FIRST CHEM BOOK 2 CHAPTER 3

REFINED SUGAR IN the DIET and TYPE 2 DIABETES

Type 2 diabetes, due to a diet high in refined sugar is on the rise and affecting all ages the world over. Sugar is a carbohydrate that can be a large complex molecule like cellulose, starch and glycogen of small sugar units termed monosaccharides (1 unit) or disaccharides (2 units). In the process of refining sugar, complex carbohydrate is converted into these small sugar units.

The cause of Type 2 Diabetes is man's genetics that is not suited to, and cannot adapt to, a steady daily intake of small sugar molecules, that scenario leading to failure of the hormone and transporter responses that regulate small sugar molecule levels, like that of glucose in the blood. Man's genetics has evolved over millions of years to be suited to a diet of complex carbohydrates like starch and glycogen that take time to digest ensuring there are no spikes in small sugar molecules in the blood. Glucose from a candy bar can be in the blood in a few minutes while glucose derived from eating potatoes or rice will enter the blood slowly over many tens of minutes to an hour and there will be no glucose spikes.

The health problem of small sugar molecules is as follows: A linear rather than a ring form of small sugars has an aldehyde group which can react adversely with body tissues particularly the delicate capillaries of the eye, the kidneys and peripheral limb capillaries of the toes. The linear form is present in the blood only at the 3% level but a sudden intake of refined sugar raises the amount of the damaging linear form.

Eating delicious cakes and exotic deserts full of refined sugar is not a problem and gives much pleasure – the problem comes when every day, and then day after day throughout the year one's liquid and solid food all contain refined sugar.

The diet must supply:

1) Liquids like water, milk and wine.
2) Minerals like calcium, iron and zinc.
3) Carbohydrates to be broken down via digestion to small monosaccharide sugars.
4) Proteins to be broken down by digestion to amino acids.
5) Fats to be broken down by digestion to free fatty acids.

Man's genes for millions of years have evolved to let him survive periods of hunger. Ideally man eats protein, fats and carbohydrates that are broken down by digestive enzymes into smaller basic units. If protein in the diet is lacking some amino acids, the basic unit of protein can be obtained from the basic units of fat and carbohydrate being converted to amino acids. Complex carbohydrates are slowly digested to small sugar units like glucose meaning there is no spike in blood glucose which occurs after drinking a can of soda. Eating also raises blood potassium (in the form of K^+ a metal ion) a state that will tend to depolarize cells. In healthy people the clearance of glucose from the blood after a meal to the cells also clears the high potassium. **Examples of complex carbohydrates are potatoes, beans, rice, pasta, maize.** Examples of refined carbohydrates are soda drinks, cakes, candy bars and even restaurant chain hamburgers which are laced with sugar plus tasty spices.

The various metabolic pathways in cells interconnect and the digestive units from proteins, fats and complex carbohydrate enter these interconnecting metabolic pathways. When you are genuinely hungry after not eating for 4 hours or food types in your diet are lacking from a poor diet, because the metabolic pathways interconnect, the missing food type can often be supplied. Some carbohydrates can be converted to amino acids the basic unit of protein and the reverse is possible when carbohydrate is needed. Man's diet also has certain essential chemicals that can't be made by interconnecting metabolic pathways and these must be eaten e.g. the amino acids, histidine, isoleucine and lysine.

Various hormones control the metabolic pathway interconversions by acting on chemicals that supply the reactants. Low blood sugar levels in hunger will release the hormone glucagon which will cause glycogen, a large complex carbohydrate of many glucose units be acted upon by enzymes that release some of the glucose units, correcting the low blood glucose level. A diet high in refined sugar and/or snacks between meals of candy results in a poor response from these interconnecting metabolic pathways. Basically, these pathways need to be used fairly regularly. Its healthy to be hungry a few times per week and initiate the release of glucagon to raise blood glucose via breaking down glycogen. Perpetual high blood glucose from sugary snacks means the glucagon response in never used.

The food industry since the 2nd world war has steadily via advertising hooked man on refined sugar. It is usually the sucrose but lately also fructose made from corn. Refined sugars are all cheap, taste good and upwardly mobile populations want to forget the days in their past when they were very poor, often hungry - they embrace this diet to their peril. If they are lucky the problems don't hit until they are quite old but today their grandchildren are frequently obese and many already have symptoms of Type 2 diabetes even before they are teenagers.

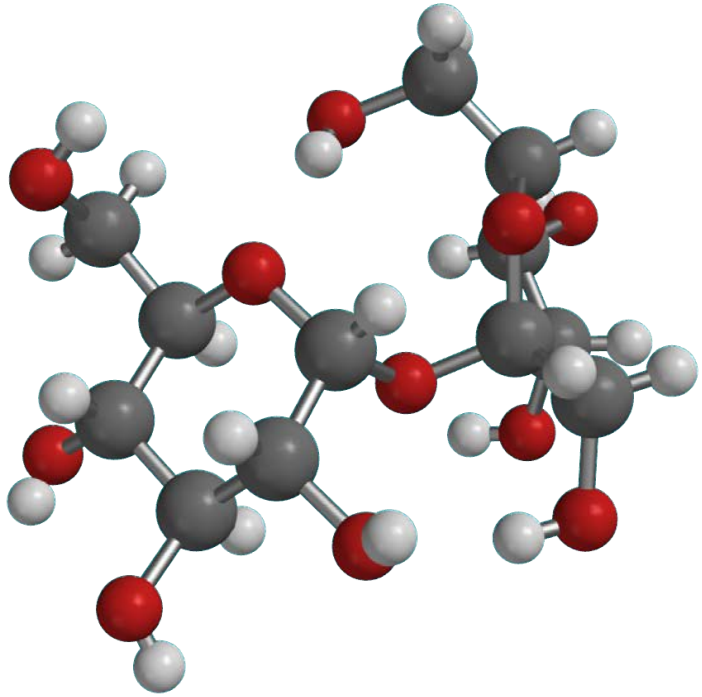
Now we name the good and bad players in this problem:

1) COMPLEX POLYMER CARBODRATES - GOOD PLAYERS

3 complex carbohydrates are starch, cellulose and glycogen which are all polymers of glucose. Starch and cellulose are found in plants, with the latter only digested by animals like cows. Man can digest starch and glycogen. Glycogen has 3 times more branches than starch and both are digested slowly to yield glucose units at a steady rate.

2) DISACCHARIDES like SUCROSE – BAD PLAYER

Sucrose consists of a 6 membered glucose ring joined to a 5 membered fructose ring – here the fructose is bent at right angles to the glucose unit. Format = Ball and Spoke. Atom key: Hydrogen white, Carbon black, Oxygen red.



Commercially sucrose it is made from sugar cane (hot climates) or sugar beet (cold climates) sources of sucrose. The plants are crushed, mixed with water to dissolve the sugar, passed over carbon filters to remove brown color, concentrated by boiling under vacuum and crystallized out as white granules.

3) MONOSACCARIDE SINGLE SUGAR UNITS like GLUCOSE & FRUCTOSE –

BAD PLAYERS particularly when linear with free aldehyde groups

97% of blood glucose is the ring form (left molecule) and 3% the linear form with a free aldehyde group (right molecule). The aldehyde group (blue ring on right molecule) tends to react chemically with delicate capillaries beds and damages the capillary structure particularly in the eye, the kidneys and peripheral limbs like toes. When blood glucose is below 80mg/ml this is not a problem as the level is so low but it becomes a problem when blood glucose rises in Diabetes.

Format = Ball and Spoke. Atom key: Hydrogen white, Carbon black, Oxygen red.