



Dehydrated Fruits and Vegetables

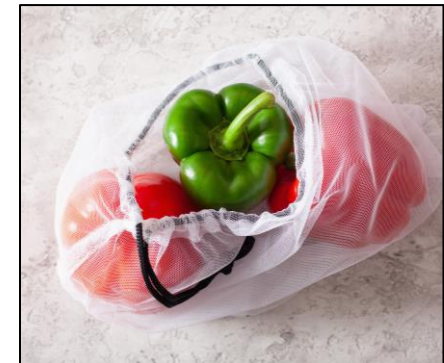


Contents

- | | |
|---|---|
| 1 | Introduction with Benefits |
| 2 | Pre-requisites/ Minimal processes |
| 3 | Processing (with process block diagram) |
| 5 | Equipments used |
| 6 | References |
| X | About PMG Engineering |

Introduction

- Dehydration is one of the oldest method of preservation of fruits and vegetable by removal of moisture present inside.
- Moisture removal: 75-90%; reduces water activity to a level sufficient to prevent products from various deteriorative agents.
- Done with the help of heat treatment using heat and mass transfer techniques.
- Impact of dehydration on fruits and vegetable:
 - Nutrient loss
 - Textural degradation
 - Discolouration
 - Loss of flavour
 - Shrinkage
 - Reduction of shape & size
 - But extends product's shelf life
- Various innovated designed has been developed to solve these problems such as, osmotic dehydration, freeze drying, vacuum drying, etc.



1.1 Benefit of Dehydration

1. Preserve Fruits and vegetable
2. Extends shelf life
3. Make it move convenient to transport & store
4. Decrease weight and bulk
5. Simple to pack & store at ambient temperature
6. Require lesser numbers of equipments
7. Cheaper than other preservation techniques
8. Handling, transportation, & storage cost lowered



1.2 Factors to be controlled during drying

1.2.1 The external factors are:

- **Dry bulb temperature:** Drying rate directly proportional to temp. gradient.
- **Relative humidity:** Inversely proportional to drying rate; lower relative humidity promotes faster drying
- **Air velocity:** higher air velocity vent off moist air faster from the drying chamber.
- **Pressure:** Lower environmental pressure increases partial pressure of moisture to evaporate faster.
- **Surface heat transfer coefficient**
- **Arrangement of stacking of produce**



1.2 Factors to be controlled during drying (cont.)

1.2.2 The Internal factors are:

- **Surface to volume ratio:** Higher the ratio, faster the drying
- **Surface temperature:** Higher the temperature higher will be the drying
- **Rate of moisture loss:** Higher the rate higher will be the drying
- **Composition** i.e., moisture, fat: higher the moisture faster will be the drying but higher fat content hinders moisture removal or drying being a heat insulator, also food with higher salts and sugar content, hinders moisture loss being hygroscopic in nature.



2. Minimal Processing

- Processing techniques used before processing (Drying) fruits and vegetables are called minimal processing.
- It includes, sorting, grading, cleaning/washing or trimming, peeling, cutting, slicing/Dicing, grating/ shredding etc.
- Done to-
 1. **Enhance drying rate** due to increase in surface area and
 2. **Minimize adverse effect** of drying on fruits and vegetable like, browning, non-uniform drying,
 3. **Decreases microbial load** and prevents possible toxic pathogen presence (mostly lie on surface)



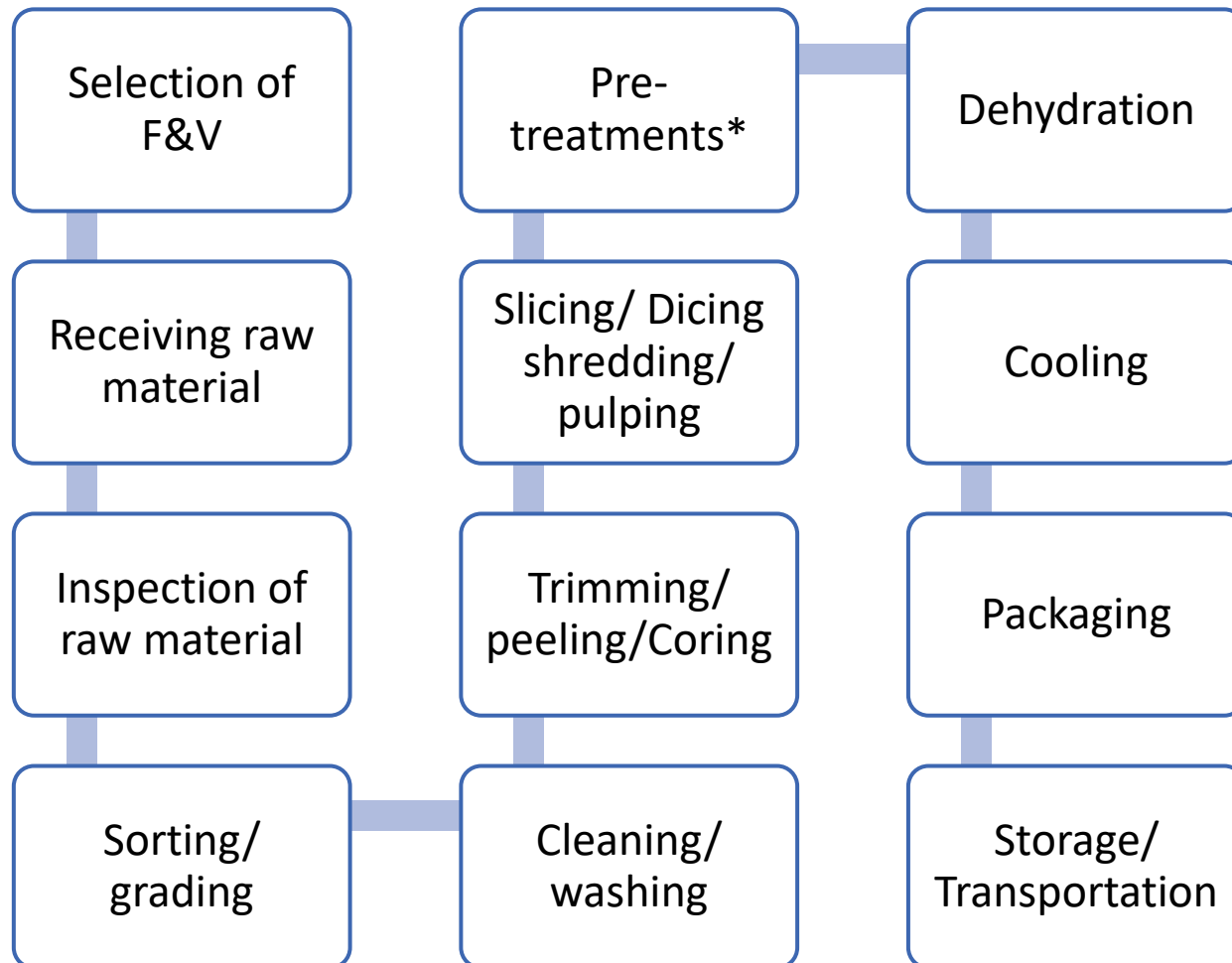
2. Minimal Processing

*Other two additional treatment,

1. **Blanching:** Hot water @85°C or steam treatment for shorter time followed by immediate cooling using chilled water.
 - Prevent discolouration in vegetables like potato, green vegetables etc.
2. **Salt or sugar treatment:**
 - Salt treatment prevent dried food from spoilage,
 - Sugar treatment preserve colour and texture and act as preservative agent.



3. Processing (Drying)



3.1 Dehydration

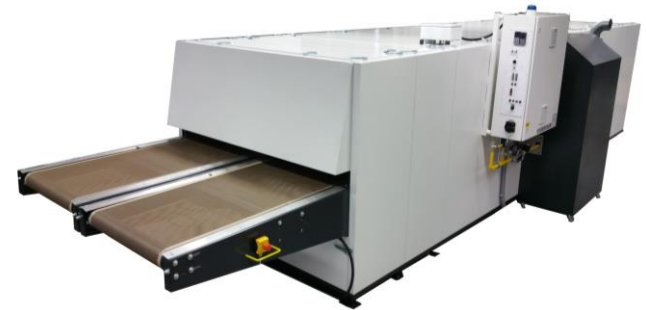
- Generally, tunnel dryer and cabinet dryer are used with the help of hot air circulation using fan or blower.
- Here, drying is done at controlled temperature @55-80°C, velocity and the humidity of the air but their value vary depending upon the type of commodity.

1. Fruits

- Dried at a lower temperature than vegetables due to the higher possibility of case hardening.

2. Vegetables

- Dried mostly after blanching and/or being treated with common salt or sulphites (SO_2 / KMS) at higher temperature.



3.1 Dehydration

#	Vegetables	Preparation	Blanching	Chemical Treatments	Dehydration condition
1.	Potato	Slices (10mm)	3-4 min	0.5% KMS	60-65°C
2.	Beans/Beet	Slices (10mm)	10 min	-	60-65°C
3.	Bitter gourd	Slices (10 mm)	7-8 min		65-75°C
4.	Brinjal	Slices (10 mm)	4-5 min	1%KMS/1hr	50-52°C
5.	Cabbage	Fine shreds	5-6 min	0.5% KMS/10 min	55-60°C
6.	Cauliflower	Small pieces	4-5 min	1%KMS/1hr	55-60°C
7.	Okra	Slices (6 mm)	5-6 min	0.5% KMS/30 min	55-60°C
8.	Peas	Shelled		0.5% KMS+0.1% NaHCO ₃ +0.1% MgO /3-4 min	50-60°C
9.	Fenugreek	Stalk removal	2-3 min	-	50-55°C
10.	Garlic	Slices (6 mm)	-	-	45-52°C
11.	Tomato	Slices (1 cm)	30-60°C/2 min	-	60-65°C

3.1 Dehydration (Cont.)

#	Fruits	Preparation	Chemical Treatments			Dehydration condition
			Salting	Caustic	Sulphuring	
1.	Grapes	Stemming	-	0.5%; Boiling	1 hr	55- 60°C
2.	Banana	Slices (12 mm)	-	-	30 min	55- 60°C
3.	Apricot / Peach	Cutting into half & destoned	-	-	30 min	50- 60°C
4.	Mango	Slices (12mm)	-	-	2 Hr.	50- 60°C
5.	Date		-	0.5%; Boiling	-	45-50°C
6.	Aonla	Grated	@40 g/kg	-	-	50- 60°C
7.	Apple	Slices (5mm)	-	-	SO ₂ or 1-2% KMS /30 min	60-65°C
8.	Pear	Cutting into half	1-2% Brine	-	30 min/ 1-2% KMS; 20 min	60-65°C
9.	Papaya	Slices (6 mm)	-	-	2 Hr.	60-65°C
10.	Fig	-	-	-	1 hr	55- 60°C

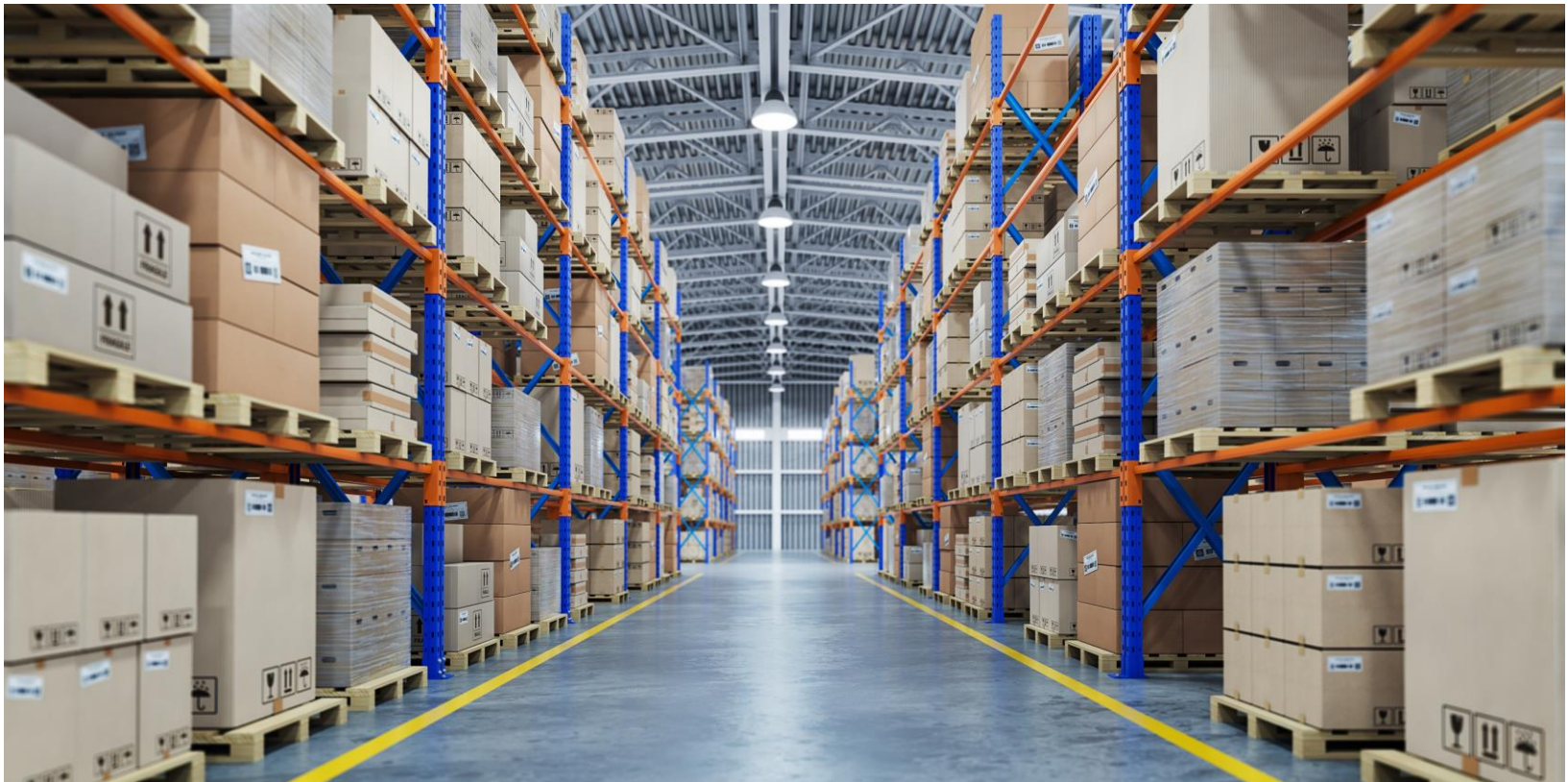
3.2 Packaging

- **Plastic Pouches:** Soft fruits and moisture susceptible fruits and vegetable
- **Glass Jars:** being transparent and air-tight container preserve dried goods for long time and product can be visible clearly.
- **Kraft Pouches:** Offer a rustic, eco-friendly appeal. Hardy dried fruits which requires less moisture protection.
- **Can Packaging:** Used to provide premium or gourmet offering.
- **Tin-Tie Bags:** Bags with metal and plastic tie at top, resealable after every opening.
- **Plastic Tubs:** Hard plastic container with lids, for bulk storage.



3.3 Storage

- The dried fruits and vegetables can be stored after effective packaging at cool temperature (10-20°C) and dry place (low humidity).



4. Equipment Required

4.1 Tunnel dryer

- Hot air-based industrial convectional dryers
- Hot air is circulated through a tunnel-like enclosure using Fan or blower
 - Air moving either in co-current motion, or counter current motion (**mostly used**) or cross flow.
- Removing moisture from the product.
- **Specification**
 - **Tray size:** 10–30 kg per m²
 - **Inlet air temperature:** 50°C to 150°C
 - **Outlet air temp:** 35-60°C
 - **Air velocity:** 2-10 ms⁻¹



4. Equipment Required

- **Advantages-**

- Efficiently, effectively, & Inexpensive,
- Easy to construct and install, maintain hygiene and space convenient.
- Precise controllable hence, allows customized drying.



Cabinet dryers

4.2 Cabinet dryer

- Batch drying method; also known as tray drier
- Contain closed compartment in which trays containing the food to be dried are placed.
- **Specification**
 - **Capacity:** 2000 to 20 000 kg per day
 - **Inlet air temperature:** 60–80°C
 - **Air velocity:** few ms⁻¹ (according shape, size, and density of food particles)
 - **Duration** of drying one batch: 2- 10 Hr.
 - Maximum nos. of trays: 25
- **Advantages**
 - Inexpensive & simple to construct.



Cabinet dryer

Reference

- [Storing Dried Fruit: Essential Tips for Freshness and Flavor \(dehydratedfoodz.com\)](http://dehydratedfoodz.com)
- [UNIT 1 TEACHING – LEARNING PROCSS : A REVISIT \(egyankosh.ac.in\)](http://egyankosh.ac.in)
- [Food Technology-I: Lesson 11. DRYING: PRINCIPLE, METHODS AND APPLICATIONS \(iasri.res.in\)](http://iasri.res.in)
- [Food Dehydration 101: Drying Fruits and Vegetables - The Seasonal Homestead](#)
- [Best practice for drying fruit and vegetables | Commercial Dehydrators | Food Dehydrators](#)
- [AP-42, CH 9.8.2: Dehydrated Fruits And Vegetables \(epa.gov\)](http://epa.gov)

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