EXPERIMENT 5 DRYING AND DEHYDRATION OF FRUITS AND VEGETABLES

Structure

5.1 INTRODUCTION

Dehydration is an age-old method of preservation of fruits and vegetables by removal of moisture. It is the process of removal of moisture by the application of artificial heat under controlled conditions of temperature, humidity and air flow. Various factors that affect the rate of drying of fruits and vegetables include the following:

i) Composition of raw materials
ii) Size, shape and arrangement of stacking of produce
iii) Temperature, humidity and velocity of air
iv) Pressure (barometric or under –vacuum)
v) Dehydration technique

Depending upon the type of dryers and drying environments available, the drying studies could be conducted.

The dried product could either be consumed directly or it needs to be rehydrated before use. For example, most vegetables need to be rehydrated. The practical will permit the study of rehydration behavior of the dehydrated products.

Their concentrated form, low cost, and convenient and easy transportability made dried products very popular among the armed forces.

Sun-Drying

Sun drying is practiced in tropical and sub-tropical regions where there is plenty of sunshine and almost no rain during the drying season. The equipment consist essentially of drying trays and few other items like knives, lye-bath, etc. Most of the work is done in a drying yard which is kept free from dust, flies, bus etc.

Packing and Storage

The dried products should be put into confectionary tins and sealed air-tight with tin or wax depending upon the length of the period of storage. Dried fruits

and vegetables are subject to insect attack even when they have been properly dried and stored.

Sulphuring and Sulphitation

In order to obtain good results during drying and storage. Fruits are given sulphuring treatment before and sometimes after drying. In case of vegetables they are dipped in a solution of KMS (Potassium Meta bisulphite 0.1 to 0.5%) after blanching and then they are dried. This treatment will help in preventing non-enzymatic browning during storage.

Objectives

After going through this experiment, you should be able to:

- know the process of drying of fruits and vegetables; and
- demonstrate the computation of moisture content, drying rates, rehydration ratio.

5.2 EXPERIMENT

5.2.1 Principle

A sample of 'X' mass is dried to the final 'Y' mass in a period of T time.

Amount of moisture loss = X – Y

Percent moisture loss = 100 ((X – Y)/ X)
(wet basis)

Percent moisture loss = 100 ((X – Y) / Y)
(dry basis)

Rate of drying = (X – Y) /T

Dehydrated vegetables need to be rehydrated for consumption. The process of dehydration that results into highest rehydration in considered to be the best.

Rehydration ration = B/A

Where, B is the drained weight of the rehydrated sample. The initial weight of the sample is A.

5.2.2 Requirements

- Selected fruits and vegetable
- Knife
- Cutting board
- Water for washing
- Peeler
- Dry and wet bulb thermo meter
- Perforated drying trays
- Desiccators
- Petri dishes
- Weighing balance (Top pan, digital)
  - 100 g cap., 10 mg. Least Count
  - 5 kg cap., 1g least count

- Hot air oven with temperature control in the range of 50 C – 200 C.
- Selected dryers/ drying environments

5.2.3 Procedure

The steps for moisture content determination, drying experiment and rehydration experiment are being given below.

I) Moisture content determination

- Wash the fruit/vegetable and pat dry to remove surface moisture.
- Cut the fruit/vegetable into small pieces of desired size (**IS- 1708, 1734, 4332**).
- Weigh a sample of about 10 gm in a clean and dry Petri dish. (let the initial weight be X g).
- Heat the oven to the desired temperate and place the sample of fruit/vegetable for the desired time.
- Remove the sample after the desired time from the oven and place it in a desiccator till it cools down to room temperature.
- Weigh the dried sample (Let the final weight be 'Y' g).

II) Drying experiment

- Wash the fruit/vegetable to remove dust and other adhering objects. Remove surface moisture by pat drying or air jet drying.
- Cut the fruit/vegetable into small pieces of desired size using knife and cutting board.
- Spread the cut fruit/vegetable in the drying tray in a thin uniform layer.
- Note the initial weight of the tray with and without the fruit/vegetable sample.
- Place the tray in the selected drying environment (dryer).
- Weigh the tray periodically (1/6, ¼, 1/3, ½ hr, etc.) till the tray weight becomes constant.
- Note the final weight of the tray with dried fruit/vegetable.

III) Rehydration experiment

In rehydration, water is added to the product which is restored to a condition similar to that when it was fresh. The following rehydration test is used to find out the quality of the dried products.

Rehydration test

- Weigh out a sample of 35 grams from the dehydrated product.
- Put the sample into a small container (beaker) and add 275 ml of cold water (and 3.5 g salt).
- Cover the container (with a watch-glass) and bring the water to the boil.
- Boil gently for 30 minutes.

- Turn out the sample onto a white dish.
- At least two people should then examine the sample for palatability, toughness, flavour and presence or absence of bad flavours. The testers should record their results independently.
- The liquid left in the container should be examined for traces of sand/soil and other foreign matter.

Rehydration ratio

If the weight of the dehydrated sample (A) used for the test is 35g and the drained weight of the rehydrated sample (B) 210g, then

$$\text{Rehydration ratio} = \frac{B}{A} = \frac{210}{35} = 6:1$$

5.2.4 Observations

i) Moisture content determination

Weight of Petri dish. = a g.

Initial weight of Petri dish and sample = X g.

Final weight of Petri dish and sample = Y g.

ii) Drying rate

Weight of empty tray = a kg.

Initial weight of tray and the fruit/vegetable sample = X kg.

Periodic weight of tray and the fruit /vegetable sample = Y_i kg.

i = 1,2,3,4 time intervals

Final weight of the tray & the fruit/Vegetable = Y_f kg

Time duration of final drying = T hours.

Table 5.1: Observations for drying experiment

Sl. No.	Time	X	X–a	Drying rate (wet basis)
1.	0.0	X_0	X_0–a	$(X_0 - X_{DT}) / DT$
2.	DT	X_{DT}	X_{DT}–a	$(X_{DT} - X_{2DT}) / DT$
3.	2DT	X_{2DT}	X_{2DT}–a	–
4.	–	–	–	–
5.	T-DT	$X_{(n-2)DT}$	$X_{(n-2)DT}$ –a	–
6.	T	Y	Y–a	$(X_{(n-2)DT} - Y) / DT$

iii) Rehydration

Initial weight of sample to be rehydrated = A g

Final weight of the drained rehydrated sample = B g

5.2.5 Results

1. Moisture Content Determination.

   Moisture content (wet basis) = ((X–Y)/ (X–a)) ×100

   Moisture content (dry basis) = ((X–Y) / (Y–a)) × 100

2. Drying Rate

   Instantaneous drying rate is computated as given in column 5 of Table 5.1.

   Final drying rate = (X–Y)/T kg/hr.

3. The rehydration ratio can be calculated as the ratio B/A

5.3 PRECAUTIONS

- All measurements of a type should be done uniformly and recorded to the same decimal point. For example, if temperatures are being measured to one decimal point, all values should be recorded to one decimal point only.
- All instruments used in the practical should be properly calibrated.
- The oven needs to be preheated to the desired temperature before the sample is put into it for moisture content determination.
- Petri dishes should be handled gently to avoid any spillage or breakage.
- The computed values need to be rounded off to just one more decimal point than that used for measurement.