Comments About My Blood Testing

By Ben Best

Glucose Monitoring

For many of my glucose tests I used the Abbott Precision Xtra until I read an article in THE JOURNAL OF DIABETES SCIENCE AND TECHNOLOGY, which gave the highest accuracy to Abbott FreeStyle Lite. I switched from using the Xtra to the FreeStyle Lite near December 2017.

I often wear a Dexcom G5 Continuous Glucose Monitor (CGM). Despite the fact that I must calibrate the CGM every 12 hours against a FreeStyle Lite blood test, the CGM seems to me to be more reliable in showing decreased blood glucose with activity (especially exercise) and increased blood glucose with inactivity. I know the CGM is measuring interstitial tissue glucose rather than the arterial blood glucose measured by the FreeStyle Lite, and I cannot assess what this means for my glucose tests.

For my food testing experiments I have not noticed a trend in the difference between my CGM and my FreeStyle Lite. Nonetheless, I often get very low CGM readings that are not credible, and are far below the FreeStyle Lite readings (especially when exercising or when in certain sitting positions that may affect blood flow to my belly).

Comments About Some of My Non-Food Tests

My week-long water-fast resulted in elevated ketones (nearly 7 mmol/L) and reduced blood glucose (below 50 mg/dL), as expected. I was surprised by the elevated triglycerides and LDL cholesterol, however, until I read some literature on fasting. Forty days of fasting by humans is associated with elevated lipolysis of triglycerides and the resulting free fatty acids – partially to increase ketone production, and partially to extract glycerol from triglycerides so that the liver can convert the glycerol into glucose. Healthy, nonobese, adults fasting for one week showed substantial lipolysis as well as LDL cholesterol.

I had hoped to determine the effects of restful nights of sleep, but was perplexed to observe that my blood pressure was higher in the mornings. My triglycerides were also elevated. These effects were probably due to cortisol, which increases shortly after awakening. In fact, it is cortisol which stimulates the lipolysis seen in fasting.

I was (and still am) perplexed by the amount of increase in my blood triglycerides following deep-tissue massage (which requires oil) in contrast to stretching massage (which does not use oil). Newborn babies have shown elevated blood triglycerides after being massaged with oil, but I would not have expected this effect in adults. I have searched the biomedical literature for an adult study on this subject, but have not found any such study.
Methods for Testing Blood Value Responses to Food

In an attempt to standardize results, I chose quantities of 400 grams for most solid foods, one liter for liquids, one kilogram for berries, and 200 grams for fat/oils. These doses were intentionally larger than what would normally be eaten because I wanted to ensure a pronounced effect. I exceeded the fat/oil quantity with sesame seeds (300 grams) because the seeds are only partially oil. I managed to eat the full 200 grams of palm kernal oil, although it was like eating candle wax, and it took me over an hour. I stopped eating the unsweetened dried cranberries after 150 grams because my mouth was burning from the acridity (which explains why commercial dried cranberries are usually loaded with sugar). Blood sampling times were hourly for most solid foods, but half-hourly for berries and liquids because the blood values changed more rapidly.

Duration of sampling ranged from 2.5 hours (strawberries) to 13 hours (olive oil). In no case did I eat anything after eating the test food until my blood sampling was complete, even though the test duration could take up to 13 hours. I generally stopped sampling when no further information was likely to be gained. But I lost patience with the olive oil. After 13 hours, ketones and triglycerides from the olive oil continued to rise, a trend which obviously could not have continued. I would guess that the triglycerides would begin to drop before the ketones, as happened with avocados and butter (although I saw the opposite with nut butter).

I often fasted for a day or more before testing (making note of hours since I last ate, but not making note of what I last ate) to ensure a wash-out of other food effects, and to increase standardization. But many times my schedule did not allow for such fasting. Fasting lowers initial glucose. The effect of low (fasting) versus high (non-fasting) initial glucose was evident in the very different ketone results for sesame seeds — about 1 mmol/L (high glucose) versus 5 mmol/L (low glucose) at the end of the test. With repeated testing for walnuts I saw similar ketone results as I had seen seen for sesame seeds corresponding to high and low initial glucose values.

Although nearly all my food tests involved only one trial, I did six trials for lactose-free sour cream. Average hours of fasting before these tests was 34.5 hours, ranging from 30 to 39 hours. As with most of my fat tests, glucose did not rise, triglycerides peaked at six hours, and ketones peaked soon thereafter (8 hours) for the average of the six trials.

The CardioChek Plus calculates LDL cholesterol based on the Friedewald equation. The Friedewald equation is used for blood tests after a 12-hour fast, when it is estimated that chylomicrons are no longer present. I immediately after eating, about 80% of blood triglycerides have been estimated to be in chylomicrons. I question this estimate based on the great variations in my triglyceride values after eating, depending on the food I chose to eat. VLDL cholesterol was estimated by Friedewald to normally be about one-fifth of the total cholesterol after fasting, so the amount of VLDL was estimated to be equivalent to one-fifth of blood triglycerides (TGs).
Thus, according to the Friedewald equation

\[ \text{LDL} = \text{Total Cholesterol} - (\text{HDL} + \text{VLDL}) \]

where VLDL is (TG/5). Insofar as I was measuring triglycerides after eating, greater inaccuracies in the LDL values would be expected very soon after eating triglyceride-raising foods. For triglycerides in the range of 200-400 mg/dL the LDL calculated value would reportedly be about 72% accurate, whereas for the 400-600 mg/dL range, the accuracy would only be about 39%. Nearly all of my triglyceride values were below 400 mg/dL, the only exception being avocado, where my triglycerides peaked at 500 mg/dL at 6 hours, and were about 400 mg/dL at 5 and 7 hours.

**Comments About Some of My Food Tests**

I did not see an increase with my blood cholesterol when eating 400 grams of eggs (about 5 eggs). People who show a large increase in blood cholesterol when eating foods high in cholesterol are called **hyper-responders**, I am evidently not a hyper-responder.

I chose palm kernal oil (47% lauric acid, 44% palmitic acid) because it is the most saturated fat I could find for my blood testing. Lauric acid, myristic acid, and palmitic acid are the saturated fats that most elevate blood cholesterol. Lauric acid and palmitic acid particularly stimulate inflammation. Myristic acid and palmitic acid increase insulin resistance more than any other saturated fatty acids.

Despite the fact that I know berries raise blood glucose, there are many benefits to berries that make me want to include them in my diet. Anthocyanins in berries reduce obesity and obesity-related chronic inflammation. Blueberries have been shown to improve insulin sensitivity and gut microbiome in rats fed a high fat diet. Humans fed freeze-dried strawberries showed a reduction in small, dense LDL cholesterol (the most harmful form of LDL cholesterol). Insulin sensitivity was improved in obese adults who took a strawberry-cranberry polyphenol extract for six weeks. Cranberries (especially the skin of cranberries) have been used for protection against urinary tract infection, protecting the gut microbiome, and improving cardiometabolic health. Cranberry polyphenols have protected experimental mice from insulin resistance, intestinal inflammation, and diet-induced obesity.

**Comments About Medium Chain Triglyceride Testing**

Ketones have many benefits, and can replace glucose as body fuel, which is why I want to increase my blood ketone levels. Ketones are produced from triglycerides, but ketone generation is faster and more efficient with Medium Chain Triglycerides (MCTs). Ketones are anti-inflammatory. Ketones inhibit cancer cell growth, in contrast to glucose, which is the preferred energy source for cancer cells. Ketones protect mitochondria. Mice fed ketones showed increase mitochondrial number and increased insulin sensitivity.

Consuming 200 grams of MCT oil was the most reckless of my experiments. Human trials have established safety of MCTs at doses of one gram MCT per kilogram of body weight, but for me 200 grams was well over triple that established safety limit. Mice have been killed with MCT at doses
equivalent to more than triple my 200 grams. Dogs administered doses equivalent to less than my 200 grams per body weight experienced vomiting and unconsciousness. Healthy humans consuming much lower doses have reported abdominal pain. I had headaches and stomach aches lasting many hours after ingesting 200 grams of MCT oil.

**Glucose and Triglycerides are more Important than Cholesterol**

Risk of coronary artery disease associated with LDL cholesterol only begins to be high above 130 mg/dL, which is the average American level of LDL. Blood tests from four independent laboratories in 2017 all have my LDL cholesterol between 60 and 70 mg/dL. Concerning glucose, according to 23andme, my greatest risk for any disease is for type 2 diabetes – a risk which is 42% above average.

But aside from my N=1 risks, I there are many reasons why triglycerides and glucose should be of greater concern for fatal disease for most people than LDL cholesterol.

**Remnant cholesterol** is all the cholesterol that is not LDL or HDL. I calculated remnant cholesterol as

\[
\text{Remnant cholesterol} = \text{Total cholesterol} - (\text{LDL} + \text{HDL} \text{ cholesterol})
\]

Remnant cholesterol is associated with chronic inflammation, whereas LDL cholesterol is not. Every increment of elevated remnant cholesterol increases the risk of heart attack. Even in statin trials in which subjects have achieved very low LDL, elevated remnant cholesterol is associated with atherosclerotic disease risk.

The extent to which blood triglycerides rise after a meal corresponds with remnant cholesterol and cardiovascular disease. Triglyceride-laden cholesterol is a greater cause of coronary heart disease than LDL cholesterol. When HDL is loaded with triglycerides, the HDL can become pro-inflammatory and cause atherosclerosis. Blood triglycerides above 280 mg/dL at any time after a test meal is associated with cardiovascular disease risk.

Persons with small, dense LDL cholesterol have much more atherosclerosis than persons with large LDL. Small, dense LDL is more easily oxidized and glycated. High carbohydrate diets (which elevate blood glucose) increase small, dense LDL, in contrast to saturated fat, which causes large fluffy LDL rather than small, dense LDL. Insulin resistance also promotes the formation of small, dense LDL.

Insulin resistance is a better indicator of cardiovascular disease risk than LDL cholesterol. Insulin resistance causes endothelial dysfunction, which leads to atherosclerosis. Elevated blood glucose causes insulin resistance. A study of more than 100,000 healthy persons showed insulin resistance to be highly predictive of cardiovascular disease, but levels of LDL cholesterol were not predictive. A study which divided 208 healthy people into thirds based on insulin resistance found that after an average 6.3 year follow-up, nearly 20% of the third with the highest insulin resistance developed stroke, cancer, high
blood pressure, coronary artery disease, or type 2 diabetes, whereas no one in the lower third
developed any of these diseases.51

Elevated blood glucose after a meal has been shown to be an even greater risk for coronary artery
disease than insulin resistance.52 Dietary sugar leads to insulin resistance, which leads to type 2
diabetes.53 About 80% of diabetics die of heart attack or stroke, while many of the other 20% die of
kidney failure.54 Type 2 diabetes reduces life expectancy by about 10, 5, or 3 years at ages 55, 65, or 75,
respectively.55

One concern I have is that so many studies of triglyceride composition of remnant cholesterol do not
distinguish the health effects of different triglyceride compositions: saturated, unsaturated, or type of
unsaturated. Nonetheless, I believe that most people should be more concerned about blood glucose
and triglycerides than about cholesterol.

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