.90
5.	Kinnaur	0.40	0.70	1.75	2.70	-	-	0.65	0.25	2.80	3.65
6.	Kullu	20.50	36.55	3.00	4.80	-	-	-	-	23.50	41.35
7.	L/Spiti	0.10	0.15	0.10	0.30	-	-	-	-	0.20	0.45
8.	Mandi	63.80	113.50	3.60	5.35	0.10	0.20	0.85	0.50	68.35	119.55
9.	Shimla	17.50	31.25	4.00	6.00	0.05	0.10	0.90	0.50	22.45	37.85
10.	Sirmour	27.95	49.80	1.75	2.90	0.30	0.50	1.20	0.85	31.20	54.05
11.	Solan	22.60	40.20	1.50	2.25	0.20	0.35	1.20	0.80	25.50	43.60
12.	Una	30.65	54.50	-	-	0.20	0.30	1.35	1.00	32.20	55.80
	<b>TOTAL:-</b>	<b>359.00</b>	<b>639.00</b>	<b>23.00</b>	<b>36.00</b>	<b>1.50</b>	<b>2.50</b>	<b>9.50</b>	<b>6.00</b>	<b>393.00</b>	<b>683.50</b>

Source: Agricultural production programme for RABI 2013-14

**Table 4: District wise agricultural production of Himachal Pradesh for 2012-13: Commercial crops**  
(Area in 000' Hectare and Prod. in 000'MT)

S.No.	District	Potato		Vegetables	
		Area	Prod.	Area	Prod.
1.	Bilaspur.	-	-	1.12	28.50
2.	Chamba.	0.14	3.25	1.23	22.00
3.	Hamirpur	-	-	1.40	20.00
4.	Kangra	0.20	2.60	3.00	62.00
5.	Kinnaur	-	-	1.50	21.50
6.	Kullu	0.25	3.25	2.30	42.00
7.	L/Spiti	-	-	-	-
8.	Mandi	0.45	5.60	4.10	76.00
9.	Shimla	1.35	16.20	5.00	83.00
10.	Sirmour	0.35	4.60	3.10	78.00
11.	Solan	-	-	3.70	105.00
12.	Una	0.15	2.00	0.75	12.00
	<b>TOTAL:-</b>	<b>3.00</b>	<b>37.50</b>	<b>27.20</b>	<b>550.00</b>

Source: Agricultural production programme for RABI 2013-14

**Table 5: Fruit production in Himachal Pradesh in year 2012-13**

Serial no.	Type of fruit	Fruit production (in tonnes)
1.	Apple	412395
2.	Mango	50001
3.	Pears	25212
4.	Orange	13214
5.	Plum	12107
6.	Lemon	6030

Source: Annual administrative report for 2012-13 by state department of Horticulture, Government of Himachal Pradesh

## 2.2 STAKEHOLDERS

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Our project focuses on the study and analysis of traditional methods which will directly or indirectly affect different sections of the society. It can be helpful not only in recording and preserving these methods for future reference, but also as a source of ideas for local entrepreneurs, sellers, vendors, local agencies, NGOs, and small cooperative societies to improve the condition of food shortage in Himachal. Furthermore, potential exists to use these skills for economic upliftment of local people, because this field hasn't been tapped financially until now. Our focus will be to understand its effect on the following stakeholders.

### The community practitioners

Out of necessity and due to peculiar geographic positions, food preservation has become important for the local people of Himachal Pradesh. Even within this group, we can look for many subgroups whose situations and lives are quite different and their food supply periods and patterns are also different which decides the importance of food preservation in their life. Along with it the methods of food preservation will also going to be different for these subgroups.

- a) **Urban class:** The residents of cities like Kullu, Mandi, and Manali have a direct supply of food on daily basis. They get their supplies of food and dairy products from nearby villages and from adjacent states like Punjab and Haryana.



**Figure 2:** *Urban residents living in the main city (Mandi)*

- b) **Rural residents from nearby areas:** These residents typically get their supply of food on weekly basis. Their requirements for better food preservation methods are more than the city people. Some of them are poor and some belong to the lower middle class thus these traditional methods have become a part of their in managing their food expenses and also to help them during financial or natural crisis.`
- c) **Rural people from remote areas:** These residents live much farther from the cities and in villages that can become disconnected from the main cities for months during snowfall, heavy rainfall or landslides. They may have developed their own traditional methods of food preservation so as to survive in extreme conditions. The communication with the other people and local authorities are also affected which further increase the importance for devising better techniques to store and preserve food till the transport routes open up and fresh supplies of food can be brought.



**Figure 3:** *Rural residents living in nearby scattered small villages*

## The Government Authorities

Because of frequent landslides, remote mountainous areas and lower production of cereals, vegetables and dairy products in Himachal Pradesh, the importance of food preservation is greater. The governmental policies of making cold storage warehouses, promoting research in food preservation field and promoting the awareness and assisting the local people in using food preservation methods have become a necessity. Thus better and economic food preservation methods will play a crucial role in assisting the government.

## The sellers and vendors

The importance of successfully marketing food preservation for the sellers of processed food items is immense. It is helpful for growers to reduce their wastage and to make their business much more profitable. If the traditional methods of food preservation can be used by this class then it might result in less financial crisis and at the same time the chemicals used in food preservation in these shops have a bad effect on the health of the consumers of the processed foods. Thus traditional methods can bring a change in the health situation of the people too.

## 2.3 BACKGROUND

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Food preservation is one form or another is being practiced from ancient times. Food preservation permeated every culture at nearly every moment in time. Since humans are in constant touch with its nature, they have to survive in the conditions available at its nearest vicinity. Food by its nature begins to spoil the moment it is harvested. Early farmers no longer had to consume or harvest immediately, but could preserve some for later use.

In ancient times the sun and wind were used to dry foods naturally (see figure 4, below). Evidence shows that Middle East and oriental cultures actively dried foods in hot sun as early as 12,000 B.C. Vegetables and fruits were also dried from the earliest times. Freezing was also an obvious preservation method to the appropriate climates. People living in geographic area that had freezing temperatures for some part of a year made use of the temperature to preserve foods [Reference given at the end].



**Figure 4:** *Fruits being dried in sun*

Fermentation was also used in some parts of the world. It was not invented, but rather discovered. The first beer was discovered when a few grains of barley were left in the rain. Microorganisms fermented the starch-derived sugars into alcohols. The skill of ancient peoples to observe, harness, and encourage these fermentations are admirable. Beer was nutritious and the alcohol was divine. Fermentation not only could preserve foods, but it also created more nutritious foods and was used to create more palatable foods from less than desirable ingredients. It was treated as a gift from the gods.

Another famous preservation technique known to our ancestors was pickling, which is a technique for preserving food in vinegar (or other acid). Pickling may have originated when food was placed in wine or beer to preserve it, since both have a low pH. Containers were made of glass or stoneware, since the metal from pots can be dissolved by vinegar. The Romans made a concentrated fish pickle sauce called “garum”. It was powerful stuff packing a lot of fish taste in a few drops. Early cultures also used salt to help desiccate foods. Salting was common and even culinary by choosing raw salts from different sources (rock salt, sea salt, spiced salt, etc.), as seen below in figure 5 and 6. However, this process allowed food storage for only few days or week.



**Figure 5:** *Pickles stored in jars*



**Figure 6:** *Fish stored by using salt*

Preservation with the use of honey or sugar was well known to the earliest cultures. In northern climates that do not have enough sunlight to successfully dry fruits, housewives learned to make preserves by heating the fruit with sugar.

Canning is the process in which foods are placed in jars or cans and heated to a temperature that destroys microorganisms and inactivates enzymes. This heating and further cooling creates a vacuum seal. The vacuum seal prevents microorganisms from re-contaminating the jar food.



**Figure 7:** *Picture depicting preservation via Canning*

The techniques mentioned above were known from ancient times. The exact moment when these activities became common is unknown. However, as humans stepped into modern era and science and technology gained pace they began to question the science behind these ancient techniques. For instance, in the 1800's it was discovered that certain sources of salt gave meat a red colour instead of the usual unappetizing grey. The red coloured meat was overwhelmingly preferred by consumers. In this mixture of salts were nitrites (salt peter). As the microbiology of *Clostridium botulinum* was elucidated in the 1920's it was realized that nitrites inhibited this organism.

Insight into these techniques also paved way to new technologies for example: In America, estates had icehouses built to store ice and food on ice. Soon the "icehouse" became an "icebox". In the 1800's mechanical refrigeration was invented and was quickly put to use.

All these ancient methods were well known to our ancestor and having this background set, now we can start our project by making an attempt to explain these activities through scientific knowledge at our disposal.

## **2.4 CASE STUDY**

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Lots of studies have been conducted all around the globe trying to explore the modern and traditional food preservation techniques prevailing in the world. With each case study performed, some conclusions are drawn and based on these conclusions, either the prevailing techniques are being improved or some new techniques are developed. Two of these case studies (one from India and one from USA) are cited below. The first case study was conducted by Department of Biotechnology, Himachal Pradesh University in 2003 ( published in the Indian Journal of Traditional Knowledge, Vol. 3(3), July 2004, pp.325-335) and the second one was conducted by Melisa & Ronit (published in Environmental Communication: A Journal of Nature and Culture, Vol. 4, No. 3, September 2010, pp. 301-317).

### **CASE STUDY I**

The aim of this study was to characterize some traditional foods and beverages of Himachal Pradesh. This study reveals that the traditional fermented foods and beverages have gained popularity in tribal and rural areas of Himachal Pradesh. Fermentation has been a commonly used food preservation techniques for a very long time. It is used to enhance quality and storage life of some of the food materials. The fermentation technique continued to be used in rural areas due to inaccessibility of industry made products in remote areas and their sociocultural linkage with such products. The traditional fermented foods and beverages form important constituents of staple diet of the people belonging to the tribal belts of Kinnaur, Chamba, Lahaul & Spiti and rural areas of Shimla, Kullu, Kangra and Mandi districts of Himachal Pradesh. The areas mentioned above are the areas which are most affected during torrential rains and landslides. They get cut-off from the main city and therefore the food preservation is indispensable for these regions. The required raw material for traditional techniques are easily available locally and the equipments used are easy to maintain and affordable by the folk people.

The following conclusion can easily be drawn from this case study that the fermented foods and beverages are nutritionally beneficial and easy to preserve. These foods and beverages have become a part and parcel of the food and nutrition of the rural and tribal people of Himachal Pradesh. Apart from these, traditional fermentations have low cost of production, need less labour input and raw materials needed for preparation are locally or easily available. These fermented products have a potential to grow into a small or medium size industry, if scientific and technological support is extended to the existing folk technologies/practices.

## **CASE STUDY II**

The aim of this case study was to explore how the food preservation can be used as alternative food activism. The study reveals that it is possible to change our food system by saving food. This study helps us to understand the popularity of home canning technique in America during World War II and how the popularity shifted from canning to freezing after the end of World War II. It clearly demonstrates the cultural impact of food preservation.

This study gives us an insight into a wide variety of reasons given by people for food preservation. One of the most frequent justification given by people for preserving food was to know and control what is in their food. The other reason being taste, the desire to eat safe food with known ingredients was taste. Many of the interview participants agreed that preserving food with others provided an opportunity to build relationships and strengthen bonds and many described their food-preservation practices as extensions of family traditions and emphasized that food preservation connected to their ancestry.

## **2.5 SUMMARY**

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In this literature review we have studied about the demographics and the agricultural pattern being followed in Himachal Pradesh, the different aspects of food preservation, its indispensability in Himachal Pradesh owing to the frequently varying climatic conditions. We have studied all the stakeholders who are directly and indirectly related to our project. We have learnt about the traditional preservation techniques prevailing in India from ancient times. The case studies have helped us to understand various reasons being associated with food preservation.

## Ch 3: METHODOLOGY

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This project aims to explore those traditional methods of food preservation along with its scientific understanding and suggest any technological interventions based on extension of the obtained knowledge. To achieve these goals we have identified the following objectives:

1. Identify practitioners and interest in local food preservation
2. Assess and archive traditional methods of food preservation
3. Evaluate the feasibility of technological enhancements of these traditional systems.

This chapter will outline and justify the different methods that we will use to accomplish our objectives. Sample interview questions are located in the Appendix 1.

### 3.1 Identify practitioners and interest in local food preservation

In order to equip us with the required knowledge about traditional food preservation method we went to some nearby villages (like Kathindi, Kamand, Kataula). We have planned to visit HPMC, Kullu to check how they preserve food and to note whether they are using any traditional method. In cities like Kullu and Shimla we will go to the agriculture department to collect required statistic or any archives they have on the ongoing practices. They can also direct us to any other government agency. When we went to the villages we first tried to meet the Sarpanch(head of the village) so that we can approach this problem in a civic way. We talked to them of the methods they are using, the exact recipe of that method, do they know any scientific or logical explanation of the technique they are using. We have documented the information collected till now in a chronological order and continue this process for further surveys. If some practice is followed in Himachal Pradesh but not close to Mandi then we are planning to call someone there so that we can get the information telephonically.

### **3.2 Assess and archive traditional methods of food preservation**

After the data collection about traditional food preservation techniques from various stakeholders, we will move on to the next phase of our project i.e. scientific understanding. During this we will try to understand the scientific reasons behind traditional methods of food preservations. For the completion of the objective we will visit government food processing and preservation offices in the Shimla, Kullu, Manali. During our visits we will interview representatives of the organization to completely understand the mechanisms behind each traditional method. If possible we will collect the scientific data about mechanisms of the preservation process. After collection of data we will compile them and group each process based on mechanisms used in each process, for example drying of fishes and drying of potato chips will come in same category 'Drying', we can also further classify them as sun dried or heat dried mechanisms etc. After grouping of each mechanism we can then easily represent the vast data about preservation in simplistic form which can be easily understood by common person or stakeholder. In these mechanisms we will not only try to understand scientific mechanism but also seasonal applications, time dependencies of the traditional preservation methods. If collected data is not satisfactory or insufficient to represent mechanism behind a traditional preservation method then we will seek information from local colleges where this study is done or going under development.

### **3.3 Evaluate the feasibility of technological interventions based on extension of the obtained knowledge**

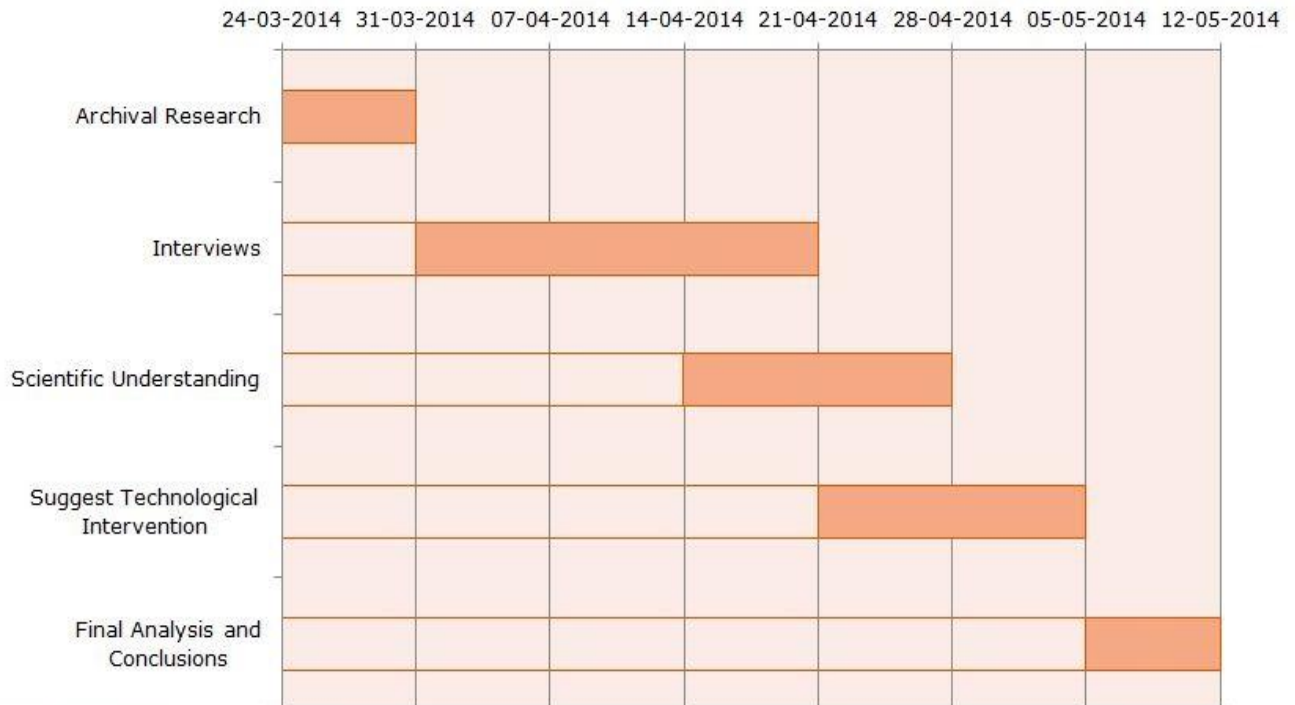
Once the scientific understanding is done, we will be in a stage where we can give some valuable suggestions (if possible) to improve the existing traditional methods. We will also provide suggestions for extending the preservation concept to other food stuffs. We will be comparing these traditional methods of food preservation with the modern food preservatives and assess the possibility of technological viability of traditional methods to be used in food processing industries and small food cooperatives so as to provide healthy and natural alternatives to the common people. For this, we will collect data regarding the modern preservatives used in processing and storage from the internet and other resources, and visit some nearby food processing unit and ask them about the problems faced with the

technological usage of these traditional methods and inquire about possible changes & adaptation of these methods with the existing food processing and storage technology.

### 3.4 Project Plan

We have provided a Gantt Chart (see figure 7, below) to illustrate the time frame in which we expect to complete each task. We have completed the archival research in the first two weeks. We have now started interviewing people and will continue it for two more weeks from now. After collecting all the raw data, we will start to analyse it and try to understand the scientific understanding behind the techniques collected via surveying and interviewing people. This process will be performed during the fourth and the fifth week. At the end of fifth week we will suggest some technological interventions wherever possible. In the final two weeks, we will finish drawing our conclusions and analyzing our data, and we will conclude by making our final suggestions.

All the information gathered during the seven week process, including data collected through interviews, participation observation, and community forums, will remain confidential and will only be collected with the participant's consent.



**Figure 8: Gantt Chart**

## **Ch 4: RESULTS AND DISCUSSION**

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The summary of the survey conducted by our team are described below. We conducted surveys in around four villages (Kataula, Kathindi, Kamand, Nadli), discussion with the workers in the Kamand campus living in Nehari and a HPMC shop in Shimla. One of our team members, who is currently in Germany, also conducted a survey in a vineyard near Munich, Germany, the summary of which is added below.

### **4.1 Summary of visit to Kataula and Nadli**

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We interviewed around 10 people in the Kataula and Nadli. We asked them general questions about availability of food in their villages. We gathered data about the various food preservation techniques prevailing in their houses. We asked them about which food materials/items are mostly preserved. The preservation processes and the duration for which foods are preserved were also inquired. We asked them about the motivation for preserving food.

Most of the people replied that there is no need of preserving food since Kataula is well connected to the main Mandi city and there is a regular supply of fruits and vegetables (*Fig. 18 & 19*) from the Mandi city. They come under previously stated stakeholders (1.b). Many people own cattles, so there is enough supply of dairy products. There is a chilling centre located at the centre of the Kataula village where the milk produced in the village is processed, stored and dispatched to the Mandi city. Vegetables like potato, peas, onion, garlic and food grains like maize and wheat (*Fig. 14*) are produced in the village itself. The maize produced is stored in the metal containers (*Fig. 15, 16 & 17*) with some insecticides being added to prevent the maize from spoiling. Wheat was currently grown in the fields and it will be stored in the similar manner after harvesting. There is a regular supply of fresh fruits and vegetables from the Mandi city after every three days. Very few households make mango and lemon pickle (*Fig. 22*). Some of the households use drying technique to store their food, for example Black Pulses is stored as '*Badi*' (*Fig. 20*) and wheat is stored as '*Sira*' (*Fig. 21*).

## 4.2 Summary of visit to Kathindi and Kamand

We interviewed around 5 people in Kathindi and Kamand. We asked them questions from our questionnaire. After interviewing them we learned that food preservation is not that common as we hoped. They come under previously stated stakeholders (1.b). Their food source is mainly from their own field and periodic supply from Mandi (10 Kms). Modern technology like refrigerator has become a part of their daily life so they don't have to worry about short term food preservation. Most of the fruits, vegetables and dairy products can be stored for few days through it.

But still few of the most common food preservation methods such as pickle making and drying are in use. Drying of potato chips & pickles of mango, amla, lemons carrots are common. We got to know few very peculiar techniques used for certain vegetables and flowers. Some of the vegetables like ladyfinger, arvi (*colocasia esculenta*), bitter gourd which are seasonal vegetables are dried and used almost throughout the year. This becomes really helpful as these vegetables are grown at large scale. Buraha and mandal (kodra) are some of the flowers whose juice is made and preserved for the whole year. Vanakshan flower which is found in upper areas is dried and stored. Along with this on daily basis few simple techniques are used to reduce wastage of food such as extra flour (after adding water) is left for fermentation and can be eaten afterwards as bread ( '*double roti*').

Thus we got to know few interesting methods of food preservation but still the entrance of refrigerators (and being a power surplus state) has taken place of most of the traditional methods. But some the villagers did ask us to inform them if we can find any efficient method of preserving cucumbers which is grown here in abundance.

### 4.3 Summary of discussion with the Kamand workers

On discussion with the Kamand workers living in Nehari, we came know about various traditional food preservation techniques prevailing in their village. We interviewed around 12 workers (*Fig. 31*). One of these methods is to store the wheat in the form of '*Sira*'. In this process the wheat is first kept in the water for few days and then it is grinded and dried in the sun for around a week. This '*Sira*' is used for about six months.

One of the other method is to store pulses as '*Badi*'. In this process, first the mixture of '*Pethu*' and '*Urad Dal*' is grinded in the mixer. The mixture is then sun dried after giving a particular shape and size for about 10-12 days. Then the dried '*Badi*' is kept in closed containers and can be used for a year.

Some of the common methods are the making pickles of Amla, Mango, Chilli and Raddish. The food grains grown in their own farms are being stored in dry containers for later use. Some of the common food grains stored in this way are wheat, maize, and rice. Food grains stored in this way can be used for about a year. Vegetables like potato, '*Chakalu*', '*Arbi*' are dried and stored for about four months. Milk products are stored in the form of Paneer, Ghee, '*Khoya*', '*Barfi*'.

### 4.4 Summary of visit to HPMC, Shimla

A couple of people were interviewed at the HPMC shop located at the old ISBT of Shimla. They told us about a variety of techniques being used to store the fruits for a longer time. Some of the products available in the shop were Plum & Aloe vera Drink (*Fig. 25*), Mango & Mixed Pickle (*Fig. 26*), Peach Halves in Syrup (*Fig. 27*), Apple Jam (*Fig. 28*), Lemon & Litchi Squash (*Fig. 29*).

#### 4.5 Relevant Pictures of the survey conducted in Himachal Pradesh



**Figure 9:** *Interviewing a local resident in Kataula*



**Figure 10:** *Interviewing a local shopkeeper in Kataula*



**Figure 11:** *A view of the Kataula village*



**Figure 12 & 13:** *Local households in Kataula village*



**Figure 14:** *View of Garlic, Wheat and Potato being grown in the Kataula village*



**Figure 15 & 16:** *Maize being stored in metal containers*



**Figure 17:** *Metal containers to store food grains in the house of a local resident*



**Figure 18 & 19:** *Fruits and vegetables in a local shop in Kataula*



**Figure 20:** *Black pulses stored as 'Badi'*



**Figure 21:** *Wheat stored as 'Sira'*

**Figure 22:** *Mango being stored as Pickle*





**Figure 23:** HPMC shop in Shimla



**Figure 24:** Inside view of the HPMC shop



**Figure 25:** Plum and Aloe Vera Drink



**Figure 26:** Mango and Mixed Pickle



**Figure 27:** Peach Halves in Syrup



**Figure 28:** Apple Jam



**Figure 29:** Lemon and Litchi Squash



**Figure 30:** *Interviewing a local resident of Kathindi village*



**Figure 31:** *Discussion with the workers in Kamand Campus living in Nehari*

## 4.6 Summary of visit to a vineyard in Germany

The Vineyard is named “*Daniel Bach*” (Also the name of the wine produced (*Fig. 32*)) and is located in Cochem (Rhineland-Palatinate, Germany). It is a young winery with 1.5 hectares of vineyards. We were lucky to have been a part of the tour through the winery by its owner (Mr. Werner Bach).



**Figure 32:** *A view of the vineyard and vines planted in front of the vineyard*

We came to know that temperature and climate play an important role in growing vine, ideal temperatures being around 15 degrees Celsius in summers and 3 degrees in winters. If temperature falls down in winters(during snowfall), the crop can be injured. After the tour, we finally interviewed the owner to get to know about how wine is fermented, how can it get spoilt and how do they preserve it.

After the juice is extracted from the vine grapes, yeast is added and the mixture is stored in large stainless steel tanks (*Fig. 37*) with temperature control. Yeast converts sugar into alcohol and this process is called Fermentation (*Fig. 34*). We also came to know that winemakers usually experiment with the type of yeast to get a different or better tasting wine. Fermentation period is different for different types of wines, for e.g. Typical white wine is usually fermented for 3 weeks (at 17 degree Celsius) and red wine for 10 days (at 30-35 degree Celsius).

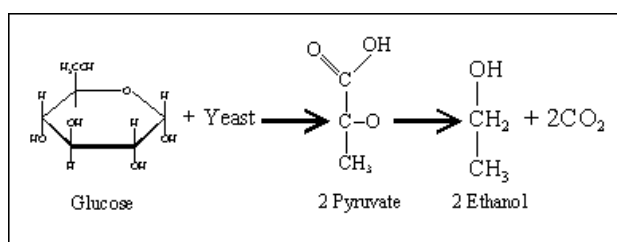
After fermentation, wine is stored for a few months before it is finally bottled. During this storing period it is important that it is not exposed to oxygen, which will cause the wine to flatten after a few days of exposure to oxygen, turning it into vinegar (*Fig. 35*).

To prevent this, wine is kept away from atmospheric exposure, which is created by pumps that suck all oxygen occupying the empty space in the container and creates a partial vacuum. We were also informed that in several other vineyards, gases like Nitrogen and Argon are used instead of Vacuum, which completely eliminates the risk of oxidization.

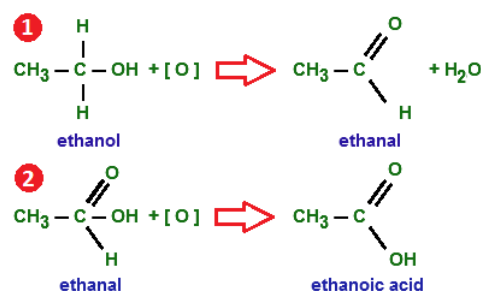
After the wine is bottled and the bottle is corked, which also prevents oxidation. An opened bottle of wine would last a day or two, after which similar practices have to be performed in order to keep the flavour and taste intact. On further investigation, we found out that there are manual pumps available in the market which is specifically used to vacate the oxygen present in the bottle of the wine so that a bottle of wine lasts longer.



**Figure 33:**  
Wine tasting  
the wine from  
the vineyard



**Figure 34:** Fermentation Reaction



**Figure 35:** Effect of oxidation on Wine



**Figure. 36:** *During the tour through the vines*



**Figure 37:** *Stainless steel drums used to Ferment wine*



**Figure 38:** *Wine storage in bottles*



**Figure 39:** *A mini shop on the vineyard*

## 4.7 Summary of visit to Technology Resource Centre, Nagwain

Two of our team members visited society for technological development, Nagwain, Kullu and Aut. At the society for technological development, they told us about the new methods used in bottling of different juices like apple, brass etc. and pickling. There were many farmers and old women working there. We tried to interview them to find



traditional way to preserve food. Since rice is the main food in Himachal Pradesh its preservation comes naturally to people. They told us two main methods. First, the rice left after consumption of traditional Dhaam dish is dried in sun so that it becomes solid again. This rice is boiled again the following day for further consumption. Second, if the rice is not fit for consumption then they can be made into Lugdi. It is done by mixing rotten rice with yeast which is commonly available in the market. It is left for a day or more to ferment. Then it is grinded to form a drink. The specialty of this drink is that it helps farmers to stay cool in summer and protects them from sun strokes.

One of the women told us about that instead of using sodium benzoate (preservative), they use more rai which acts as a natural preservative. And they also have unique way for preserving raw pulses for longer periods, in which they rub the pulses with mustard oil which protects it from pests and fungus. And they also treat the utensils in which these are kept, with smoke of red '*mirchi*'. It helps in longer preservation. We came to know about Kodra which doesn't rot for months and is used in making biscuits. Such biscuits can be kept for months without any added artificial preservative. And for keeping the wheat preserved for longer periods, people here use '*neem*' leaves, Safeda leaves and Derek leaves, which protect it from rotten and pests. One local lady went on the length to describe a traditional technique of cooling when refrigerators were not there. The vessel containing food is kept in another vessel containing water and left for overnight. This water loses heat to the atmosphere due to radiation which is at  $-50^{\circ}\text{C}$ . However this method works only if the wind speed is less otherwise convection becomes major heat exchanging process.

After talking to all the farmers and local people, Mr. Karam Chandra showed us around the facility which is a fusion of traditional and modern techniques. They make fruit and flower juice, pickles, carbonated drinks and kodra biscuits. They are making all these items through modern machines and technology. However there is touch of traditional methods everywhere. Pickle is made by old women of village. They have their traditional recipe along with oils and spices.

We interacted with some dry fruits vendors in Aut. They told us that all the fruits were procured from the local farmers and then sun dried for a week to make dry fruits. But before drying they are chopped into thin chips, soaked in salt solution.

#### 4.8 Relevant Pictures of the survey conducted in Nagwain



**Figure 40 & 41:** *Some of the equipments used for food processing*



**Figure 42 & 43:** *Some of the equipments used for food processing*



**Figure 44 & 45:** *Equipment used for food processing (Left: Equipment used in freezing), (Right: Boiler to heat the water to sterilise the bottles)*



**Figure 46 & 47:** Some of the preserved food products (Left: dried Apricot), (Right: Lemon prepared for making pickle)



**Figure 48 & 49:** Some of the preserved food products (Left: Mixed Veg Pickle), (Right: Dried Apple chips)



**Figure 50:** Preserved food products



**Figure 51:** Packaging of juice bottles



**Figure 52 & 53:** *Interaction with the workers of the industry*



**Figure 54:**

*Trays used for drying potato chips*



**Figure 55:**

*Visit to Technology  
Resource Centre,  
Nagwain*

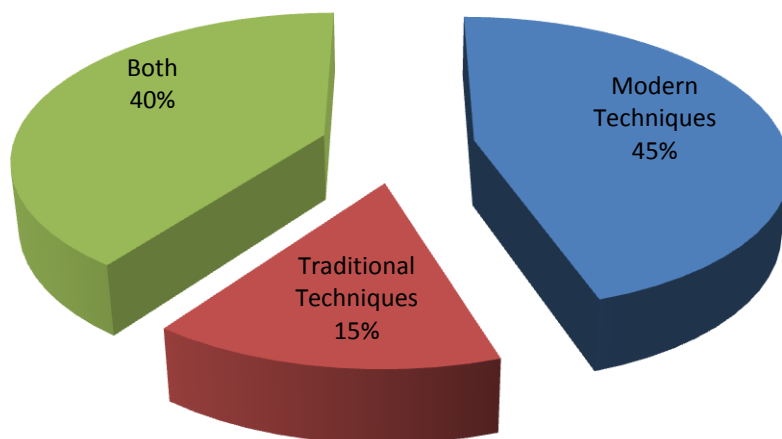
## 4.9 Discussion about the data collected

Based on the surveys conducted and data collected, many important conclusions can be drawn. The survey revealed many surprising facts. In spite of severe climatic variations, there is very little preservation done. Most of the people interviewed in nearby villages replied that there is no need of preserving food since these villages are well connected to the main Mandi city and there is a regular supply of fruits and vegetables from the Mandi city. Since both are small villages with limited population they generally produce whatever they can consume leaving no scope for food preservation. They come under previously stated stakeholders (section 2.2.b of the literature review). Owing to the availability of water throughout the year, there is a general trend of growing vegetables like potato, peas, onion, garlic in the village farms itself and consuming them within few days. Food grains like maize and wheat are also produced in the village itself and they are generally stored in metal containers for longer use. The data collected clearly reveal that the use of traditional food preservation techniques in cities and nearby villages (which are well connected to the main city) is depleting and people are moving towards the modern easy to use preservation techniques like use of refrigerator.

Some of the traditional techniques (out of the techniques listed in the background section of the literature review) which are still being commonly used in these villages are pickling and canning. As described in the background section of the literature review, Fermentation is a traditional technique being used even today in many parts of the world. The survey conducted in the vineyard clearly justifies the fact that Fermentation is still being used in wine production. Fermentation is the heart of wine production.

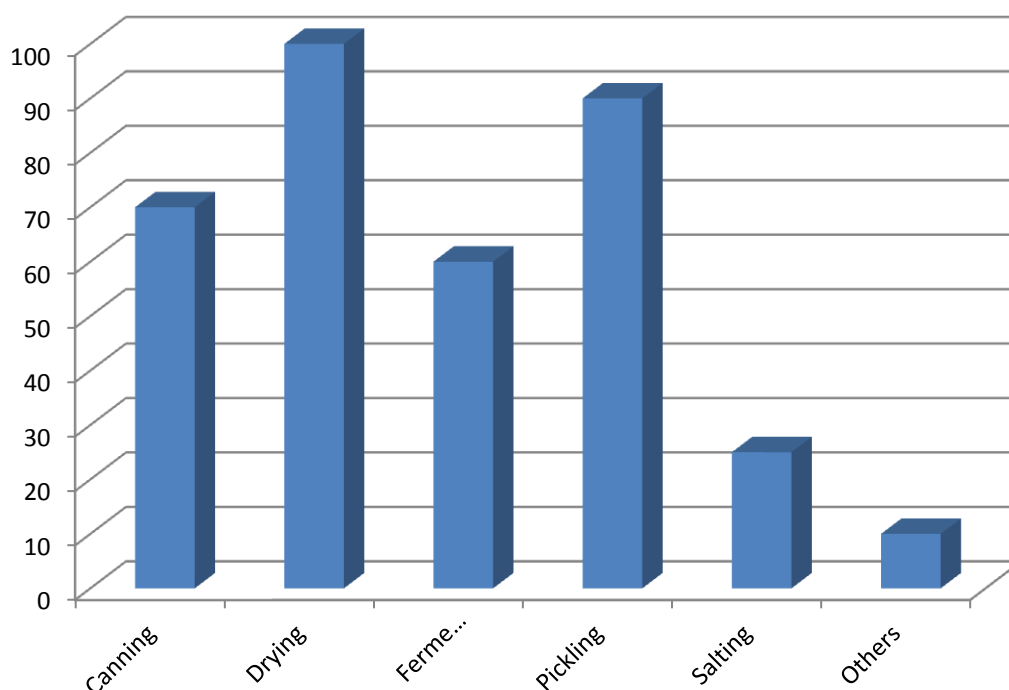
It will not be incorrect to say that people are more judicious now in terms of food production and consumption which reduces the need for preservation in these areas. As the living standard of the people is improving, they are more attracted towards the modern, easy to use and efficient techniques and saying 'good-bye' to the traditional techniques which were once an integrated part of the lives of common people.

### Proportion of usage of food preservation techniques in Himachal Pradesh



**Chart 1:** *Proportion of usage of food preservation techniques in Himachal Pradesh*

### Proportion of people using different techniques



**Chart 2:** *Proportion of people using different techniques*

## **Ch-5: SCIENTIFIC UNDERSTANDING**

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After the data collection about traditional food preservation techniques from various stakeholders, we now move on to the next phase of our project i.e. scientific understanding. In this section we will try to understand the scientific reasons behind traditional methods of food preservations. We will try to understand the mechanisms behind each traditional method. After grouping of each mechanism we can then easily represent the vast data about preservation in simplistic form which can be easily understood by common person or stakeholder. In these mechanisms we will not only try to understand scientific mechanism but also seasonal applications, time dependencies of the traditional preservation methods.

Food preservation usually involves preventing the growth of fungi (such as yeasts), bacteria or any other micro-organisms, as well as retarding the oxidation of fats that cause rancidity. Food preservation can also include processes that inhibit visual deterioration, such as the enzymatic browning reaction in apples after they are cut, which can occur during food preparation.

Maintaining or creating nutritional value, texture and flavour is an important aspect of food preservation, although, historically, some methods drastically altered the character of the food being preserved. In many cases these changes have come to be seen as desirable qualities – cheese, yoghurt and pickled onions being common examples.

Now let's have a look at science behind common traditional food preservation techniques.

### **5.1 Pickling**

Pickling is the process of preserving food by anaerobic fermentation in brine or vinegar. The resulting food is called a pickle. This procedure gives the food a salty or sour taste. In South Asia, vinaigrette (vinegar and vegetable oil) are used as the pickling medium. Typical pickling agents include brine (high in salt), vinegar, alcohol, and vegetable oil, especially olive oil but also many other oils. Commonly made pickles are: Mango, Cucumber, Green Chilli, Lemon, 'Amla'.

Another distinguishing characteristic is a pH less than 4.6, which is sufficient to kill most bacteria. Pickling can preserve perishable foods for months. Antimicrobial herbs and

spices, such as mustard seed, garlic, cinnamon or cloves, are often added. If the food contains sufficient moisture, a pickling brine may be produced simply by adding dry salt. Natural fermentation at room temperature, by lactic acid bacteria, produces the required acidity. Other pickles are made by placing vegetables in vinegar. Unlike the canning process, pickling (which includes fermentation) does not require that the food be completely sterile before it is sealed. The acidity or salinity of the solution, the temperature of fermentation, and the exclusion of oxygen determine which microorganisms dominate, and determine the flavour of the end product. (Source: Wikipedia)

When both salt concentration and temperature are low, “*Leuconostoc mesenteroides*” dominates, producing a mix of acids, alcohol, and aroma compounds. At higher temperatures “*Lactobacillus plantarum*” dominates, which produces primarily lactic acid. Many pickles start with “*Leuconostoc*”, and change to “*Lactobacillus*” with higher acidity. (Source: Wikipedia)



**Figure 56:** Home- made Pickles

### **Pickling Process:**

In chemical pickling, the jar and lid are first boiled in order to sterilize them. The fruits or vegetables to be pickled are then added to the jar along with brine, vinegar, or both, as well as spices, and are then allowed to ferment until the desired taste is obtained.

The food can be pre-soaked in brine before transferring to vinegar. This reduces the water content of the food which would otherwise dilute the vinegar. This method is particularly useful for fruit and vegetables with high natural water content.

In commercial pickling, a preservative like sodium benzoate or EDTA may also be added to enhance shelf life. In fermentation pickling, the food itself produces the preservation agent, typically by a process involving “Lactobacillus” bacteria that produce lactic acid as the preservative agent.

### **Health benefits/hazards:**

Traditionally manufactured pickles are source of healthy probiotic microbes, which occur by natural fermentation in brine, but pickles produced using vinegar are not probiotic. (Source: *"Naturally Fermented Dill Pickles". Mark's daily apple*) Beneficial bacteria grow in salt water and sour mixture and make traditional pickle probiotic. (Source: *"Top 9 powerful probiotic foods". Sprouts- farmers market*).

The World Health Organization has listed pickled vegetables as a possible carcinogen, and the British Journal of Cancer released an online 2009 meta-analysis of research on pickles as increasing the risks of esophageal cancer. The report cites a potential two-fold increased risk of oesophageal cancer associated with Asian pickled vegetable consumption.

## **5.2 Canning**

Canning is an important, safe method for preserving food if practiced properly. Canning involves cooking food, sealing it in sterile cans or jars, and boiling the containers to kill or weaken any remaining bacteria as a form of sterilization. Foods have varying degrees of natural protection against spoilage and may require that the final step occur in a pressure cooker.

We generally think of "cans" as being metal, but any sealable container can serve as a can. Glass jars, for example, can be boiled and sealed. So can foil or plastic pouches and boxes. Milk in a box that you can store on the shelf is "canned" milk. The milk inside the box is made sterile (using ultra high temperature (UHT) pasteurization) and sealed inside the box, so it does not spoil even at room temperature.



**Figure 57:** Food preserved using canning

### **Canning Process:**

The canning process involves placing foods in jars or similar containers and heating them to a temperature that destroys micro-organisms that cause food to spoil. During this heating process air is driven out of the jar and as it cools a vacuum seal is formed. This vacuum seal prevents air from getting back into the product bringing with it contaminating micro-organisms.

There are two safe ways of processing food, the boiling water bath method and the pressure canner method:

- The boiling water bath method is safe for tomatoes, fruits, jams, jellies, pickles and other preserves. In this method, jars of food are heated completely covered with boiling water (212°F at sea level) and cooked for a specified amount of time
- Pressure canning is the only safe method of preserving vegetables, meats, poultry and seafood. Jars of food are placed in 2 to 3 inches of water in a special pressure cooker which is heated to a temperature of at least 240° F. This temperature can only be reached using the pressure method. A microorganism called "*Clostridium botulinum*" is the main reason why pressure processing is necessary. Though the bacterial cells are killed at boiling temperatures, they can form spores that can withstand these temperatures. The spores grow well in low acid foods, in the absence of air, such as in canned low acidic foods like meats and vegetables. When the spores begin to grow, they produce the deadly "*botulinum*" toxins(poisons).

### **Problems associated with Canning:**

Food preserved by canning or bottling is at immediate risk of spoilage once the can or bottle has been opened. Lack of quality control in the canning process may allow ingress of water or micro-organisms. Most such failures are rapidly detected as decomposition within the can causes gas production and the can will swell or burst. However, there have been examples of poor manufacture (underprocessing) and poor hygiene allowing contamination of canned food by the obligate “anaerobe *Clostridium botulinum*”, which produces an acute toxin within the food, leading to severe illness or death. This organism produces no gas or obvious taste and remains undetected by taste or smell. Its toxin is denatured by cooking, however. Cooked mushrooms, handled poorly and then canned, can support the growth of “*Staphylococcus aureus*”, which produces a toxin that is not destroyed by canning or subsequent reheating.

Canned food can be a major source of dietary salt (sodium chloride). Too much salt increases the risk of health problems, including high blood pressure.

### **5.3 Fermentation**

Fermentation in food processing is the conversion of carbohydrates to alcohols and carbon dioxide or organic acids using yeasts, bacteria, or a combination thereof, under anaerobic conditions. Fermentation is a metabolic process that converts sugar to acids, gases and/or alcohol. It occurs in yeast and bacteria, but also in oxygen-starved muscle cells, as in the case of lactic acid fermentation. Fermentation is also used more broadly to refer to the bulk growth of microorganisms on a growth medium. Fermentation usually implies that the action of microorganisms is desirable.

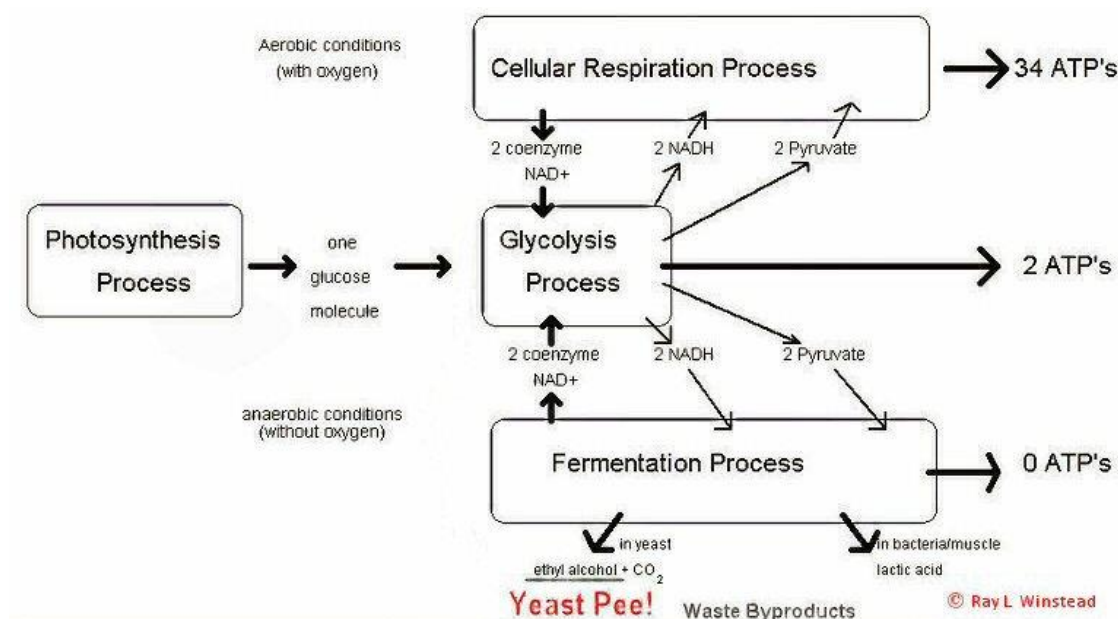
The term "fermentation" is sometimes used to specifically refer to the chemical conversion of sugars into ethanol, a process which is used to produce alcoholic beverages such as wine, beer, and cider. Fermentation is also employed in the leavening of bread (CO<sub>2</sub> produced by yeast activity); in preservation techniques to produce lactic acid in sour foods such as sauerkraut, dry sausages, kimchi, and yogurt; and in pickling of foods with vinegar (acetic acid). (Source: Wikipedia)

Food fermentation has been said to serve five main purposes:

- Enrichment of the diet through development of a diversity of flavors, aromas, and textures in food substrates
- Preservation of substantial amounts of food through lactic acid, alcohol, acetic acid, and alkaline fermentations
- Biological enrichment of food substrates with protein, essential amino acids, and vitamins
- Elimination of antinutrients
- A decrease in cooking time and fuel requirement

### **Fermentation Process:**

Fermentation takes place in the absence of oxygen (when the electron transport chain is unusable) and becomes the cell's primary means of ATP (energy) production. It turns NADH and pyruvate produced in the glycolysis step into NAD<sup>+</sup> and various small molecules (see examples below). In the presence of O<sub>2</sub>, NADH and pyruvate are used in respiration; this is oxidative phosphorylation, it generates a lot more ATP in addition to that created by glycolysis, and for that reason cells generally benefit from avoiding fermentation when oxygen is available. Exceptions include obligate anaerobes, which cannot tolerate oxygen. (Source: Wikipedia)

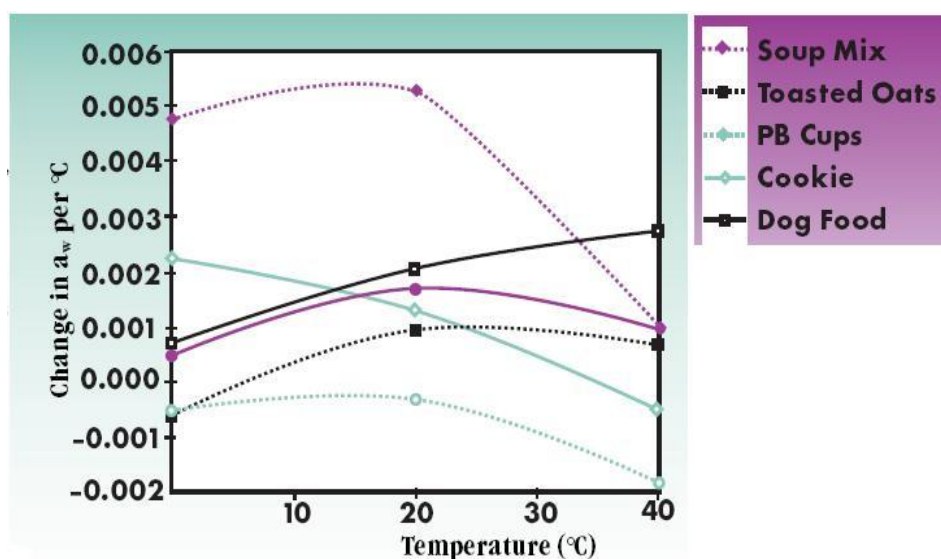


**Figure 58: Fermentation in yeast**

## 5.4 Food preservation methods related to water activity

### Water activity

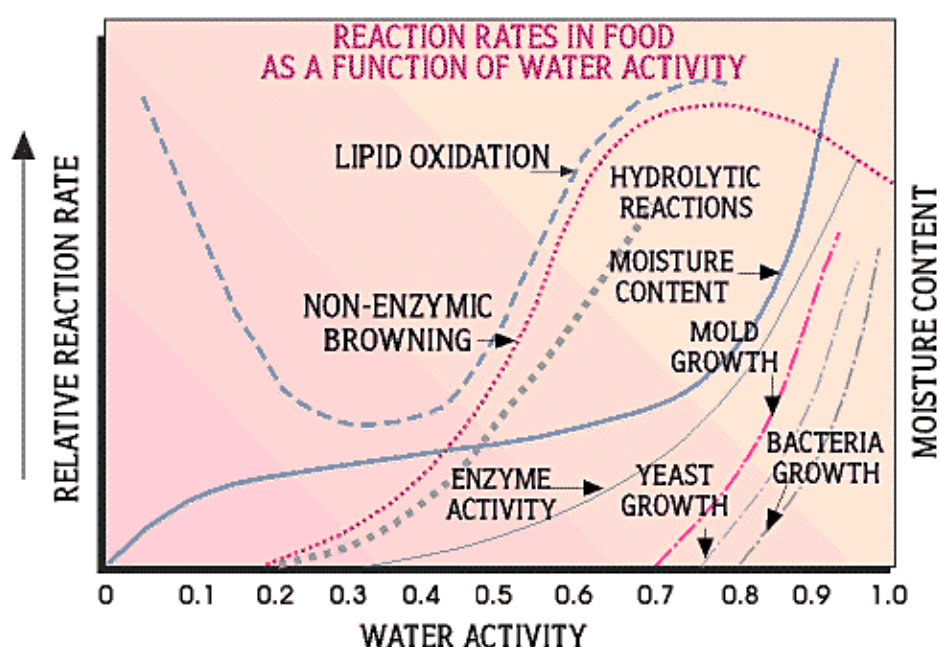
Relationship between water content of food and its perishability does exist. Concentration and dehydration processes decrease the water content of food and results in decrease in perishability of the food which leads to increase in life of the food product. But regardless of these facts various types of food with the same water content differ significantly in perishability, i.e., water content alone is not a reliable indicator. We need to consider the difference in the intensity with which water is associated with non-aqueous constituents. Thus the term water activity ( $a_w$ ) was developed to reflect the intensity with which water associates with non-aqueous constituents. Water activity ( $a_w$ ) correlates well with rates of microbial growth and rates of many degradative reactions a useful indicator of product stability and microbial safety. Higher  $a_w$  substances tend to support more microorganisms. Bacteria usually require at least 0.91, and fungi at least 0.7.



**Figure 59:** Water activity in different food products at different temperature

## Water activity and reaction rate

Water activity manipulates microbial degradation as well as enzymatic and chemical reactivity. It has a profound effect on the rate of many chemical reactions in foods and on the rate of microbial growth. Water influences chemical reaction by acting as a solvent, adsorbent, absorbent, reactant and in many other ways. Water activity influences reaction rates of lipid oxidation, hydrolytic reactions, mold growth, bacteria growth, yeast growth, enzyme activity, non-enzymic browning which are shown in the below diagram. To say generally when the water activity level is decreases, the rate of chemical degradative reactions decreases.



**Figure 60:** Reaction rates in food vs Water Activity

## Water activity and food spoilage:

Moisture content and water activity affect the progress of chemical and microbiological spoilage reactions in foods. Dried or freeze-dried foods, which have great storage stability, usually have water contents in the range of about 5% to 15%. Intermediate moisture foods (e.g. dates, cakes) have moisture contents in the range of about 20% to 40%. Reduction of water activity can be obtained by drying or by adding water soluble substances, such as sugar to jams or salt to pickled preserves. Bacterial growth is virtually

impossible below a water activity of 0.9, which helps during food preservation. Molds and yeasts are usually inhibited between 0.88 and 0.8 water activity. Most enzymes (amylases, phenoloxidas and peroxidases) are inactive when the water activity falls below 0.85. However, lipases may remain active at values as low as 0.3 or even 0.1. The manner in which components of food system are put into contact significantly influences the enzyme activity such as separation of substrate and enzyme could greatly retard the reaction. Enzymatic reactions such as nonenzymic browning or Maillard reactions are one of the most important factors causing spoilage in foods. These reactions are strongly dependent on water activity and reach a maximum rate at values of 0.6 to 0.7. Browning of milk powder kept at 40°C for 10 days results in loss of lysine causes the color change. Browning reactions are usually slow at low humidity values.

#### 5.4.1 Salting

Salting is a one of the most widely used food preservation method used since ancient times. In salting food to be preserved is covered with salt. As the concentration of the salt considering water as a solvent is very high at outside salt covered body which is almost 1 than inside the body of the food. This creates concentration gradient between these two parts leading to mass transfer of water molecule from body cells of the food to outside of the body, this process is known as osmosis. It reduces the water content of the food product. Reduced water content of the food product results in the reduction of the overall water activity of food product. It prevents various biochemical and enzymatic reactions and microbial growth. This prevents the spoilage of the food product.



**Figure 61:**

*Food preserved using salting*

### **5.4.2 Drying**

Drying is the process of preserving food by removing water from it. Drying foods is done by various methods like sun drying, air drying, heat drying, and wind drying, or drying near an open fire. Removing water prevents decay and the growth of microorganisms. This method of food preservation has been known since ancient times.

Principle of drying is based on water activity, lesser the water activity more will be the life of the food product. Dehydration reduces the water content of the food products leading to reduction in water activity, hence more food product life.

#### **Benefits of drying**

Molds, yeast and bacteria need water to grow. When foods are sufficiently dehydrated (dried) microorganism cannot grow and foods will not spoil. Dried fruits and fruit leathers may be used as snack foods; dried vegetables may be added to soups, stews or casseroles. Campers and hikers value dried foods for their light weight, keeping qualities and ease of preparation.

#### **Nutritional values**

Dried fruits are a good source of energy because they contain concentrated fruit sugars. Fruits also contain a rather large amount of vitamins and minerals. The drying process, however, destroys some of the vitamins, especially A and C. Exposing fruit to sulphur before drying helps retain vitamins A and C. Sulphur destroys thiamine, one of the B vitamins, but fruit is not an important source of thiamine anyway. Many dried fruits are rich in riboflavin and iron.

Vegetables are a good source of minerals and the B vitamins thiamine, riboflavin, and niacin. Both fruits and vegetables provide useful amounts of the fiber (bulk) we need. Save the water used for soaking or cooking dried foods because this nutrient-rich water can be used in recipes to make soups, sauces, and gravy.



**Figure 62:** *Food preserved using drying*

### **5.4.3 Freezing and refrigeration**

Refrigeration and freezing are probably the most popular forms of food preservation in use today. In the case of refrigeration, the idea is to slow bacterial action to a crawl so that it takes food much longer (perhaps a week or two, rather than half a day) to spoil. In the case of freezing, the idea is to stop bacterial action altogether. Frozen bacteria are completely inactive. Basic principle of the freezing and refrigeration are same. Freezing and refrigeration reduces water activity as well as reduced temperature reduces or stops many biochemical processes and bacterial, fungal growth.



**Figure 63:** *Deep-freezing if the food is to be stored for a longer time*



**Figure 64:** *Refrigeration if the food is to be stored for a short time*

### **Textural changes during Freezing and refrigeration**

Water makes up over 90 percent of the weight of most fruits and vegetables. This water and other chemical substances are held within the fairly rigid cell walls which give support structure, and texture to the fruit or vegetable. Freezing fruits and vegetables actually consists of freezing the water contained in the plant cells. When the water freezes, it expands and the ice crystals cause the cell walls to rupture. Sometimes freezing may cause changes in foods that make the product unacceptable such as destabilization of emulsions, flocculation of proteins, increase in toughness of fish flesh, loss of textural integrity and increase in drip loss of meat.

### **Chemical changes during Freezing and refrigeration**

The chemical changes that can take place in frozen products is the development of rancid oxidative flavors through contact of the frozen product with air. This problem can be controlled by using a wrapping material which does not permit air to pass into the product. It is also advisable to remove as much air as possible from the freezer bag or container to reduce the amount of air in contact with the product.

## **Ch-6: RECOMMENDATIONS and CONCLUSION**

### **Recommendations:**

The results of this study raised some questions that we as researchers were not in a position to answer. The major question is that why people are more attracted towards the modern preservation techniques inspite of many harmful side-effects of the artificial preservatives used in modern preservation techniques. Why the use of traditional techniques is decreasing, inspite of their many useful features like easy to use, cheaper, eco-friendly, no side-effects if used judiciously.

According to us, the use of traditional food preservation among common people should be motivated via awareness campaigns, seminars, newspaper articles. and new industries should be set up which would help a lot in promoting traditional methods. The traditional techniques can be modified, by introducing technological interventions wherever possible, which will be beneficial not only for the common people and government but also our future generations.

### **Conclusion:**

Food preservation has been and will continue to be a vital part of the life of the common people. It reduces the wastage of a large amount of food all around the globe. By conducting surveys we have evaluated aspects of food preservation and its necessity in Himachal Pradesh. We have explored traditional food preservation techniques prevalent in the state. We can easily estimate the inevitability of food preservation in a state like Himachal Pradesh where such large climatic variations persist. Consequently there was a need to study these food preservation techniques and try to modify them, so that food can remain healthy and nutritious for a longer time without deteriorating its quality.

Our project focused primarily on studying the traditional food preservation methods prevailing in Himachal Pradesh and then trying to understand the scientific reasoning hidden behind these techniques, which gave us a much deeper insight into these techniques.

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## Appendix 1: Sample Community Questionnaire

City/Village:	Age:	Gender: M    F	Household size:
<ol style="list-style-type: none"><li>1. How did you come to live here?</li><li>2. Do you live here permanently or do you come here on weekends?</li><li>3. How does the climate remains here throughout the year?</li><li>4. How is the connectivity of your village to the main city?</li><li>5. What are the sources from where you acquire your food?</li><li>6. For how long you have been using these sources?</li><li>7. Do you preserve some of the food/fruits?</li><li>8. What is your motivation for preserving food?</li><li>9. Which technique do you frequently use to preserve your food?</li></ol>			

10. How did you learn this technique?

11. What are the exact processes of these techniques?

12. How is your experience with food preservation?

13. With whom do you preserve your food, individually or in groups?

14. How much do you typically preserve?

15. What are your future plans for preserving food?

16. Food preservation has changed how you think about food?

17. According to you, what role might preserving play in the food system nationally?