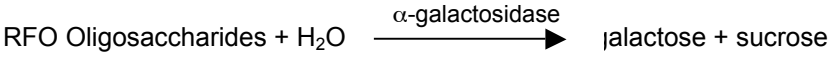
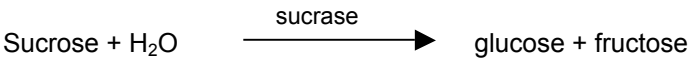
Flatulence

Carbohydrates, Digestion & Enzymes

Experimental Background:

Stock solutions were prepared by soaking ~50g of raw RFO containing produce, which were selected from the Table: *Foods Associated with Flatulence*, with 100mL of deionized water at 25 ^{o}C for 12h. Each of the stock solutions served as the initial stock substrate $[S]_o$ solution that was diluted and incubated with active enzymes: α-galactosidase and sucrase, which are contained in *Beano*. They produce glucose and fructose.





Procedure: *(The following procedure was followed for peas and kidney beans.)*

5mL of each of the respective produce solutions was placed in a vial and labeled $[S]_o$. A second 5mL aliquot was diluted with deionized water to 10mL and labeled $0.5[S]_o$. 5mL of this solution was diluted to 10mL and placed in a third vial labeled as $0.25[S]_o$. The vials were sealed and placed in a constant temperature water bath for 20-30 minutes at either 25 ^{o}C or 35 ^{o}C. 10μL of liquid *Beano* was added to each vial and the time recorded. One drop from each substrate vial was tested every 5-10 minutes over a period of 40-50 minutes using a glucometer. (Glucometers are used by diabetics to monitor their blood sugar levels.) The cost per analysis is ~$0.50.

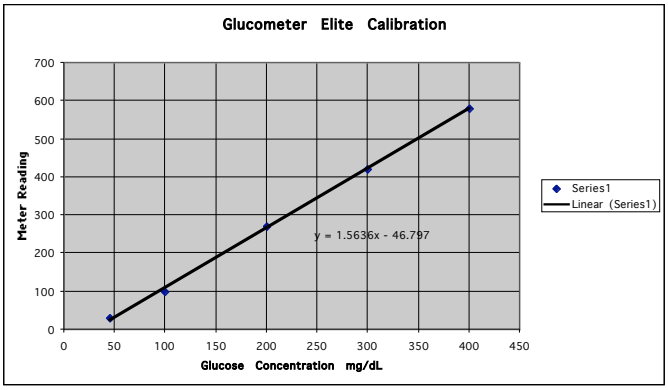
At the end of the test period, 4-5 drops of 0.1 M $HCl_{(aq)}$ were added to vial $[S]_o$. Placed in a constant temperature bath for ~5min, then tested.

Data:

Sugar Source	*Concentration* [S]o [S]o =100mL deionized H_2O Extracts of 50g of produce time (min)	*Reading* Glucometer (mg/dL) (lo = below detection limit)	*Temperature* (oC)
Split Green Peas	[S]o		25
	5	110	
	15	402	
	25	526	
	35	582	
	45	574	
	+ 0.1M HCl		
	25	110	
	0.25[S]o		25
	10	68	
	20	131	
	30	151	
	40	149	
	0.25[S]o		35
	12	44	
	22	139	
	38	140	
	59	135	
Red Kidney Beans	0.5[S]o		25
	3	32	
	14	41	
	17	53	
	40	52	
	0.5[S]o		35
	12	63	
	28	74	
	36	69	
	45	74	

Post-lab Questions: (***Clearly*** and ***neatly*** answer the following questions on separate pages and turn in. Can be done in partnerships of no larger than three members per group.)

1. Draw a Haworth structure for sucrose.
2. Draw Fisher formulas for the un-cyclized forms of D-glucose and D-fructose.
3. What are the respective molecular formulas of a) verbascose, b) stachyose, and c) raffinose?
4. How many grams of galactose would be produced by complete hydrolysis of 5 mmol of a) verbascose, b) stachyose, and c) raffinose respectively?
5. Glucometers are calibrated for blood chemistry and not for simple aqueous solutions. Therefore, using the calibration graph that follows, convert the *Glucometer Elite*™ data readings for split green peas to respective concentrations of glucose. Place them in a separate table and graph the concentrations versus time for each of the 3 substrate trials on the same graph.



6. The *Glucometer Elite*™ measures the concentration of only the β-anomer of D-glucose. A computer chip processes the input to determine the overall concentration of glucose. The calibration curve that was produced used glucose solutions that were prepared 12h before analysis. Draw Haworth structures for the α-anomer and β-anomer of D-glucose and use them to explain how mutarotation and K_{eq} need to be considered in programming and building the chip in the *Glucometer Elite*™.

7. Do you think that *Beano* is just as effective *in vivo* as in these tests? Explain within the context of stomach acidity and oral administration.

8. What volume of gas could gastrointestinal bacteria theoretically produce from complete fermentation of 100g of red beans that were eaten by Dr. R. in his favorite Los Panchos' burrito? Clearly state your assumptions and show your calculation. (A review of General Chem gas laws would be a good place to begin. You can assume that Los Pancho's would produce nothing less than "ideal" gases.)

9. Would washing raw beans, discarding the water, and then cooking them have an effect on the RFO concentration in the cooked beans? Explain your answer.

10. Refer to the graph below. Would *Beano* work if added to foods before cooking? Estimate the optimum temperature for *Beano* performance. Explain your answers.