An Investigation into the relative gluten content of wheat flours

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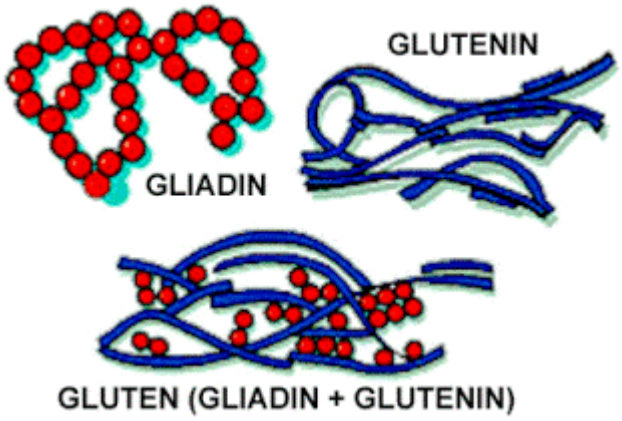
Background Research

Earlier this year, my younger cousin was diagnosed with coeliac disease and at family functions there is much concern as to whether foods being served contain gluten. I am interested to find out a little bit more about coeliac disease and gluten and have decided to investigate.

Gluten does not actually exist naturally. It is a water insoluble, elastic, stretchy protein that is formed when wheat flour is mixed with water. Two proteins, glutenin and gliadin are found in the seeds of wheat and related grains and so are in the flour that is made from them. Gliadin are mainly small protein molecules (monomers), while glutenin molecules are typically larger proteins (polymers). When these two proteins come into contact with water they are hydrated, collide with each other and join together to make an even larger protein polymer called gluten. The process of kneading helps rearrange, stretch and elongate glutenin and gliadin until they are so arranged that the elastic network of gluten can be pulled and stretched without tearing. This gluten network plays an essential role in food production, particularly in bread manufacture. The network of gluten traps carbon dioxide bubbles produced by yeast or baking soda and the trapped bubbles make the bread rise.



Coeliac disease is an allergic reaction to gluten. The allergy is linked to the part of the gluten protein gliadin. It's an autoimmune disease that damages the small intestine and at this stage there is no known cure so eliminating gluten from your diet is the only way for people with coeliac disease to stay healthy. Coeliac disease tends to cluster in families. Although the genes associated with coeliac disease are known, the actual inheritance pattern is unknown.

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Aim

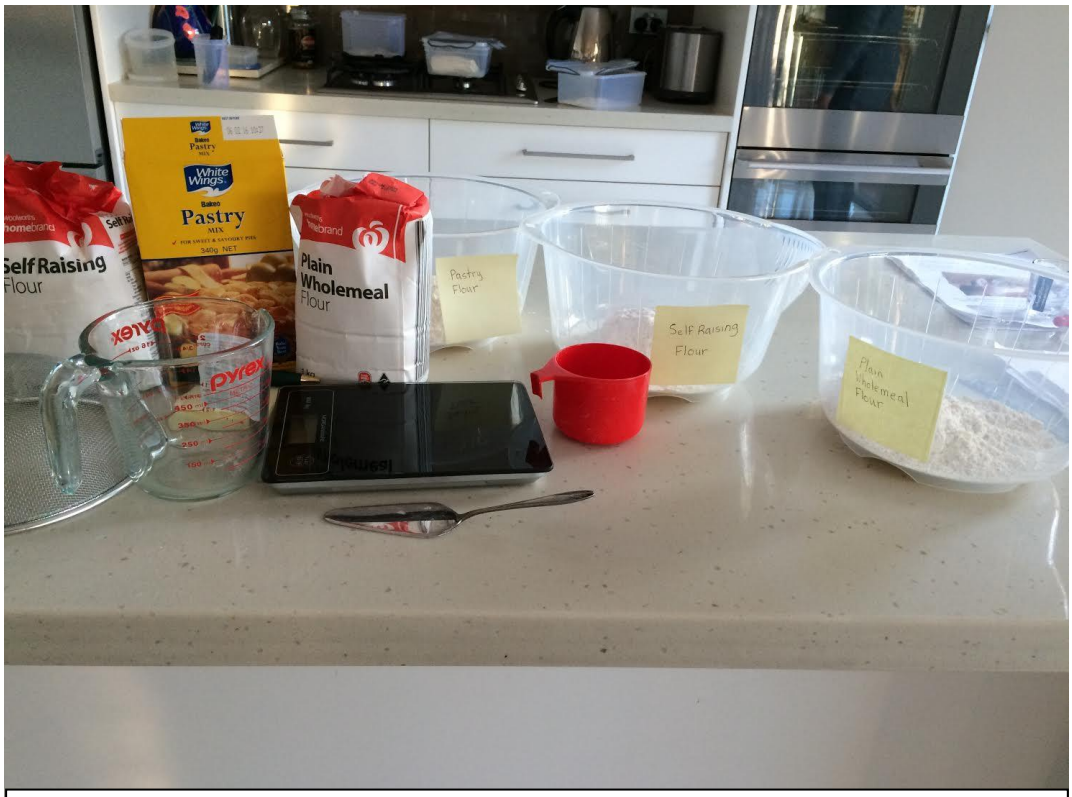
To determine under the same controlled conditions which type of flour, plain, wholemeal or bread & pizza contains the most gluten.

Hypothesis

The bread & pizza flour will contain the most gluten.

Equipment

- 3 cups of Home Brand Wholemeal flour
- 3 cups of Lighthouse Bread & Pizza flour
- 3 cups of Home Brand Plain flour
- 1x Electronic balance
- 3x Mixing bowls
- 1x Measuring Cup
- 3x Forks
- 1x Measuring spoon
- 3x Chopping boards
- 3x Plates
- 1x Sieve
- Stopwatch
- Sticky notes
- Assistant
- Knife



Equipment used in Experiment

170312 Variables

Independent Variable

-Type of flour (plain, wholemeal and self-raising)

Dependent Variable

-The mass of gluten

Controlled Variables

-Quantity of flour

-Volume of water

-Temperature of water

-Kneading time

-Resting time after being kneaded

-Electronic Balance

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Method

1. 1 cup of wholemeal flour, 1 cup of plain flour and 1 cup of bread & pizza flour were each placed in separate small mixing bowls. Each mixing bowl was given a sticky note label with the type of flour on it.
2. ½ a cup of water was slowly added to the flour while being mixed with a fork.
3. Once the flour was in the shape of a ball, a tablespoon of the same flour was sprinkled onto the chopping board and 1 teaspoon of the same flour onto the hands of the kneader. The flour was kneaded for 10 minutes then left to rest for 10 minutes.
4. The sieve was placed in the sink and the ball of kneaded flour was gently pulled and stretched over the sieve with tap water running over it until very little milky white liquid was coming out. This washed away all the water-soluble parts but left behind the gluten.
5. The ball of gluten was left until dry and then the plate was weighed on the electronic balance. The ball of gluten from the flour was placed on the plate on the scales. The weight on the scales minus the weight of the plate (the actual weight of the gluten ball) was recorded.
6. Steps 2-5 were repeated with the bread & pizza flour and plain flour.
7. Steps 1-6 were repeated 2 more times.

Wholemeal flour being kneaded

Starch being washed out of flour

170312 Risk Assessment

Science Practical Activity Risk Assessment

Step 1: Identify the hazard	CSIS User code (for chemicals only	Step 2: Strategies to minimise the hazard	Step 3: Assess the risk	Step 4: What if something goes wrong?	Step 5: Packing up
Water spilling on to floor can cause falls.	na	Carry water carefully and keep water away from the edge of the table.	1+1=2 LOW RISK	In case of an injury, seek first aid and wipe up spill to avoid further accidents.	Pour any leftover water down the sink and dry wet equipment.
Flour can get into eyes.	na	Keep flour in bowls when not being used. Wash the flour of the hands of the kneader.	1+1=2 LOW RISK	In case of contact with eyes, wash flour out of eyes with clean water. If eyes are sore and/or irritated, seek first aid.	Pack away into containers without spilling any and wash hands clean afterwards.

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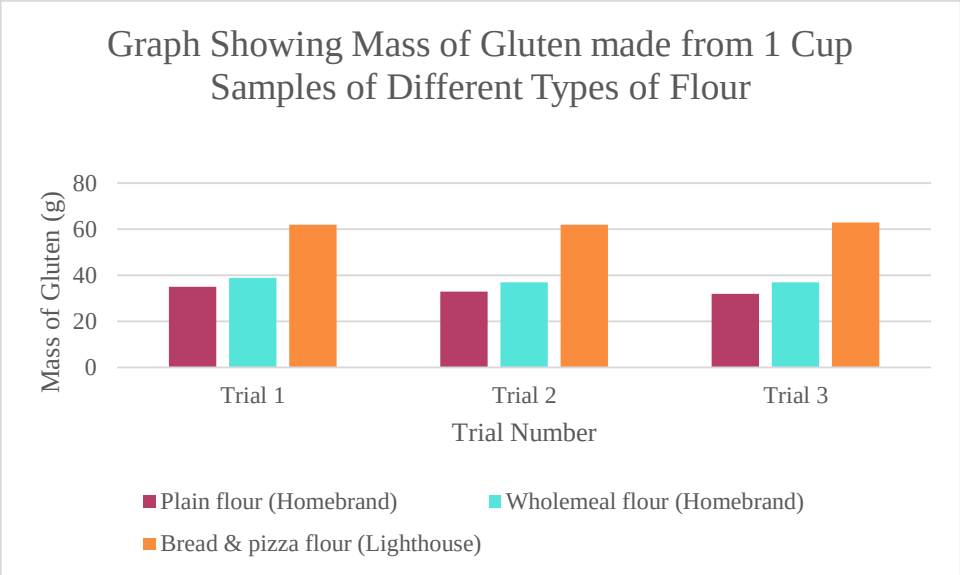
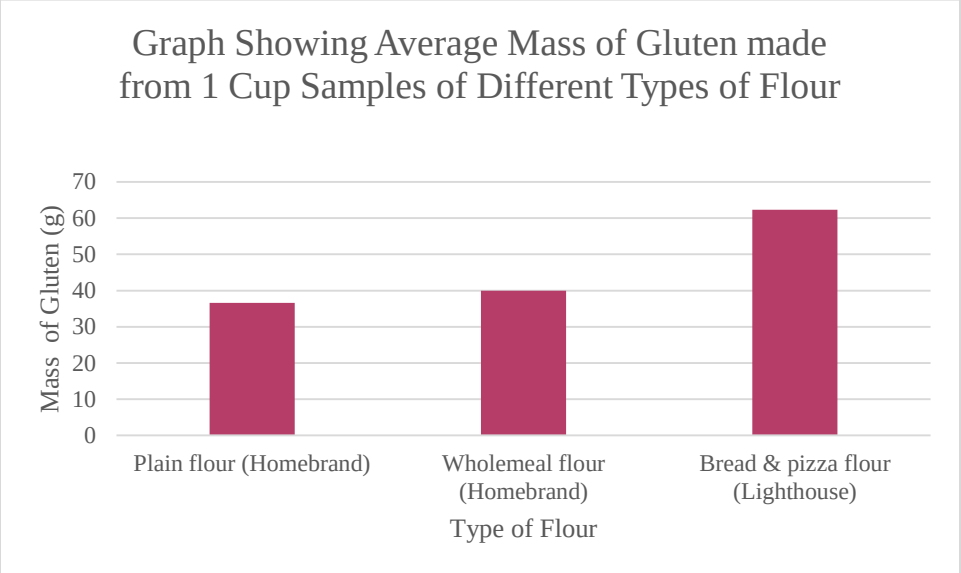
Results

Mass of Gluten made from 1 Cup Samples of Different Types of Flour

Type of Flour	Mass (g) of Gluten Produced			
	Trial 1	Trial 2	Trial 3	Average
Plain Flour (Home Brand)	35	33	32	36.66…
Wholemeal Flour (Home Brand)	39	37	37	40
Bread & Pizza Flour (Lighthouse)	62	62	63	62.33…





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Discussion

The Bread & Pizza flour contained the most gluten of the 3 flours after being kneaded for 10 minutes while the Plain flour contained the least. These results supported the hypothesis.

Bread and Pizza flour is used in baking bread and pizza bases and therefore must create stronger dough with greater elasticity than other types of flour. To achieve this ideal texture for the dough, gluten is necessary for making it strong and stretchy and for making the bread rise by reacting with yeast. This must be the reason for the Bread and Pizza flour containing the most gluten of the 3 flours.

The reliability of the results is high because the experiment was conducted three times with only a slight variation in results. In each trial the Bread & Pizza flour's gluten weighed the most and the Plain flour's gluten weighed the least. The accuracy of the measurements is high because an electronic balance was used and the results were recorded in grams.

People with coeliac disease or gluten intolerance can have only little or no gluten. Knowing which types of flour contain the most and least gluten would be very important and helpful for people like this. Knowing which types of flour contain the most gluten can also be important for cooking. When baking foods that need to rise, it is better to have a flour with more gluten because it reacts with the yeast and traps rising air bubbles which will make the bread rise. However, when trying to bake a cake, bread & pizza flour would not be ideal because it is too strong and stretchy while cake is supposed to have a light and fluffy texture.

Although the results were very reliable, there were some problems encountered. The balls of gluten were left until dried before being weighed, however, there was no real way to know for certain that all the water was gone entirely. Perhaps if this experiment was repeated, it would be better to place the gluten balls inside the oven to dry before weighing them. Another possible error in the experiment is that the wholemeal and plain flour were the same brand (Homebrand), while the bread & pizza flour was a different brand (Lighthouse). This could be classified as a second independent variable and the same brand of each flour should have been used.

Glutenin and gliadin are two proteins found in the seeds of wheat and therefore are found in all wheat flours. When they come into contact with water they are hydrated and come together to form a larger protein called gluten. The process of kneading stretches and rearranges the glutenin and gliadin until the elastic network of gluten can't be torn.

This could be further investigated. Because kneading is essential in producing gluten, the time each flour was kneaded for was a very important controlled variable in this experiment. Another experiment idea could be 'Does plain flour contain the most gluten after 0 minutes, 5 minutes or 10 minutes of kneading?'

Ball of wholemeal gluten

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Conclusion

Bread & pizza flour contains the most gluten of the 3 flours tested (bread & pizza, plain and wholemeal) while the plain flour contains the least gluten.

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