A Field Project Report

On

Foam Mat Drying of Tomato Pulp

Submitted by

Vanga Priyanka	**201FB12014**
Vemula Harisai	**201FB12005**
K Tarun Kumar	**201FB12004**

Under the guidance of

Dr. Sandeep Singh Rana
Assistant Professor
Department of Food Technology

Division of Food Technology

Department of Chemical Engineering

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be UNIVERSITY)
-Estd. u/s 3 of UGC Act 1956

(ACCREDITED BY NAAC WITH "A+" GRADE)

VADLAMUDI, GUNTUR-522213, AP, INDIA

2021

CERTIFICATE

This is to certify that project reported titled **"Foam Mat Drying of Tomato Pulp"** Submitted by **Vanga Priyanka (201FB12014)**, **Vemula Harisai (201FB12005)**, and **K Tarun Kumar (201FB12004)** are carried out as field project work under my supervision. I approve this field project work for submission towards partial fulfilment of the requirements and course work in as prescribed for M. Tech- Food Technology, VFSTR (Deemed to be University).

Project Guide

Head of the Department

ABSTRACT

The experiments were conducted to study the effect of microwave power on foam-mat drying of tomato pulp and also to study the effect of quality attributes of foamed tomato pulp and egg albumin mixture in microwave assisted foam-mat drying. Samples were prepared by using of tomato pulp and 10% of egg albumin as foaming agent and whipping for 5 minutes with 10mm thick layer of foamed tomato pulp was spread on a tray and dried in drier at different microwave power levels at an inlet air temperature at 45°C.

By the increase of microwave power there is a dehydration of foam and it is observed that drying time of tomato is reduced to 15-16 times if it is a foam-mat drying than simple foam-mat drying. There are many adverse effects like color, acidity and pH of product, retention of ascorbic acid is better to foam-mat drying than samples dried in air condition foam-mat drying.

1.0 Introduction

Drying is a mass transfer process consisting of the removal of water by evaporation. It is the most used processes to improve food stability because it considerably reduces the water activity of the material, reduces the microbiological activity and minimizes physical and chemical alterations during storage.

Foam Mat Drying: Dehydration of heat sensitive, high sugar content and viscous foods, which are difficult to dry and sticky under relatively mild conditions. Liquid food should be capable of forming stable foam.

Principle of Foam Mat Drying is the transformation of products from liquid to stable foam followed by air drying. Stable gas liquid foam is primary condition for successful foam drying. Proteins, gums and various emulsifiers are used as foaming agents. Mixtures are whipped to form stable foams using blender or specially designed device.

The foam is then spread as a thin sheet or mat and exposed to stream of hot air until it is dried to desired moisture content. Drying at relatively low temperatures to form a thin porous honeycomb sheet or mat, which is disintegrated to yield a free flowing powder. Capillary diffusion is also the main reason for the moisture movement within the product.

The formation of foams is generally by the following three methods:

Sparing or bubbling: a known amount of air is bubbled through an orifice into a known quantity of liquid. Liquid may be completely converted to foam if a large amount of gas is introduced. The stability of the bubble formed highly depends on the viscosity of the liquid.

Shaking: Foam is obtained by agitating the liquid vigorously. The volume of the foam formed by shaking depends on the factors like the amplitude and frequency of shaking, shape of the container, the volume, protein content and temperature of the liquid.

Drying by foam is a process which a liquid is beaten by various means to form stable foam that is then dehydrated by evaporation of the water in the form of thin layer. The main advantages of foam drying are lower temperatures and shorter drying times compared to drying non - foamed materials.

Foam has these advantages because it increases the surface area by the incorporation of air, increases the heat and mass transfer and forms a porous structure that provides an instantaneous dry product with high quality. Foaming properties include the capacity of formation of an air in water dispersion, which is due to the volume expansion of the dispersion promoted by an emulsifier with incorporation of air through whipping, agitation techniques. Egg albumin is an example of an efficient foaming agent that has been used in various studies.

Fruits and vegetables pastes/Juices

⇩

Addition of foaming agents and foam stabilizers

⇩

Whipping/induction of foams

⇩

Spreading of foams in trays/drying in drier

⇩

Scrapping from trays/milling to develop powders

⇩

Packaging

Flow chart of Foam mat dryer

Food is a basic need for human beings which is required to get energy to do our daily activities. Fruits and vegetable are agriculture crops which are grown in surplus amount during their season. A large proportion of fruits and vegetables get wasted of due to lack of proper processing and storage. There are different types of food materials which are grouped in different categories namely perishable, nonperishable, raw foods, fermented foods. All these foods have their different shelf life. Raw food materials after a period start spoilage, which is caused by different microbial, physical and chemical agents. All the fruits and vegetables are very perishable, containing higher amount of water. Water is a main source for the bacterial growth and proliferation. Water present in food also takes part in different chemical reactions such as oxidation and non-enzymatic browning. Enzymatic and microbial activity also base on water availability. It can remove or lower the water contents in our foods to make it unavailable for different kind of organisms which cause food spoilage. Fruits and vegetables have only few days shelf life after harvest. After few days they are subjected to microbial and enzymatic spoilage which result into off flavor and color. Drying is a primary process to preserve different fruits and vegetables. In drying fruits and vegetables are subjected to heat, which lowers the water contents of fruits and vegetables and reduces the growth of different enzyme and microbes and increases the product stability. Moreover by drying product volume is decreased and it reduces the cost of packaging, transportation and storage. There are different drying method such as direct sun drying, solar augmented drying, freeze drying, microwave drying, vacuum drying, infrared drying. Selection of a suitable drying method is very important in cost and final quality of the dried product. Some of these drying method need of high installment, energy expenses make them not suitable. Many compounds in the fruits and vegetables are very sensitive to temperature. Foam-mat drying is a new and very suitable drying technique which have high drying rate with minimum quality changes in our final product.

Foam-mat drying- In the drying of liquids foods containing higher amount of water, foam-mat drying is a new technique in the field of drying technology. It is a best suitable drying technique for those fruits and vegetable extracts which are very sensitive to heat and those which are viscous, sticky and difficult to dry. With this technique a large range of food materials (e.g. Milk, vegetables puree, fruit juices, soluble coffee etc.) are dried without quality changes. Foam-mat drying is a technique by which aqueous food concentrates are air dried at lower temperature to lower the moisture contents in food and form a stable honey comb like porous sheet which is milled to form powders. In the foam-mat drying technique the surface area of the product which is to be dried increased by foam formation and time required for the drying of foamed product decreased than non-foam dried products. The product obtained from foam-mat drying process is better quality, porous and retain original properties when reconstituted .This drying technique is very cast effective and suitable for heat sensitive food components due to relatively fast drying, high quality and easily reconstitution of product.3 Foam-mat drying process developed by Morgan4 in the western regional research laboratory of USA in the Agriculture department. In this technique foamed food concentrates are dried by application of hot air at atmospheric pressure. It is reported that foam-mat drying method is coast effective than vacuum, spray drying and freeze drying methods.4 Foams Generally three methods used for formation of food foams. a) Sparager: In this method gas is introduced in liquid through porous sparager. All portion of liquid will be converted into foams if large amount of gas is incorporated. b) Whipping (Beating): In this method liquid is continuously agitated with specially designed devices. In this method of foam formation liquids are subjected to higher mechanical stress, shear and more uniform distribution of air in liquids as compare to sparager method.

2.0 Review of literature

In the drying of liquids foods containing higher amount of water, foam-mat drying is a new technique in the field of drying technology. It is a best suitable drying technique for those fruits and vegetables extracts which are very sensitive to heat and those which are viscous, sticky and difficult to dry. With this technique a large range of food materials are dried without quality changes. Foam-mat drying is a technique by which aqueous food concentrates are air dried at lower temperature to lower the moisture contents in food and form a stable honey comb like porous sheet which is milled to form powders. In the foam-mat drying technique the surface area of the product which is to be dried increased by foam formation and time required for the drying of foamed product decreased than non-foam dried products. The product obtained from foam-mat drying process is better quality, porous and retain original properties when reconstituted. This drying technique is very cast effective and suitable for heat sensitive food components due to relatively fast drying, high quality and easily reconstitution of product. Foam-mat drying process developed by Morgan4 in the western regional research laboratory of USA in the Agriculture department. In this technique foamed food concentrates are dried by application of hot air at atmospheric pressure. It is reported that foam-mat drying method is coast effective than vacuum, spray drying and freeze drying methods.

Foam –Mat drying of fruits and vegetables

Drying process: There are following steps of foam mat drying methods which are given below. Fruits and vegetable extracts or any liquid food material for drying. Addition of foaming agents, foam stabilizers and whipping to incorporate air in concentrate to develop stable foams .Spreading of foams in a tray and drying in dryer .Scrapping from trays and disintegration of porous mat to foam free flowing powders. As the process of foam mat drying developed by Morgan by which liquid and semisolid foods are dried to desired moisture level. In this process liquid concentrates are mixed with different foaming agents. Egg whit made of high quality proteins and used as foaming agent .Sharada et al., (2010) studied the foam-mat drying of tomato, guava and banana by using different concentration of (egg albumin, soy protein isolate) as foaming agent, using tray drier at 55°C to 80°C.

Investigated different drying parameters and found that by foaming treatment large amount of air is incorporated to make structure porous which decreased the drying time. Powder developed by this method has good quality and high reconstitution properties. It should be able to adsorb readily at the air-water interface, reduce interfacial tension, withstand thermal and mechanical agitation. Foaming agents should posses the following properties. Stabilize foams effectively and rapidly at low concentrations; Perform effectively over the pH range Perform efficiently in the medium with foam inhibitors such as fat, alcohol or flavor substances.The initial moisture content of tomato pulp-egg albumin foam was 14.52 g (H_2O/g d.m). Titratable acidity, ascorbic acid content and pH of fresh tomato pulp were 0.422%, 15.476 (mg/100 mL) and 4.15 respectively which changed to 0.358%, 13.095 (mg/100 mL) and 4.39 respectively when 10% egg albumin was added as foaming agent to the tomato pulp. This change in acidity and pH was because of the difference in the acidities and pH of tomato pulp and egg albumin. The ascorbic acid content of fresh tomato pulp reduce. On whipping, the proteins of egg white denature at the interface and interact with one another to form stable, viscoelastic interfacial film. Foaming stabilizers -Greater foam volume has been reported for egg white that are beaten at room temperature than for those beaten at refrigerated temperature (Henry and Barbour 1933). The EA stabilized foams were collapsed after 20 min of whipping and found to be unstable, thus could not be used to dried products (Faladeet *al. 2003).* In those cases, foam stabilizers may be added to enhance the stability of foam over time when 10% egg albumin as foaming agent was added to it. Decrease the instability of foams, polysaccharides are employed as stabilizers. Being hydrophilic, they do not adsorb at the interface. Enhance the stability of foam proteins by a thickening or a gelling effect. It act by either increasing the viscosity of the continuous phase or by forming a 3D network that retards the movement of components within the foam. Example: CMC, cellulose gum, xanthan gum, Arabic gum, starches, pectins and gelatin.

3.0 Results and discussions

This decrease in ascorbic acid content was due to the absence of ascorbic acid in egg albumin. Microwave power had a pronounced effect on the drying time. From the Figure 1, it can be clearly observed that moisture content of the sample decreased as the drying time progressed till a constant value of 0.06 (g H_2O/g d.m). was attained. Initial moisture content of the foam i.e., 14.52 (g H_2O/g d.m). reduced faster during initial stage of drying, however, at the end, the slope of curves became flatter indicating the slower drying rate. Similar results were also reported in the microwave foam-mat drying of tomato paste (Rzepecka et al., 1976). An increase in microwave power from 0 to 800 W caused a drastic reduction in the drying time. The time taken to attain a moisture content of about 0.06 (g H_2O/g d.m). for foam of thickness 10 mm at inlet air temperature 45°C and 0 W microwave power was 110 min while the drying time for the foam of same thickness and inlet air temperature but at 480 W microwave power was 15 min. The drying time further decreased to 12 min and 10 min when the microwave power level was increased to 640 W and 800 W, respectively with other conditions remaining the same. This enormous decrease in drying time of the foam-mat is attributed to the ability of the microwave to

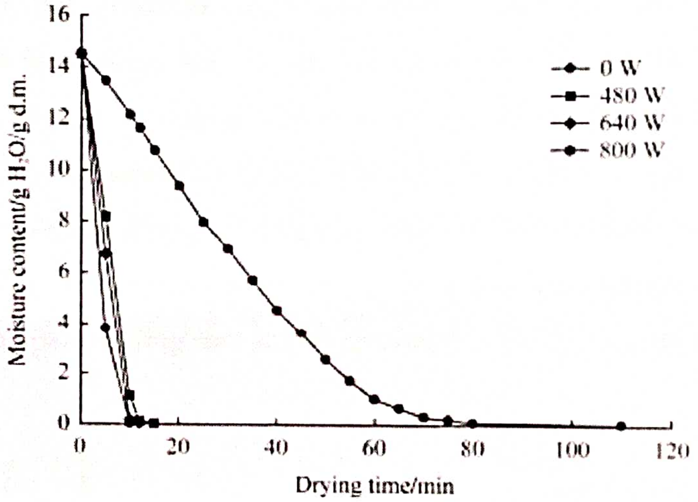

Figure 1. Effect of microwave power on drying time

cause rapid heating of foam to a greater depth which increased the mass transfer rate and hence the faster drying. Similar results have been reported in the microwave drying of tomato paste by Rzepecka et al., (1976), kiwifruits by Maskan (2001), garlic by Sharma and Prasad (2001), and spinach by Ozkan and Akbudak (2007).

Effect of microwave power on drying rate

Drying rate was calculated in terms of gram of water lost per minute per gram of dry matter and henceforth the unit used for drying rate is denoted as g H_2O/g d.m./min. The drying rate increased sharply at the beginning when microwave power was used while there was a gradual increase in the drying rate of the foam-mat dried at 0 W microwave power, as can be seen in the Figure 1. The increase in the drying rate at the beginning shows the presence of a heat up period which reduced with the increase in microwave power. The drying rate had a maximum value at microwave power 800 W but after reaching the peak value, it dropped sharply, whereas, at microwave power 640 W and 480 W the drying rate after attaining the peak value remained almost constant for some time and then decreased. At microwave power 0 W, the heat up period was slow and the constant rate period persisted for longer duration. The reason for this is volumetric heat generation by microwave energy which resulted in instantaneous heating up and continuous heat generation in the foam until the moisture content decreased. Also, as the microwave power increased from 480 W to 800 W there was more heat generation because of greater penetration and higher energy of the microwaves, whereas, at 0 W microwave power the mode of heat transfer to the foam was convection, and within the foam principally was conduction that resulted in slower heat transfer as compared to that occurred when microwave energy was used. In all the cases, after the surface of the foam dried out, the rate of water movement from the interior to the surface of the foam fell below the rate at which water evaporated to the surrounding air and hence resulting in falling rate period (Fellows, 2002). The drying rate at microwave power 800 W reached a peak value of 2.55 g (H_2O/g d.m./min) while at 640 W and 480 W the peak drying rates were 1.77 g (H_2O/g d.m./min) and 1.54 g (H_2O/g d.m/min), respectively. In comparison to these, the peak drying rate at 0 W microwave power was much lower.

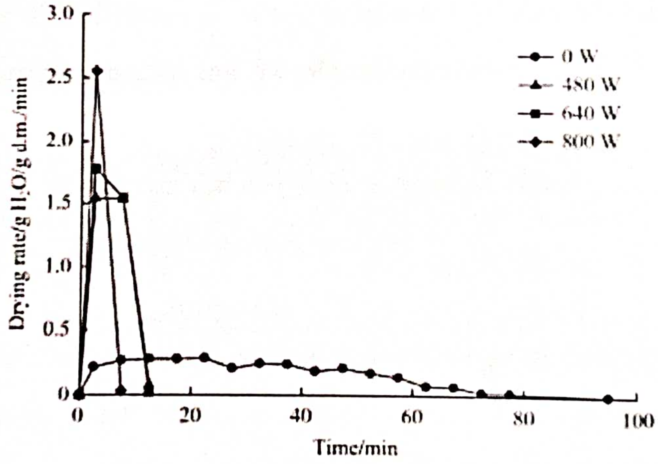

Figure 2. Effect of microwave power on drying rate

Effect of microwave power on physical & chemical properties

The average experimental values of the ascorbic acid of the reconstituted tomato powder ranged between 4.284 (mg/100 mL) and 6.845 (mg/100 mL) (Table 1). The ascorbic acid content reduced during the foam-mat drying, evidently due to its heat labile nature. The ascorbic acid content of the sample increased with an increase in microwave power in the selected range (0 to 800 W), exhibiting a positive correlation with microwave power. This supports the concept that nutrients are more sensitive to time than to temperature, which implies that a greater reduction in time at the cost of slighter increase in temperature results in better retention of nutrients (Teixeira, 2012). Similar decline in ascorbic acid content was noticed in other studies with tomato by Kadam et al., (2012), potato by Marwaha and Pandey (2006), pulses by Mehta *et al.*, (2007), muskmelon by Fernandez *et al.*, (2007), cauliflower by Kadam *et al.*, (2005), and onion by Kadam *et al.*, (2009), following heat treatment.

Table 1. Effect of microwave power on physical and chemical properties of tomato pulp

Microwave power (W)	Ascorbic acid (mg/100 mL)	Acidity (%)	pH
0	4.284	0.317	4.28
480	5.952	0.304	4.28
640	6.786	0.326	4.30
800	6.845	0.336	4.31

Titrability acidity & pH

Citric acid is the main acid present in tomato and pH is an important measure of the active acidity which influences the flavour or palatibility of a product. The average experimental values of the titrable acidity of the reconstituted tomato powder ranged between 0.304% and 0.336% and the pH of the samples varied between 4.28 and 4.31 as given in Table 1. It was observed that the titrable acidity and the pH of reconstituted tomato powder varied randomly but the values were very close with those of the fresh tomato pulp egg albumin mixture. This suggests that the drying process did not have a marked effect on organic acids of the tomato powder responsible for the titrable acidity and pH.

Color difference

Color difference (ΔE) is a measure of qualitative change in processed sample with respect to raw sample indicating effect of processing on color. The average value of color difference for the dried samples varied between 7.914 (microwave power 0 W) and 12.738 (microwave power 800 W). A slight increase was observed in color difference (ΔE) when microwave power increased from 0 W to 640 W, but at 800 W the increase was substantially high as shown in Table 3. An increase in temperature of foam-mat due to the increase in microwave power resulted in whiter tint to the foam-mats owing to increased cauglation of egg albumin which resulted in the increase in *L* value (brightness). The color parameters of the microwave dehydrated tomato pulp foam-mat samples were very close to the parameters of the untreated samples, so no adverse effects on the color quality were observed. Similar results were reported by Rzepecka *et al.*,(1976).

Table 2. Effect of microwave power on *L*, *a*, *b* and color difference

Microwave power, W	L*	a*	b*	Color difference (ΔE)
0	21.5	19.58	24.69	7.914
480	23.18	19.83	24.25	8.216
640	26.14	17.94	22.35	8.5
800	27.24	18.25	27.29	12.738

Foam density is a factor commonly used to evaluate whipping properties. Higher amounts of air incorporated during whipping results in lower foam densities with more air present within the foam .The foam density decreased with increased whipping time. After the initial decrease, however, a slight increase in the density was noticed after 7.0 minutes of whipping. Raharitsifa et al. (2006) studied the foam drying of apple juice using egg white and methylcellulose as foaming agents and they reported similar behavior of the density variation with increased whipping times in which longer times may have caused excessive whipping and led to the collapse of the structure. Higher degrees of aeration result in the liquid between the bubbles being thinner and mechanical deformation can cause the foam to rupture .

Lower density values provide a greater contact surface area and greater contact surface area exposed to the drying air accelerates water removal(THUWAPANICHAYANAN et al., 2012). However, other studies have pointed to capillarity as the main moisture movement during foam drying (SANKAT CASTAIGNE, 2004). The foam densities obtained in the present work varied between 0.27g.cm-3 and 0.51g.cm-3. These values were close to the range of values recommended for the foam drying process (0.3 to 0.6g.cm-3) according to Ratti and Kudra (2006), except for the 7.5% albumin and 7.5 minute whipping time treatment, which formed foam with a density of 0.27g.cm-3.The average density obtained for the in natural tomato pulp was 0.94g.cm-3. Lower densities indicate more air retained in the foam structure. Thus, low density values can lead to the collapse of the structure and, consequently, low stability of the foam.

In addition to accelerating the transport of liquid water to the evaporation front, studies have repeatedly pointed to the increase of the foam interface area as the main factor responsible for the reduction in the drying time (KUDRA; RATTI, 2006). In addition to favoring a higher water removal speed, the drying processes for foam at the two studied temperatures provided the lowest moisture equilibrium values . The moisture equilibrium values did not present a significant difference ($p > 0.05$) among the foam treatments at 60°C and 80°C with values remaining close to 12%. However, the moisture equilibrium values were significantly different ($p < 0.05$) among the treatments without albumin addition with higher moisture values at 60°C as compared to 80°C. At 60°C and 80°C, the treatments with and without albumin addition were significantly different ($p < 0.05$) with the treatments lacking albumin addition having the highest moisture values.

4.0 Conclusion

There was an enormous decrease in drying time of tomato pulp egg albumin foam in microwave assisted foam mat drying as compared to air convection foam mat drying. Color, titrable acidity and pH of the product were not much affected. The study has indicated that microwave assisted foam mat drying is a alternative to convention drying methods applied to liquid foods in dehydration industry. Present review is about Foam-mat drying technique for fruits and vegetables to develop good quality powders. Those fruits and vegetables which are very sensitive to high temperature, sticky and difficult to dry can easily dried by using this technique with preservation of its maximum nutritional values. By using this technique products can be dried in a short time with minimum quality changes in final product.

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A Field Project Report

On

NON- TIMBER FOREST PRODUCTS AND ITS NEED FOR CONSERVATION

Submitted by

Tejaswi Boyapati **201FB12012**

P. Divya Sruthi **201FB12001**

Under the guidance of

Dr. Payel Ghosh
Assistant Professor
Department of Food Technology

Division of Food Technology
Department of Chemical Engineering

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be UNIVERSITY)
-Estd. u/s 3 of UGC Act 1956

(ACCREDITED BY **NAAC** WITH "A+" GRADE)

VADLAMUDI, GUNTUR-522213, AP, INDIA

2021

CERTIFICATE

This is to certify that project reported titled **"Non- Timber Forest Products and its Need for Conservation"** Submitted by **Tejaswi Boyapati (201FB12012)** and **P. Divya Sruthi (201FB12001)** are carried out as field project work under my supervision. I approve this field project work for submission towards partial fulfilment of the requirements and course work in as prescribed for M. Tech- Food Technology, VFSTR (Deemed to be University).

Project Guide

Head of the Department

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1. INTRODUCTION

Many of millions of individuals rely heavily on biological goods derived via nature.

Non-timber forest products (NTFPs) are wild plant and animal items obtained from forests, savannahs, and other forms of natural vegetation. This definition covers canoes, woodcarvings, local home building, fence materials, and firewood, but excludes industrial timber.

Table 1: State wise Value of NTFP per hectare of forestland

States	Value of NTFP per hectare of Forest Land (Rs per hectare)
Andhra Pradesh	906.2
Arunachal Pradesh	1110.5
Assam	944.7
Bihar	1699.8
Goa	1121.3
Gujrat	1488.6
Haryana	1397
Himachal Pradesh	6753.6
Jammu & Kashmir	7364.8
Karnataka	914.1
Kerala	833.9
Madhya Pradesh	1268.6
Maharastra	1361.5
Manipur	953.8
Meghalaya	1290.5
Mizoram	904.7
Nagaland	857.1
Orissa	1547.9
Punjab	2704.6
Rajastan	916.1
Sikkim	1711.4
Tamil Nadu	827.3
Tripura	1065.8
Uttar Pradesh	3724.4
West Bengal	2486.9
A&N Island	1327.5
Dadra & Nagar Havelli	2276.2

OBJECTIVE

- Packaging study of few NTFP (Non-Timber Forest Products).
- Storage study of few NTFP (Non-Timber Forest Products).
    - Samples: Pumpkin Flower
      Dragon Fruit
      Banana Flower

2. IMPORTANCE

2.1. LIVELIHOOD OF LOCAL PEOPLE

According to World Health Organization estimates, 80 percent of people in underdeveloped nations use wild plants to satisfy part of their health and nutritional needs. As a result, billions of people, particularly those living in rural regions in developing nations, rely on NTFPs on a daily basis. This encompasses thousands of plant and tree species, the majority of which are consumed within the gatherers' households and are not exchanged in marketplaces.

This type of consumption at home is also known as 'subsistence usage.' Without the availability of palm leaves for roof thatch, medicinal plants, and natural fibres to create baskets and fish traps, life would be nearly difficult for most people living in rural regions in developing nations. Many residents in these areas do not have enough money to purchase zinc sheets for roofing, prescription drugs, building materials, or household items.[1]

Furthermore, the greater the distance from cities and towns, the higher the transportation expenses. Commodity items inevitably become too expensive or even scarce in isolated remote places, leaving people largely reliant on forest and savannah products close to their dwellings. Although the bulk of the items never reach a market, a tiny fraction is sold in local and regional marketplaces, providing an important source of cash revenue owing to its high commercial importance.

The extraction, processing, and trade of NTFPs is sometimes the sole employment accessible to those living in isolated rural regions. Make use of categories. To gain a sense of how valuable plants and animals are, split them into groups based on their function. These categories aid researchers and non-governmental organisations in compiling inventories of valuable plants in a certain location. The following list is an example of multiple lists of NTFP usage categories based on the recently adopted Inter-national Economic Botany Data Collection Standard.

Food includes wild fruits, vegetables, nuts, edible roots, bush meat, edible insects, and honey.

Spices, flavourings, food colourants, and fermentation agents are examples of food additives.

Animal food includes cattle feed, straw, animal bait, and bee plants.

Skins (leather and fur), live animals as pets, feathers, and bones are all examples of animal goods.

Construction materials include palm leaves or grass for roof thatch, bamboo, and wood (sticks and poles). Fibbers, baskets, furniture, bow and arrow, dye, paint, varnish, and glue

Fuel options include firewood, charcoal, petroleum replacements, and lighting resins.

Medicinal plants, bark, resin, and seeds are all used in medicine.

Poisons are used for a variety of purposes, including fishing and bug control.

Social applications include religious and magical plants, medications, narcotics, and toxicants.

Uses in the environment include aesthetic plants, shelter trees, and plants for soil enhancement.

The motivation for encouraging NTFP commercialization is frequently to enhance the lifestyles of underprivileged, particularly NTFP growers. It is intended that through producing and capturing more value, underprivileged people can benefit from increased income and job prospects. NTFPs are sometimes the only source of earnings for those living in rural places, such as fragrance cultivators in Bolivia. It might be especially crucial for females, who could have few other choices of making a living.

2.2.INTERNATIONAL MARKET

Edible plants are marketed in almost all of marketplace in Africa, mediterranean Caribbean, and the Pacific, and very little is documented regarding their significance to the nations' economic systems. Few nations keep track of which varieties are marketed when and how, in what proportions, or at what costs. Even however little is known about who produces, distributes, and purchases them[2]. Unlike agriculture and forest goods, no constant monitoring or assessment of NTFP resources, market networks, and social and economic contribution is done at the national and regional level[3].

Only exports of non-timber tree commodities are occasionally included in official statistics. Nonetheless, the yearly global market for wild plant products is projected to be worth US$ 60 billion, and so this industry is growing at a rate of about 20% per year.

The world market for medicinal herbs was valued at us$ 1.3 billion in 1996 by the trade monitoring network TRAFFIC. These numbers don't really indicate the proportion of farmed crops or the proportion of actual NTFPs present. Due to a lack of accurate data, it is impossible to provide an overview of the major commercial NTFPs in Africa, the Caribbean, and the Pacific. Contrary to national statistics information, several references may indicate differing production numbers for the same product.

2.3.TRIBAL RITUALS

Many forest resources play an essential part in cultural and religious rituals in indigenous values. In Ethiopia and Eritrea, for illustration, frankincense resin is commonly employed in religious rites.

Kava, a medical plant with moderate hallucinogenic qualities, is often used as a ritualistic beverage in the Islands In the pacific. This produces a brief blissful sense of serenity & kindness. Consuming kava is an important part of life for the native groups of the South Pacific. It's indeed nearly impossible to foresee kava being taken off the trade. However, its usage has come into question on several fronts. A few Pacific Islanders believe the beverage does have a bad influence on weddings, employment efficiency, and household income.

Unfortunately, however, Kava confronts a larger barrier: the substance has indeed been prohibited in a number of Western nations because to concerns that it could induce liver illness as well as other disorders. Kava economic output have plunged, wreaking havoc on domestic economy.[4]

2.4.ENIVIRONMENTAL ASPECT

The use of NTFPs is frequently recommended like a viable way of guaranteeing forest management and bio-diversity conservation. This, therefore, is very dependent on the variety and the amount to which they are taken. Industrial exploitation can start contributing to sustainable forest management when standing forest is required to produce certain plant products such as aerial roots or rattan, as harvesters frequently safeguard essential trees from removal. Furthermore, if people can make a livelihood by selling indigenous plants items, they would no longer need to clear land.

However, if NTFP demand falls and gathering becomes unprofitable, or if equipment and machinery are barred from traditional collecting places, individuals may turn to more damaging industries such as logging, cash crop farming, or livestock grazing. The many case studies provided here show that wild plant harvesting often does not help to preserve nature. Harvesting fragile species or employing damaging harvesting practises has a detrimental influence on NTFP-producing species populations. This might lead to the loss of native flora and fauna, impacting the biodiversity[5].

COLLECTION

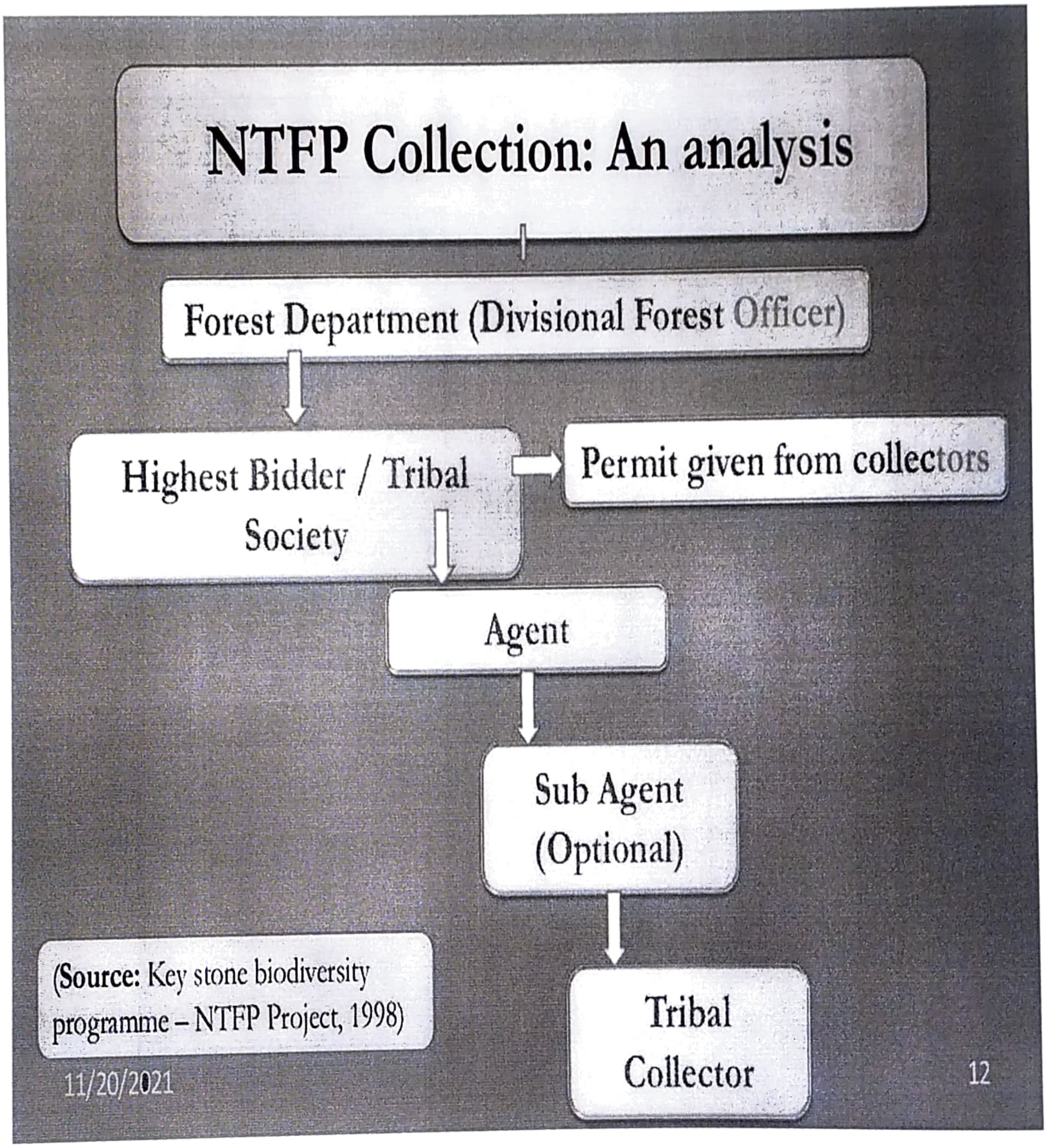

Figure 1. NTFP Collection: An analysis

MATERIAL LOSS DURING COLLECTION, PROCESSING AND MARKETING OF VARIOUS NTFP'S

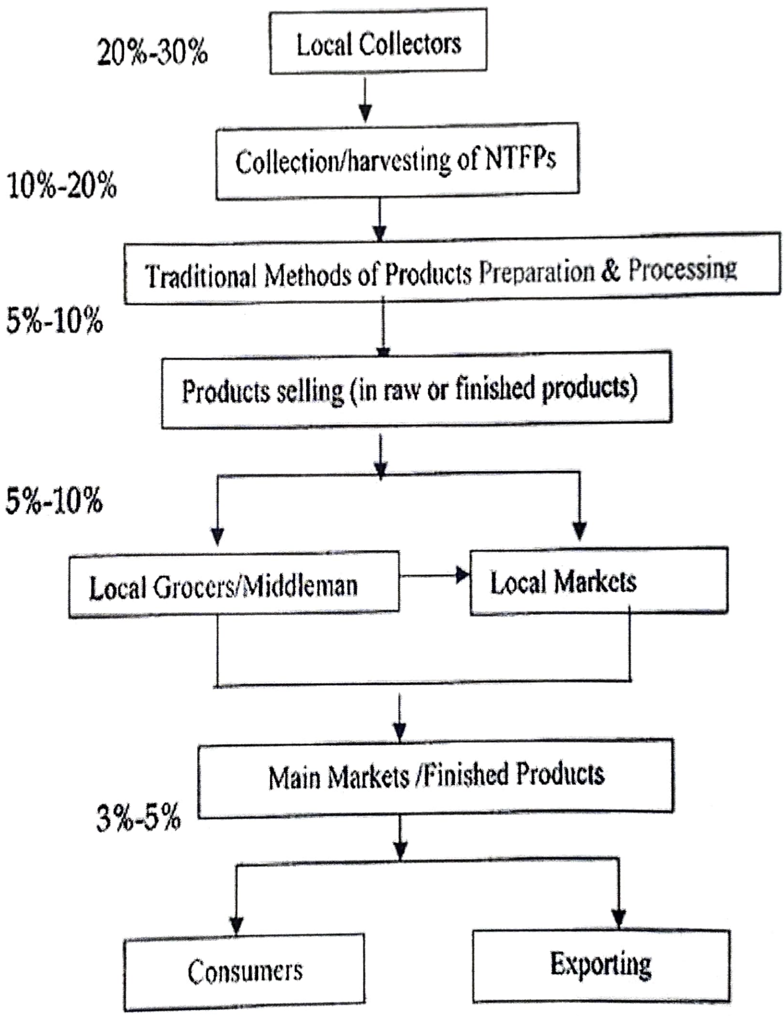

Figure 2. Material loss during collection, processing and marketing of various NTFP's

COMMON NTP'S MARKET CHANNELS

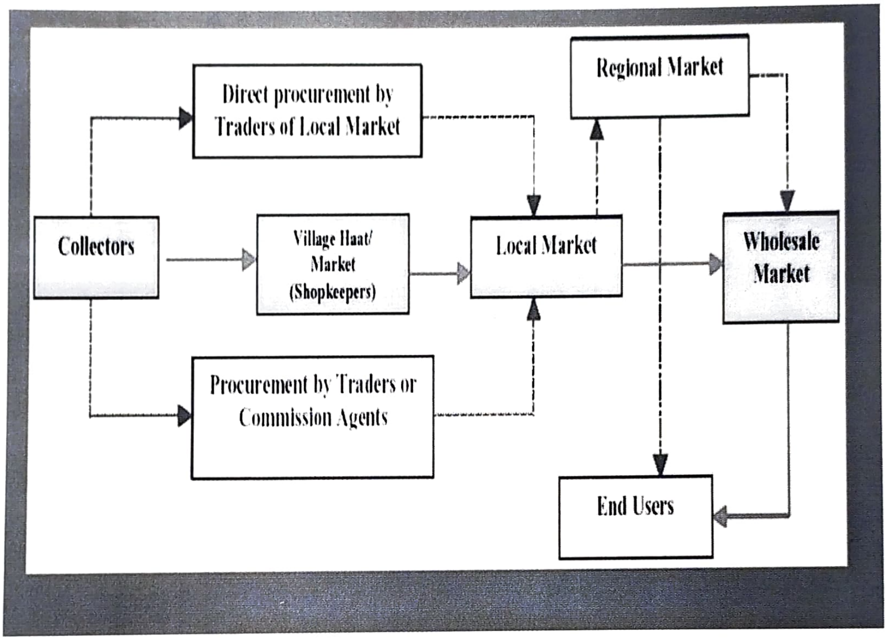

Figure 3: Marketing channels of NTFP

3. PACKAGING

Table 2: Packaging conditions for few NTFP- food products

S: No	Name of the Product	Packaging material	Reference
1	Jackfruit	The Modified Atmospheric Packaging was performed using a gaseous combination of 3 kPa O_2+ 5 kPa CO_2 (with a balance of N_2) flushing polyethylene (PE) bags, polyethylene terephthalate (PET) jars with a silicon membrane window on the lid, and a PE bag with air. Fresh-cut jackfruit were pretreated with $cacl_2$, ascorbic acid, and sodium benzoate under moderate acidic solution conditions after a post-cutting phytosanitation wash.	6
2	Jamun	The jamun syrup formula with 35 percent jamun juice, 65°Brix TSS, and 1.50 percent acid was shown to be the highest in terms of physical, chemical and sensory attributes criteria. The substance could be securely stored for six months both under storage temperature and in both package choices. When compared to PET bottles, the quality of this product could be preserved best in glass bottles held under chilled storage conditions.	7
3	Dates	Water loss can be reduced by packaging in plastic bags or using a plastic liner in the box.	8
4	Honey	PET Bottles and Glass bottles	9

4. LAWS

Non-timber forest products (NTFPs) are a significant source of revenue and resources from woodland settings. As a result, the goal of this study was to carry out a gathering of publications on NTFPs in Brazil, available in the Scopus database until 2019, offering a bibliometric analysis review and state-of-the-art of this topic based on the examination of these articles, discussing the Brazilian legislation on NTFPs is being challenged.

Following the assessment of the articles of interest, 196 documents were examined in which they noticed institutions and authors, analysed networks of citations and phrases used, fields of forest sciences and sciences that comprise the most investigated biomes and the most researched species. The findings revealed that interest in NTFP research in Brazil began in the 1990s, with a rise in the number of publications over time. Aside from that, NTFP research is multidisciplinary, with a concentration on Agricultural and Biological Sciences, as well as Environmental Science.

The necessity for statutory provision that involves the evaluation aspects such as the phytogeographic domain the investigated region, producing species, and the goods and co-products acquired was noticed for better control of the process of exploration and management of NTFPs in Brazil[10].

5. MATERIALS AND METHODS

Figure 4: Pumpkin Flower

Figure 5: Dragon Fruit

Figure 6: Banana Flower

6. RESULTS

Table 3: Pumpkin Flower Storage conditions and parameters

S: No	Parameter	Remarks
1	Color	Preserved
2	Texture	Preserved
3	Shelf Life	30 days
4	Packaging Material and Type	Polyethylene bags, Vacuum Packaging
5	Storage Condition	0 degrees Fahrenheit

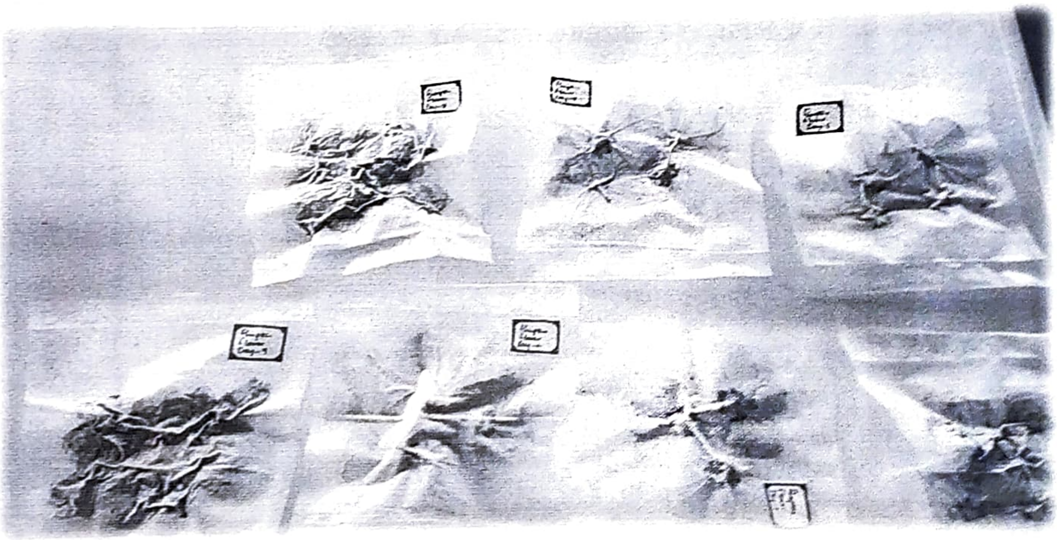

Figure 7: Pumpkin Flower Storage Phases for 30 days

Table 4: Dragon Fruit Storage conditions and parameters

S: No	Parameter	Remarks
1	Color	Preserved
2	Texture	Preserved
3	Shelf Life	15 days
4	Packaging Material and Type	Polyethylene bags with ventilation, Refrigeration condition.
5	Storage Condition	40 degrees Fahrenheit

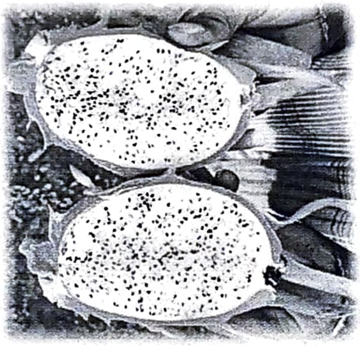

Figure 8: Dragon Fruit Storage for 15 days

Table 5: Banana Flower Storage conditions and parameters

S: No	Parameter	Remarks
1	Color	Preserved
2	Texture	Preserved
3	Shelf Life	30 days
4	Packaging Material and Type	Polyethylene bags with, Refrigeration condition.
5	Storage Condition	40 degrees Fahrenheit

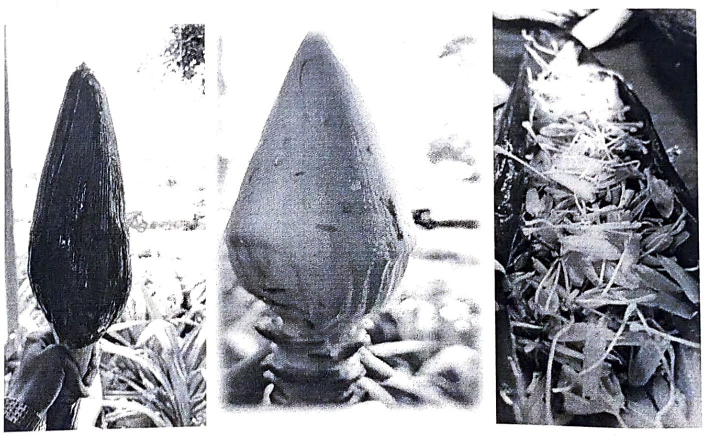

Figure 8: Banana Flower Storage Phases for 30 days

7. <u>Conclusion</u>

The shelf life of the

- Dragon fruit is extended up to 15 days,
- Pumpkin flower to 30 days and
- Banana flower to 30 days.

8. <u>Further Scope</u>

- There are many other NTFP's as mentioned in the presentation and there is scope for the research and storage studies of the product.
- A detailed review of the nutritional parameters may be performed to assess the change in the nutritional profile of the product during storage.

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