

DECOMPOSITION: HOW NATURE RECYCLES

A study on decomposition of organic materials



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GRADE 4 - SCIENCE TALENT SEARCH

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INTRODUCTION

One day when me and my father came back from shopping we found that it was raining. My father told me that wood on the exterior of the house was decomposing and we need to do something about it. I was surprised to find out that wood decomposes when moist. This episode inspired me to do an experiment on decomposition.

Decomposition is a process in which organic materials transform by breaking down into simpler components-compounds and molecules. This process happens with the help of microorganisms which helpfully translates into “Feeders who eat dead or decaying organic substances.” Organic materials are compounds of life and have carbon in them with few exceptions.

Decomposition is important because without it our world would be littered with unwanted things like dung, carcasses etc. But nature cleverly found a way to get rid of all the unwanted waste while providing food for bacteria, fungi, insects and animals at the same time!

Factors causing decomposition:

- Temperature- regulates the growth and activity of microorganisms
- Aeration - presence of oxygen (O₂)
- Moisture - moisture in the air, soil etc.

I conducted a research experiment, testing the below mentioned four easy to obtain organic materials to see which one decomposes the fastest.

- Apple - has dietary fibres in its skin and core. Apple has a composition of 10% carbohydrates, 4% minerals and the rest more than 80% water
- Cucumber - has 95% water, 4% carbohydrates, 1% protein and very little fat
- Avocado - is made of 73% water, 15% fat, 8.5% carbohydrates which is mainly fibres and 2% protein
- Ginger - has 60 to 70% water, 9 to 12% proteins, 3 to 6% ash, 3 to 8% crude fibres and 2 to 3% essential oils

AIM

Which organic material takes the least amount of time to decompose and why.

HYPOTHESIS

My hypothesis is that cucumber will decompose the fastest due to the fact that it has the highest water, fat and carbohydrate content.

MATERIALS

1. Organic materials chosen: Apple, Cucumber, Avocado, Ginger
2. Materials assisting testing: Masking Tape, Paper, Sticky Tape, Gloves

3. Apparatus: Weighing Scale
4. Applications/Softwares: Weather App, Canva software, Google Docs and Sheets

METHOD

FAIR TESTING SETUP

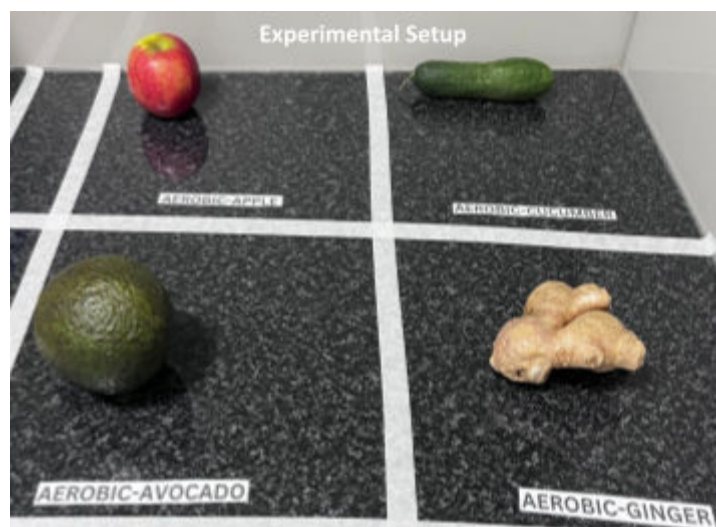
1. Closed room (laundry room), on the clean bench with no heaters
2. Surface of the bench was cleaned and dried
3. I assigned each of the materials a specific spot on the bench and made a square around each of the materials with the help of masking tape
4. Then, on the Canva software, I made labels for each of the materials
5. After that I stuck the labels on the designated square
6. Temperature Recordings: The Australian Meteorology weather app and website <https://www.timeanddate.com/weather/australia/melbourne> on the phone was used to record the range of temperature daily
7. The temperatures across the period ranged between 1 degree to 20 degree as per normal temperatures outside (without heaters)

VARIABLES

Apple, Cucumber, Avocado and Ginger

CONSTANTS

1. Temperature
2. Location
3. Quality – Fresh Produce and unwaxed apples
4. Source of material – Big Watermelon Shop



PROCEDURE

Recording Observations

1. The experiment was set up for twenty one days from 23 June 2024 to 14 July 2024
2. I observed the materials every day and recorded my findings in the logbook.
3. Observations recorded :
 - a. change in colour : Apple – Red, Cucumber– Green, Avocado – Brown and Green, Ginger – Beige.
 - b. mould growth : Yes or No, spread.
 - c. change in feel: Deflated, Squishy and Hard.
 - d. change in shape : Shrunk, No change.

Weight Recordings

1. Recorded the weight in the unit of grams (g) using the kitchen weighing scale.

SAFETY REQUIREMENTS

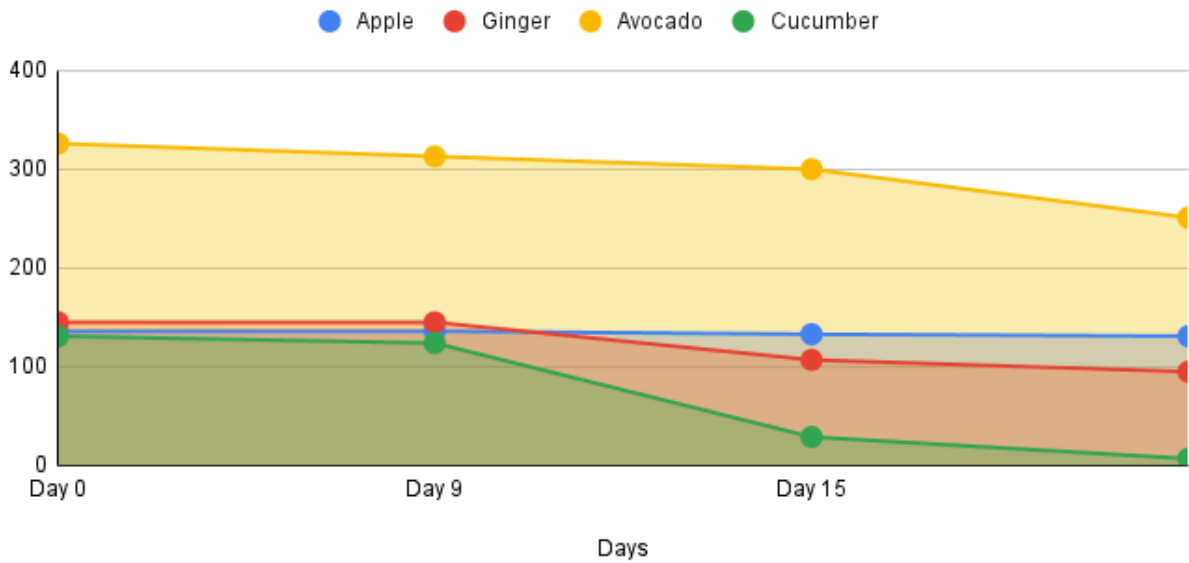
1. PPE: Gloves,mask and goggles worn at all times during the experiment.
2. The experiment was not interfered with by other personnel.

RESULTS

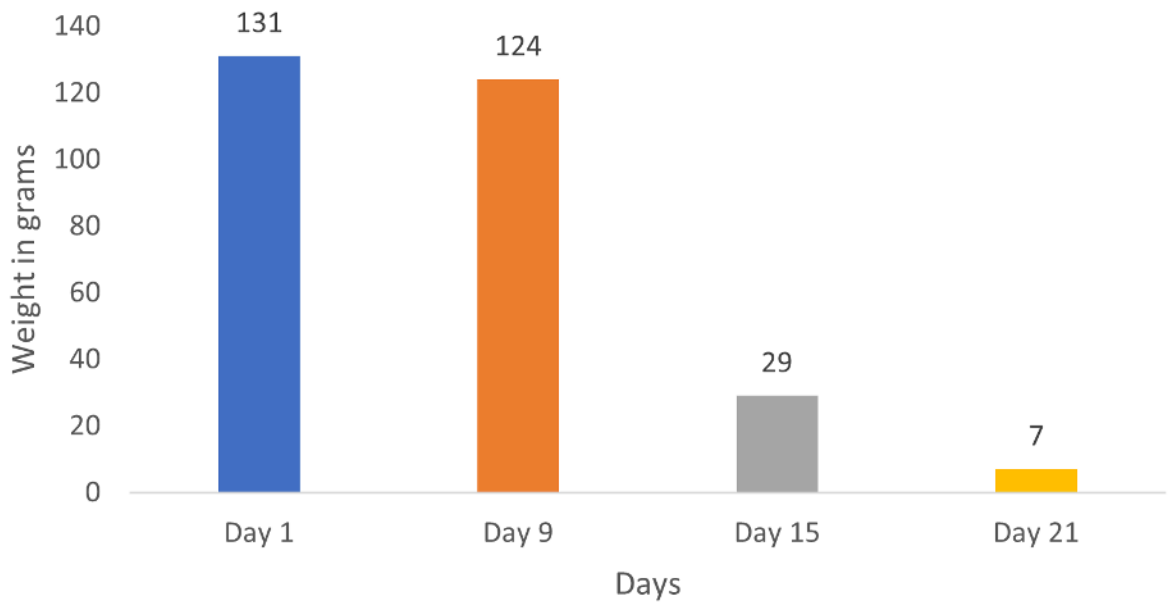
WEIGHT OBSERVATIONS

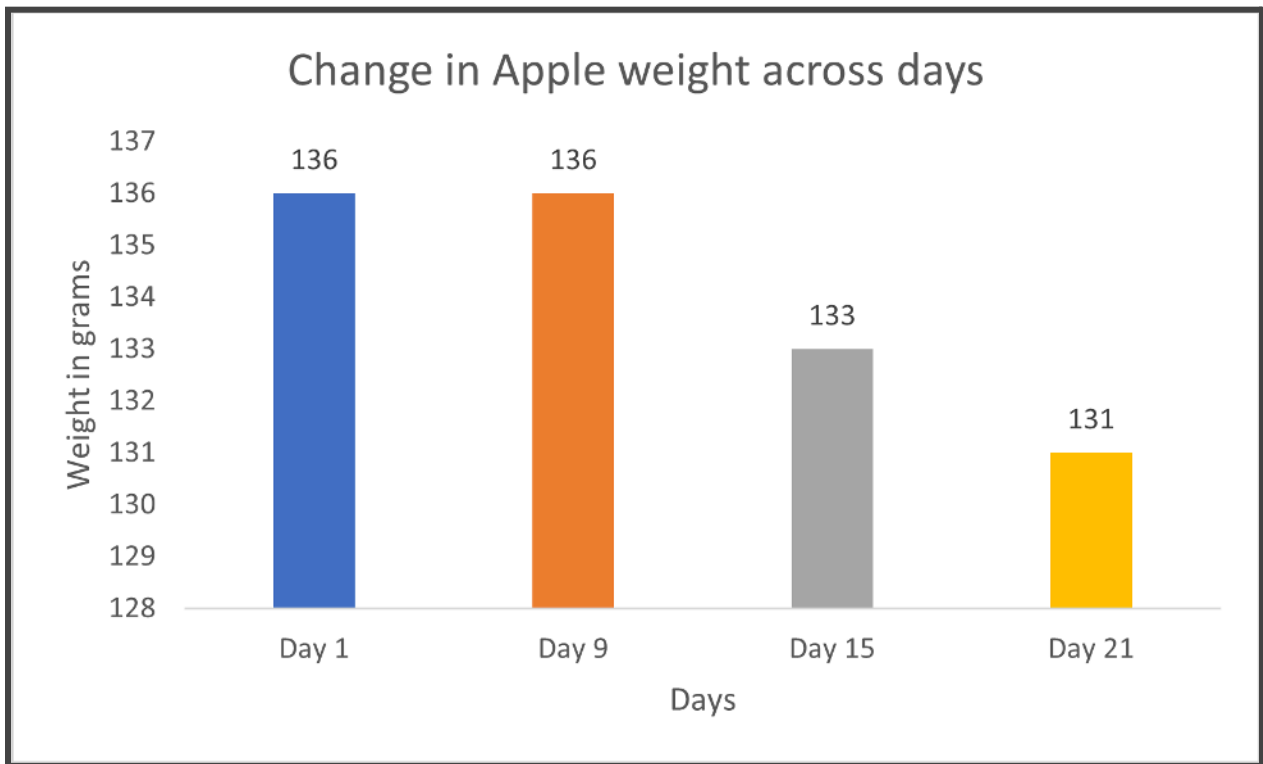
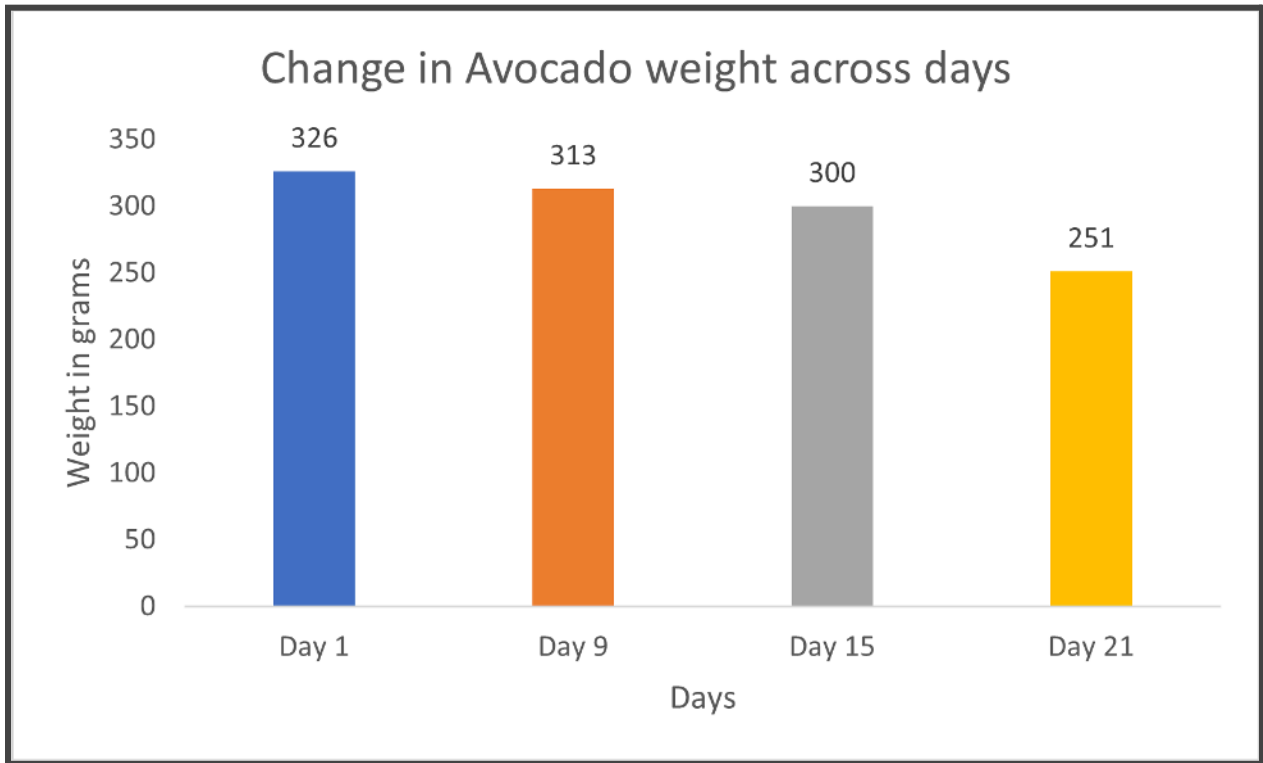
Days	Apple weight in grams	Cucumber weight in grams	Avocado weight in grams	Ginger weight in grams
Day 1	136 grams	131 grams	326 grams	145 grams
Day 9	136 grams	124 grams	313 grams	145 grams
Day 15	133 grams	29 grams	300 grams	107 grams
Day 21	131 grams	7 grams	251 grams	95 grams

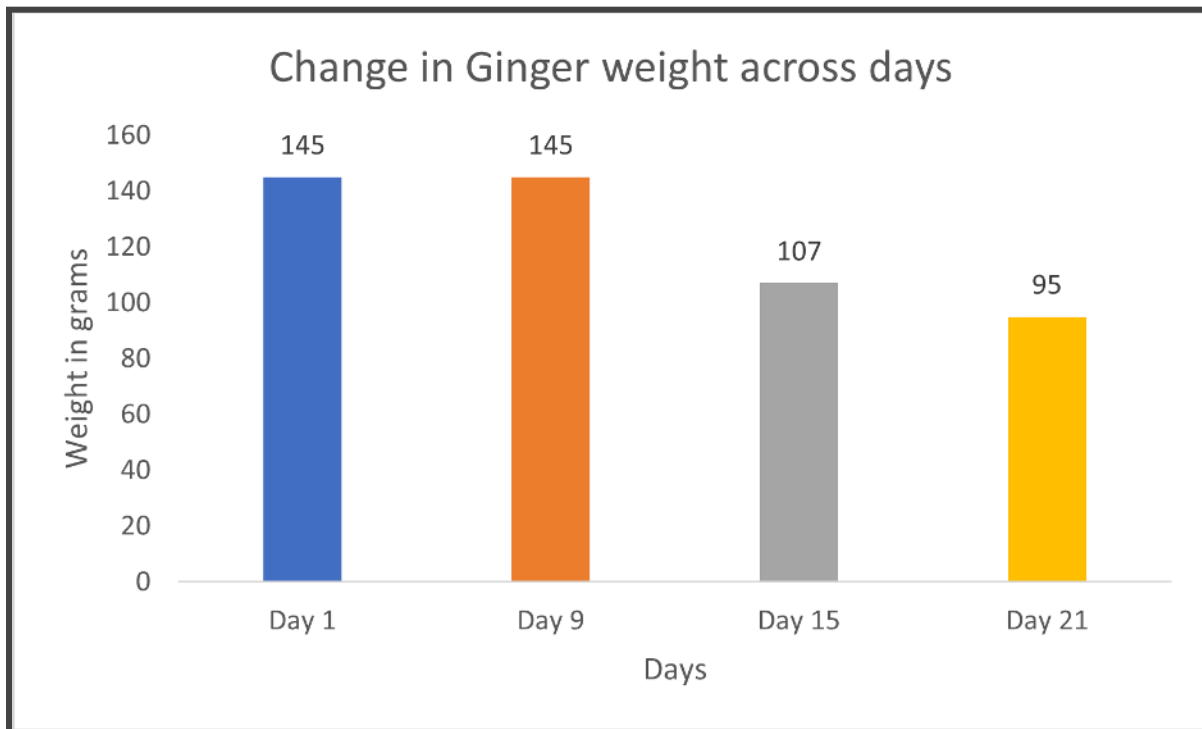
Change in weight of organic materials across days



Change in Cucumber weight across days







RECORDED OBSERVATIONS: Colour, mould, feel and shape/size

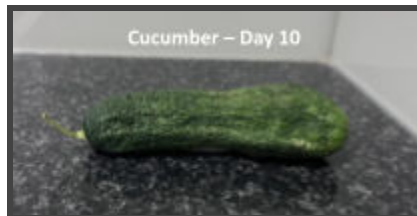
APPLE

Days	Colour	Mould	Feel	Shape/Size
Day 1	No change	No mould	Hard	No change
Day 5	No change	No mould	Hard (small bumps & flat parts)	No change
Day 11	No change	No mould	No change	No change
Day 15	No change	No mould	No change	No change
Day 21	No change	No mould	No change	No change



CUCUMBER

Days	Colour	Mould	Feel	Shape/Size
Day 1	No change	No mould	Slightly squishy	Cracks
Day 5	darker at top	No mould	Squishy	Pruned, cracked
Day 11	No change	No change	Extremely squishy	Extremely pruned, cracked
Day 15	No change	Extreme white mould, light green spots	Very deflated	No change
Day 21	No change	Mould on nearly whole cucumber	Very hard but deflated	Extremely shrunk and pruned



AVOCADO

Days	Colour	Mould	Feel	Shape/Size
Day 1	Green with brown/black flecks	No mould	Hard	No change
Day 5	More black/brown spots on one side	No mould	Squishy on opposite side, hard at top	No change
Day 11	Darker spots	No mould	No change	No change
Day 15	No change	No mould	No change	No change

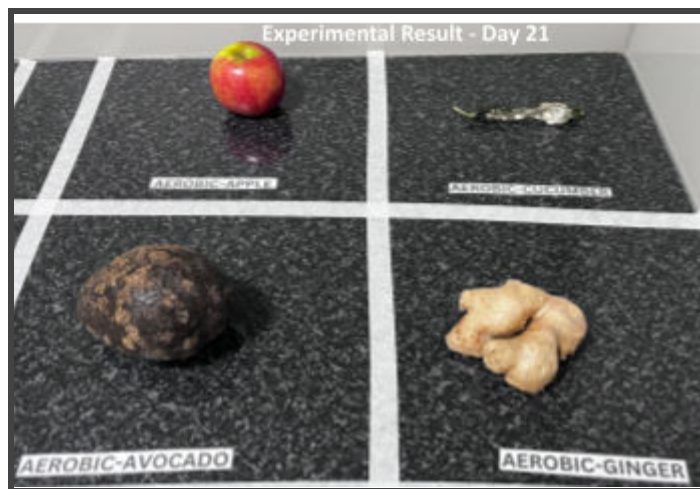
Day 21	No change	Brown spots everywhere	Very deflated	Giant ditches
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GINGER

Days	Colour	Mould	Feel	Shape/Size
Day 1	Beige with purple spots	No mould	Hard	No change
Day 5	No change	No mould	No change	Small pits
Day 11	No change	Mould increased and spread	No change	No change
Day 15	No change	No change in mould	No change	No change
Day 21	No change	No change in mould	No change	Shrunk slightly





DISCUSSION

All the chosen organic materials showed good signs of decomposition. I came to learn how decomposition works, what organic materials are, what detritivores/microorganisms are and what they do.

I am happy to say that my hypothesis was right and that the cucumber decomposed the fastest.

If there is less water then less decomposition will occur because microorganisms will not survive. Microorganisms like bacteria release enzymes into decomposing matter and then absorb all dissolved molecules which is their food. If there was no water these reactions would not have happened. Like water, they also need oxygen to survive, spread and grow. Oxygen helps to completely break down carbohydrates into carbon dioxide. Therefore, the more oxygen there is, the more decomposition there is. Also, if there is more fat it will decompose faster since fats liquify which makes for a big portion of decomposition.

The cucumber got pruned over time and cracked. It lost a lot of weight and got darker in colour. White and green mould had grown all over the cucumber. It got squishier until it deflated. It lost its water, carbohydrate and fat content like I predicted. I think the bacteria sucked all the water and other contents in the cucumber. The fungi and mould ate up most of the contents, reducing its weight and size.

In the case of the apple, it took a while but eventually, I saw minor changes like flat surfaces and bumpy parts. But overall during the period of the experiment, I could see very minute changes in the apple. I had expected some mould growth, but could not find any. I think that the apple needs more time to show better signs of decomposition.

The avocado started getting dark brown spots which kept getting darker and bigger. Avocado started becoming squishier as time passed, and the dark black and brown parts

were the most soft parts. Eventually in the last few days, I observed avocado had brown flakes in groups which kept spreading and I think it might be mould.

Ginger started shrinking and I think that it was because it lost water content. Ginger started getting some green mould on it which also had cob-web like structures. Upon research I now know that this is how the mould spreads.

Overall, in the process of decomposition I observed that the organic materials, colour changes, coloured spots and they start shrinking and decrease in weight which is because of loss of water, carbohydrate and fat content. They start getting softer and finally shrink until they are fully deflated and eaten up by mould, bacteria and other microorganisms.

While doing the experiment, I ran into many problems like making sure nobody turned the tap on in the laundry room since it could affect the experiment and making sure the heaters and my one year old sister stayed away from the experiment setup.

I could have done more research and seen if protein makes decomposition faster or slower since some of the organic materials did have protein and would like to do it next time. Even though I know carbohydrates make decomposition faster, I want to research more on it in the future.

I was really interested, so I did an extra parallel study and observed the same materials with similar weights, in a closed container aiming to create anaerobic conditions. Details are provided in the appendix below. But I did not exactly create anaerobic conditions using a closed container. There was some air in it. In future I want to create exact anaerobic practices to research and observe the decomposition process in detail.

CONCLUSION

To conclude, I achieved my aim and completed the experiment successfully. I learned about decomposition, factors like water, oxygen and microorganisms affecting the process, and how to conduct an experiment. I am glad that my hypothesis was right, cucumber decomposed the fastest as it had most water, carbohydrate and fat content

EXTENDED PARALLEL TESTING (APPENDIX)

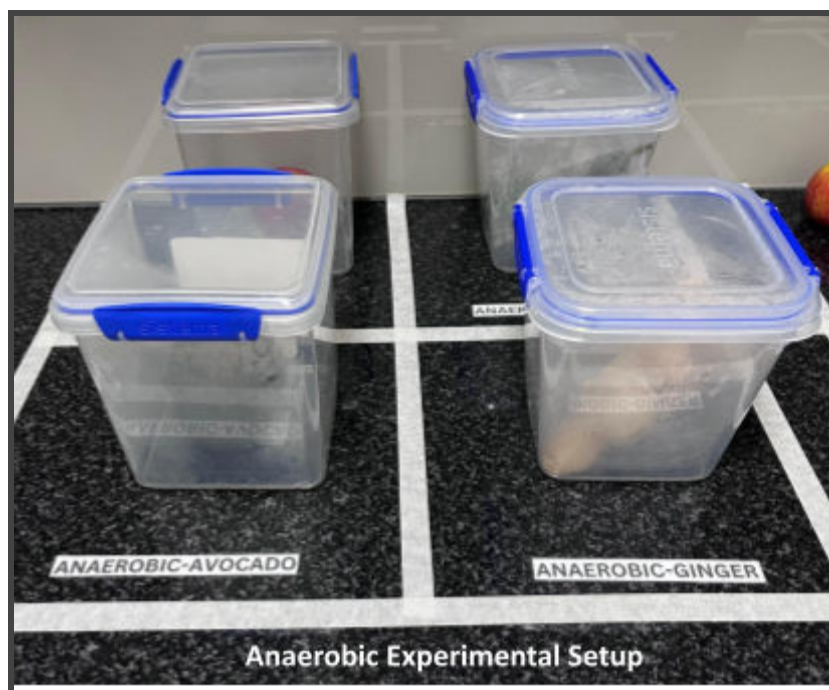
Out of curiosity, I wanted to observe decomposition on the same materials in anaerobic conditions. Although I could not create exact anaerobic conditions, I placed the same materials with similar weights in separate tightly closed containers.

I observed that the materials decomposed much slower. During the period, cucumber and apple barely decomposed and the avocado and ginger made decent progress. I think it was because only a certain amount of oxygen was in the container, and there was less bacteria floating around. The moisture condensed into mist on the inside walls of the containers. I recorded the changes in colour, mould and weight in my logbook. Aerobic detritivores like aerobic bacteria, actinomycetes and fungi work together to break

complicated molecules in composting. Aerobic decomposition allows oxygen which helps to completely break down carbohydrates into carbon dioxide. But in the containers, there was very less air and oxygen, hence comparatively decomposition was slower.

In future, I would like to create actual anaerobic conditions with no oxygen at all and observe how it would affect the process of decomposition.

Below are the observations and results.



ACKNOWLEDGEMENT AND REFERENCES

1. <https://treesforlife.org.uk/into-the-forest/habitats-and-ecology/ecology/decomposition-and-decay/>
2. <https://simplicable.com/materials/organic-materials>
3. <https://sciencenotes.org/examples-of-organic-compounds-in-everyday-life/>
4. <https://www.twinkl.com.au/teaching-wiki/decomposition>
5. <https://quadram.ac.uk/spotlight/apple-facts/#:~:text=Apples%20contain%20dietary%20fibre%20in,than%2080%25%2C%20is%20water.>
6. <https://www.universityofcalifornia.edu/news/10-things-you-probably-didnt-know-about-pumpkins#:~:text=Technically%20a%20fruit%2C%20the%20pumpkin,pumpkins%20are%2092%20percent%20water.>
7. [https://en.wikipedia.org/wiki/Pumpkin#:~:text=Pumpkin%20is%2092%25%20water%2C%206.5,1%25%20protein%20\(table\).](https://en.wikipedia.org/wiki/Pumpkin#:~:text=Pumpkin%20is%2092%25%20water%2C%206.5,1%25%20protein%20(table).)
8. [https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10669910/#:~:text=Ginger%20comprises%20carbohydrates%20\(60%E2%80%9370,%2C%20and%20phosphorus%20%5B5%5D](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10669910/#:~:text=Ginger%20comprises%20carbohydrates%20(60%E2%80%9370,%2C%20and%20phosphorus%20%5B5%5D)

9. <https://www.bbc.co.uk/bitesize/guides/zw4n97h/revision/7#:~:text=With%20little%20or%20no%20water,then%20absorb%20any%20dissolved%20molecules.>
10. https://www.scielo.cl/scielo.php?script=sci_arttext&pid=S0718-95162015000300020#:~:text=Results%20indicate%20that%20fresh%20herb,aromatic%20and%20aliphatic%20compounds%20increase.
11. <https://www.medicalnewstoday.com/articles/318620#nutrition>
12. Image source: <https://aaaksc.com/what-is-decomposition/>
13. Mrs. Gilligan, science teacher, Glendal Primary School, Glen Waverley– helped me by teaching me about decomposition and detritivores in a science unit.