**Experimental Data Sets**

The following data sets are useful when exploring fermentation to make a dough. During fermentation with yeast, a sugar substrate is mixed with a yeast suspension and carbon dioxide and ethanol are produced. The carbon dioxide gas causes the dough to rise. The height of the dough can be measured as an indirect measure of carbon dioxide production as a result of fermentation.

In this document, we look at the following independent variables:

* Type of flour
* Mass of yeast
* Type of sugar
* Mass of sugar
* Incubation temperature
* Incubation time

|  |
| --- |
| The basic recipe for each of the investigations below was:   * 1 teaspoon sugar * 0.5 teaspoon yeast * 80 cm3 warm water   + *Leave for 5 minutes* * 100 g flour   + Mix all ingredients together   + Measure the height of the dough using a ruler   + Incubate at 40 °C for 60 minutes   + Measure the height of the dough after 60 minutes. |

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**Effect of FLOUR TYPE**

***Brief overview of the method***

Sugar (sucrose), yeast and warm water were mixed in 4 Ziploc bags and left for 5 minutes. A different type of flour was added to each bag and mixed inside the bag. A ruler was used to measure the height of dough at the start of the experiment. The bag of dough was left at 40 C for 60 minutes and then the height of the dough was measured again. The change in dough height in one hour was calculated.

***Trial 1***

|  |  |  |  |
| --- | --- | --- | --- |
| **Type of flour** | **Height of dough at start (mm)** | **Height of dough after 60 min (mm)** | **Change in dough height (mm/hr)** |
| Strong white bread flour |  |  |  |
| Wholemeal bread flour | 21 | 26 | 4 |
| Plain flour |  |  |  |
| Self-raising flour | 23 | 69 | 46 |

***Trial 2***

|  |  |  |  |
| --- | --- | --- | --- |
| **Type of flour** | **Height of dough at start (mm)** | **Height of dough after 60 min (mm)** | **Change in dough height (mm/hr)** |
| Strong white bread flour |  |  |  |
| Wholemeal bread flour | 22 | 30 | 8 |
| Plain flour |  |  |  |
| Self-raising flour | 25 | 67 | 42 |

***Trial 3***

|  |  |  |  |
| --- | --- | --- | --- |
| **Type of flour** | **Height of dough at start (mm)** | **Height of dough after 60 min (mm)** | **Change in dough height (mm/hr)** |
| Strong white bread flour |  |  |  |
| Wholemeal bread flour | 23 | 30 | 7 |
| Plain flour |  |  |  |
| Self-raising flour | 25 | 72 | 47 |

***Average***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Type of flour** | **Change in dough mm/hr** | | | |
| **Trial 1** | **Trial 2** | **Trial 3** | **Average** |
| Strong white bread flour |  |  |  |  |
| Wholemeal bread flour | 4 | 8 | 7 | 6 |
| Plain flour |  |  |  |  |
| Self-raising flour | 46 | 42 | 47 | 45 |

**Effect of YEAST MASS**

***Brief overview of the method***

Sugar (sucrose), different masses of yeast and warm water were mixed in 4 Ziploc bags and left for 5 minutes. Self-raising flour was added to each bag and mixed inside the bag. A ruler was used to measure the height of dough at the start of the experiment. The bag of dough was left at 40 C for 60 minutes and then the height of the dough was measured again. The change in dough height in one hour was calculated.

***Trial 1***

|  |  |  |  |
| --- | --- | --- | --- |
| **Mass of yeast (tsp)** | **Height of dough at start (mm)** | **Height of dough after 60 min (mm)** | **Change in dough height (mm/hr)** |
| 0 |  |  |  |
| 0.25 |  |  |  |
| 0.5 |  |  |  |
| 1 |  |  |  |

***Trial 2***

|  |  |  |  |
| --- | --- | --- | --- |
| **Mass of yeast (tsp)** | **Height of dough at start (mm)** | **Height of dough after 60 min (mm)** | **Change in dough height (mm/hr)** |
| 0 |  |  |  |
| 0.25 |  |  |  |
| 0.5 |  |  |  |
| 1 |  |  |  |

***Trial 3***

|  |  |  |  |
| --- | --- | --- | --- |
| **Mass of yeast (tsp)** | **Height of dough at start (mm)** | **Height of dough after 60 min (mm)** | **Change in dough height (mm/hr)** |
| 0 |  |  |  |
| 0.25 |  |  |  |
| 0.5 |  |  |  |
| 1 |  |  |  |

***Average***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Mass of yeast (tsp)** | **Change in dough mm/hr** | | | |
| **Trial 1** | **Trial 2** | **Trial 3** | **Average** |
| 0 |  |  |  |  |
| 0.25 |  |  |  |  |
| 0.5 |  |  |  |  |
| 1 |  |  |  |  |

**Effect of TYPE OF SUGAR**

***Brief overview of the method***

Different types of sugar (glucose, sucrose, lactose or starch), yeast and warm water were mixed in 4 Ziploc bags and left for 5 minutes. Self-raising flour was added to each bag and mixed inside the bag. A ruler was used to measure the height of dough at the start of the experiment. The bag of dough was left at 40 C for 60 minutes and then the height of the dough was measured again. The change in dough height in one hour was calculated.

***Trial 1***

|  |  |  |  |
| --- | --- | --- | --- |
| **Type of sugar** | **Height of dough at start (mm)** | **Height of dough after 60 min (mm)** | **Change in dough height (mm/hr)** |
| Glucose | 26 | 80 | 54 |
| Sucrose | 23 | 69 | 46 |
| Lactose | 20 | 40 | 20 |
| Starch | 20 | 34 | 14 |

***Trial 2***

|  |  |  |  |
| --- | --- | --- | --- |
| **Type of sugar** | **Height of dough at start (mm)** | **Height of dough after 60 min (mm)** | **Change in dough height (mm/hr)** |
| Glucose | 25 | 75 | 50 |
| Sucrose | 24 | 65 | 41 |
| Lactose | 20 | 39 | 19 |
| Starch | 20 | 30 | 10 |

***Trial 3***

|  |  |  |  |
| --- | --- | --- | --- |
| **Type of sugar** | **Height of dough at start (mm)** | **Height of dough after 60 min (mm)** | **Change in dough height (mm/hr)** |
| Glucose | 24 | 76 | 52 |
| Sucrose | 24 | 62 | 38 |
| Lactose | 21 | 37 | 16 |
| Starch | 22 | 29 | 7 |

***Average***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Type of sugar** | **Change in dough mm/hr** | | | |
| **Trial 1** | **Trial 2** | **Trial 3** | **Average** |
| Glucose | 54 | 50 | 52 | 52 |
| Sucrose | 46 | 41 | 38 | 42 |
| Lactose | 20 | 19 | 16 | 18 |
| Starch | 14 | 10 | 7 | 10 |

**Effect of MASS OF SUGAR**

***Brief overview of the method***

Different mass of sugar (sucrose), yeast and warm water were mixed in 4 Ziploc bags and left for 5 minutes. Self-raising flour was added to each bag and mixed inside the bag. A ruler was used to measure the height of dough at the start of the experiment. The bag of dough was left at 40 C for 60 minutes and then the height of the dough was measured again. The change in dough height in one hour was calculated.

***Trial 1***

|  |  |  |  |
| --- | --- | --- | --- |
| **Mass of sugar (tsp)** | **Height of dough at start (mm)** | **Height of dough after 60 min (mm)** | **Change in dough height (mm/hr)** |
| 0 |  |  |  |
| 0.5 |  |  |  |
| 1 |  |  |  |
| 1.5 |  |  |  |

***Trial 2***

|  |  |  |  |
| --- | --- | --- | --- |
| **Mass of sugar (tsp)** | **Height of dough at start (mm)** | **Height of dough after 60 min (mm)** | **Change in dough height (mm/hr)** |
| 0 |  |  |  |
| 0.5 |  |  |  |
| 1 |  |  |  |
| 1.5 |  |  |  |

***Trial 3***

|  |  |  |  |
| --- | --- | --- | --- |
| **Mass of sugar (tsp)** | **Height of dough at start (mm)** | **Height of dough after 60 min (mm)** | **Change in dough height (mm/hr)** |
| 0 |  |  |  |
| 0.5 |  |  |  |
| 1 |  |  |  |
| 1.5 |  |  |  |

***Average***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Mass of sugar (tsp)** | **Change in dough mm/hr** | | | |
| **Trial 1** | **Trial 2** | **Trial 3** | **Average** |
| 0 |  |  |  |  |
| 0.5 |  |  |  |  |
| 1 |  |  |  |  |
| 1.5 |  |  |  |  |

**Effect of INCUBATION TEMPERATURE**

***Brief overview of the method***

Sugar (sucrose), yeast and warm water were mixed in 4 Ziploc bags and left for 5 minutes. Self-raising flour was added to each bag and mixed inside the bag. A ruler was used to measure the height of dough at the start of the experiment. The bag of dough was incubated at various temperatures for 60 minutes and then the height of the dough was measured again. The change in dough height in one hour was calculated.

***Trial 1***

|  |  |  |  |
| --- | --- | --- | --- |
| **Incubation temperature (°C)** | **Height of dough at start (mm)** | **Height of dough after 60 min (mm)** | **Change in dough height (mm/hr)** |
| 4 | 23 | 23 | 0 |
| 20 | 25 | 34 | 10 |
| 40 | 26 | 69 | 37 |
| 60 |  |  |  |

***Trial 2***

|  |  |  |  |
| --- | --- | --- | --- |
| **Incubation temperature (°C)** | **Height of dough at start (mm)** | **Height of dough after 60 min (mm)** | **Change in dough height (mm/hr)** |
| 4 |  |  |  |
| 20 |  |  |  |
| 40 |  |  |  |
| 60 |  |  |  |

***Trial 3***

|  |  |  |  |
| --- | --- | --- | --- |
| **Incubation temperature (°C)** | **Height of dough at start (mm)** | **Height of dough after 60 min (mm)** | **Change in dough height (mm/hr)** |
| 4 |  |  |  |
| 20 |  |  |  |
| 40 |  |  |  |
| 60 |  |  |  |

***Average***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Incubation temperature (°C)** | **Change in dough mm/hr** | | | |
| **Trial 1** | **Trial 2** | **Trial 3** | **Average** |
| 4 |  |  |  |  |
| 20 |  |  |  |  |
| 40 |  |  |  |  |
| 60 |  |  |  |  |

**Effect of INCUBATION TIME**

***Brief overview of the method***

Sugar (sucrose), yeast and warm water were mixed in 4 Ziploc bags and left for 5 minutes. Self-raising flour was added to each bag and mixed inside the bag. A ruler was used to measure the height of dough at the start of the experiment. The bag of dough was incubated at 40 °C for various durations and then the height of the dough was measured again. The change in dough height in one hour was calculated.

***Trial 1***

|  |  |  |  |
| --- | --- | --- | --- |
| **Incubation duration (min)** | **Height of dough at start (mm)** | **Height of dough after 60 min (mm)** | **Change in dough height (mm/hr)** |
| 30 |  |  |  |
| 60 | 23 | 69 | 46 |
| 90 |  |  |  |
| 120 |  |  |  |

***Trial 2***

|  |  |  |  |
| --- | --- | --- | --- |
| **Incubation duration (min)** | **Height of dough at start (mm)** | **Height of dough after 60 min (mm)** | **Change in dough height (mm/hr)** |
| 30 |  |  |  |
| 60 |  |  |  |
| 90 |  |  |  |
| 120 |  |  |  |

***Trial 3***

|  |  |  |  |
| --- | --- | --- | --- |
| **Incubation duration (min)** | **Height of dough at start (mm)** | **Height of dough after 60 min (mm)** | **Change in dough height (mm/hr)** |
| 30 |  |  |  |
| 60 |  |  |  |
| 90 |  |  |  |
| 120 |  |  |  |

***Average***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Incubation duration (min)** | **Change in dough mm/hr** | | | |
| **Trial 1** | **Trial 2** | **Trial 3** | **Average** |
| 30 |  |  |  |  |
| 60 |  |  |  |  |
| 90 |  |  |  |  |
| 120 |  |  |  |  |