**ACTIVITY: Water content of foods**

**Activity idea**

In this activity, students quantitatively analyse carrot and banana for moisture content and total solids using and comparing two drying methods.

By the end of this activity, students should be able to:

* report experimentally determined moisture and solids content values for banana and carrot
* explain the meaning of the term ‘gravimetric analysis’
* describe possible sources of error in each of the methods used
* effectively manipulate the laboratory equipment used in this activity.

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**Introduction/background**

The fresh fruit and vegetables that form part of a balanced diet have high moisture content. Water is an essential component of a balanced diet, and it is estimated that about 1 litre of our daily requirement of water is provided from the consumption of food alone.

This activity involves a gravimetric analysis of moisture content and total solids content of carrot, a typical vegetable, and banana, a typical fruit.

Two methods, thermal oven and microwave oven, will be used and the results compared.

The moisture content is determined by measuring the mass of a food before and after the water is removed by evaporation.

The basic principle of this technique is that water has a lower boiling point than the other major components within foods such as lipids, proteins, carbohydrates and minerals. All the water molecules need to be removed to get a true indication of moisture content and this is often difficult to achieve.

The two methods outlined below have heating times that may need to be adjusted as a consequence of this.

The results can be reported as either % moisture or % total solids, where % total solids is defined as 100 - % moisture.

**What you need**

* Copies of the student worksheet: [Analysing moisture content](#analysing)
* Fresh carrots, ripe bananas
* Chopping board, knife, grater
* Spatula
* Top pan balance accurate to 0.1g
* Dinner size plates or suitable dishes
* Access to a thermal drying oven and a microwave oven
* Food content data tables – [www.health.govt.nz/publication/concise-new-zealand-food-composition-tables-8th-edition](http://www.health.govt.nz/publication/concise-new-zealand-food-composition-tables-8th-edition)

**What to do**

1. Hand out copies of the student worksheet: [Analysing moisture content](#analysing) and have students work in pairs to complete the experiment.
2. Discuss the results using these prompts:

* How do the results from the two drying methods compare? Ideally, how should they compare?
* How do your results compare with the entries found in food data tables?
* Can you identify any problem areas with these moisture-determining methods?
* High moisture content indicates a low energy value for a given food. What is the explanation for this?
* High total solids *may* indicate high-energy value. Comment on this.
* Why is it recommended that average, healthy adolescents should monitor their daily water intake?

**Analysing moisture content**

1. Finely grate the carrot and chop the banana.
2. Transfer about 50g of the grated carrot into a preweighed dish.
3. Weigh the dish and the contents and record (see next page).
4. Record the exact mass of grated carrot.
5. Transfer the dish and contents into a thermal oven set at 100°C.
6. Leave for a time period of 3 hours, inspecting at regular intervals.
7. On removal, allow to cool to room temperature.
8. Weigh the dish and contents (now dehydrated).
9. Record the mass of the dehydrated carrot.
10. Calculate the % moisture content – % moisture = (initial mass - final mass) x 100/initial mass.
11. Calculate the % total solids – % total solids = 100 - % moisture content.
12. Repeat this process for the chopped banana carrot.

1. Compare your experimental results for carrot and banana with the food content data tables.
2. Repeat the process but this time place the samples in a microwave oven set at high power. Run for 2 minutes. Inspect the samples. Repeat until five 2-minute heating sequences have been conducted.

Record your results in the spaces provided:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Thermal oven drying – carrot – before heating** | | | | | | | | |
| Mass of dish | g | Mass of dish + carrot | | g | Mass of carrot | | | g |
| **Thermal oven drying – carrot – after heating** | | | | | | | | |
| Mass of dish | g | Mass of dish + carrot | | g | Mass of dehydrated carrot | | | g |
|  |  |  | |  |  | | |  |
| % moisture content for carrot = (initial mass - final mass) x 100/initial mass | | | | | | | |  |
|  |  | | = ( - ) x 100/ | | | | = | % |
| % total solids for carrot = 100 - % moisture content | | | | | | | |  |
|  |  | | = 100 - | | | = | | % |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Microwave oven drying – carrot – before heating** | | | | | | | | |
| Mass of dish | g | Mass of dish + carrot | | g | Mass of carrot | | | g |
| **Microwave oven drying – carrot – after heating** | | | | | | | | |
| Mass of dish | g | Mass of dish + carrot | | g | Mass of dehydrated carrot | | | g |
|  |  |  | |  |  | | |  |
| % moisture content for carrot = (initial mass - final mass) x 100/initial mass | | | | | | | |  |
|  |  | | = ( - ) x 100/ | | | | = | % |
| % total solids for carrot = 100 - % moisture content | | | | | | | |  |
|  |  | | = 100 - | | | = | | % |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Thermal oven drying – banana – before heating** | | | | | | | | |
| Mass of dish | g | Mass of dish + banana | | g | Mass of banana | | | g |
| **Thermal oven drying – banana – after heating** | | | | | | | | |
| Mass of dish | g | Mass of dish + banana | | g | Mass of dehydrated banana | | | g |
|  |  |  | |  |  | | |  |
| % moisture content for banana = (initial mass - final mass) x 100/initial mass | | | | | | | |  |
|  |  | | = ( - ) x 100/ | | | | = | % |
| % total solids for banana = 100 - % moisture content | | | | | | | |  |
|  |  | | = 100 - | | | = | | % |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Microwave oven drying –banana – before heating** | | | | | | | | |
| Mass of dish | g | Mass of dish + banana | | g | Mass of banana | | | g |
| **Microwave oven drying – banana – after heating** | | | | | | | | |
| Mass of dish | g | Mass of dish + banana | | g | Mass of dehydrated banana | | | g |
|  |  |  | |  |  | | |  |
| % moisture content for banana = (initial mass - final mass) x 100/initial mass | | | | | | | |  |
|  |  | | = ( - ) x 100/ | | | | = | % |
| % total solids for banana = 100 - % moisture content | | | | | | | |  |
|  |  | | = 100 - | | | = | | % |