Carbohydrate Craziness

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I. Today's Goals: To explain carbohydrate metabolism and the metabolic dangers of high-fructose corn syrup and our country's 'sugar addiction.' Let's explore the evidence and controversies with carbohydrate intake and determine the best approach for performance and health.

II. Anaerobic metabolism basics and terms

A. Where do anaerobic energy reactions take place? Sarcoplasm of muscle cell
B. Phosphagen: ATP=PC or ATP-phosphocreatine or creatine phosphate; 10-30 sec
C. Anaerobic is also referred to as glycolytic; predominates for 2 minutes; no oxygen needed
D. NADH: coenzyme in anaerobic metabolism that carries electrons and hydrogen ions (H atom=H+ and e-): coenzymes are so special in metabolism because they are not changes when they cary H+
E. Pyruvate: end product of glycolysis; junction between anaerobic and aerobic metabolism
F. Glycogenolysis: the breakdown of glycogen in muscle and liver
G. Gluconeogenesis: metabolic pathway that results in generation of glucose from non-CHO carbon substrate
H. Lactate: produced in muscle cells during the breakdown of CHO to use for energy in low oxygen level

III. Digging deeper into anaerobic energy systems

A. ATP hydrolysis = ADP + Pi + energy for work and heat; 7.3 kilocalories of usable energy
B. Review of the phosphagen system; observing the 3 high energy phosphates attached to the ribose
C. Hydrolysis of ATP: Splitting of ATP occurs by WATER: One proton (H+) is released from reaction
D. Phophocreative CrP or PCr is high energy molecule which synthesizes ATP in cell
E. Why is there such a drop in PCr in sprint exercise? 40%-60% depletion of ATP; more for PCr. ATP is supplied by the phosphagen, glycolytic and mitochondria respiration; PCr just from phosphagen: phosphagen replenishment occurs in recovery by oxidative means: Thus aerobic training improves recovery for anaerobic exercise: important training implications why doing aerobics improves anaerobic exercise.
F. Enzymes: biological catalysts; lower activation energy of a reaction; unaltered by reaction; induced fit
G. Why does our body prefer glucose for fuel; plenty of it and have all enzymes to break it down fast (we break down carbohydrates 30-40 times faster than fat)
H. Glycolysis is oldest metabolic pathway known. Why do we need 10 reaction steps? All about heat
I. Training implications of the hexokinase reaction (first reaction). Glucose is 'stuck' in cell.
J. In reaction 3 of glycolysis the enzyme is PFK. It is an allosteric enzyme. Means it is rate limiting.
K. Importance of pyruvate kinase reaction and PEP (reaction 10): body produces a lot of heat
L. Net yield of glycolysis: 2 water, 2 ATP, 2 pyruvate, 2 NADH+H+ (shuttled to 2 FAD in the ETC)
M. Lactate formation explanation:

1. At end of glycolysis the two molecules of interest are two NADH+H+ (a vitamin carrying a proton with another loosely coupled proton) and two pyruvate molecules
2. Under steady state conditions the two pyruvate go to the TCA cycle and the two NADH+H+ go to the Electron Transport Chain to be used for ATP synthesis
3. Strenuous exercise, energy demands exceed oxygen supply (pyruvate and NADH+H+ are inhibited)
4. To resolve this situation, pyruvate accepts 2 protons into its structure and temporary converts itself to lactate; so, lactate is actually a 'buffer' to acidosis and not the cause of acidosis; NAD+ returns to step 6
5. Latest on lactate and burn. The cause of the burn (or acidosis) is the accumulation of protons at the muscle myofilaments (from the splitting of ATP); not lactate; aerobic exercise is best way clear acidosis
6. Practical applications: serious body builders (who do little cardio) should do high intensity cardio (2x a week, 5min bouts at the end of the workout). This will train their buffering system to buffer acidosis. It is an 'organic ergogenic aid'. To read more about lactate go to Len's web page and do search on Lactate

IV. America's Sugar Addiction: Are we scooping too much?

A. "The evidence clearly shows that added sugars are not just empty calories, they are very hurtful calories."
B. Historical comparison: We consume approximately 66lbs of added sugar over the course of a year. In contrast, in 1790 the average yearly intake of sugar was 8lbs annually.

C. Historical reflection: added sweeteners to foods, which began as a way to combat high fat intake (and obesity) are now becoming an even bigger health problem?
D. Added Sugars: on average Americans consume 17 teaspoons of added sugars a day; Sugar is added to processed foods such as sweet drinks, cakes, cookies, candy, ice cream, yogurt, and some breads
E. Pie Chart shows that 47% of sugars is from beverages; 31% from snacks and sweets
F. Sugars other names: nectar such as peach nectar or fruit nectar; any ingredient with word 'syrup' such as corn syrup, brown rice syrup or malt syrup; any ingredient containing the end 'ose' such as sucrose, dextrose, glucose, fructose, galactose, saccharose, and mannose
G. The three simple sugars are the monosaccharaides: glucose, fuctose and galactose: every caloric sweetener in the world is formed with some combination of these: most often glucose and fructose
H. Fruits and vegetables are healthy because they have sugars in their cell walls along with minerals, vitamins, phytochemicals (chemicals that fight of pathogens), antioxidants (that fight oxidative stress) and fiber (that slows the release of sugar in the blood—keeping blood sugar levels from rising to fast).
I. Sugar message #1 to clients: our bodies evolved to metabolize small amounts of slowly digested sugars. We have not adapted well to high doses of rapidly digesting refine sugar (beet sugar or cane sugar), which has undergone a refining process
J. Sugar message #2 to clients: We are not getting fat from eating too many fruits and vegetables
K. Interesting fact: before the 2nd industrial revolution (1870-1914), carbohydrates were the major source of nutrients and energy for people throughout the world

V. Health risks of too much sugar intake
A. Added sugars, predominantly sucrose and high-fructose corn syrup, appear to be independent risk factors for cardiovascular disease, type 2 diabetes, abnormal lipids, and hypertension
B. Cardiovascular disease (CVD) risk becomes elevated once added sugar intake surpasses 15% of daily calories. People who consume approximately 17% to 21% of calories from added sugar have a 38% higher risk of CVD mortality. The Dietary Guidelines for Americans recommend limiting added sugars to less than 10% of total daily caloric intake.
C. The link of sugar intake and type 2 diabetes: consumption of sugar-sweetened beverages may be linked to 4-13% of type 2 diabetes incidence in the United States. Artificially sweetened beverages and sweetened fruit juice are not healthy options for the prevention of type 2 diabetes.
D. Sugar and blood pressure (BP): New BP guidelines: Normal is systolic <120mmHg and diastolic <80mmHg. Study results show that higher intakes of sugar are associated with harmful increases in blood pressure. The most likely explanation for the effect of higher sugars on blood pressure is the fructose component
E. Dietary fructose, particularly from sugar-sweetened beverages, has been shown to increase liver fat synthesis, which results in increased concentrations or circulating triglycerides and LDL-C (unhealthy cholesterol).
F. Food category sources of added sugars: soft drinks, sweetened tea, sweetened coffee, energy drinks, sports drinks, fruit drinks

VI. Are there unique health risks to high-fructose corn syrup (HFCS)
A. HFCS was first introduced in the 1970's
B. It is a process that converts glucose to fructose
C. HFCS makes up a very large proportion of added sweeteners in beverages and many packaged foods
D. Fructose is advantageous in processing because it is 1.5 times sweeter than sugar and inexpensive to produce
E. HFCS definitely contributes to the development of several adverse health effects including insulin resistance, high blood fats, intra-abdominal fat accumulation, high blood pressure and elevated uric acid (which contributes to kidney diseases, gout and cancer)
F. We metabolize fructose different from glucose: with fructose we make fat, pyruvate and glycogen; with glucose we make pyruvate and glycogen

G. HFCS message to fitness professionals: At this point in time, we need to determine the doses of HFCS that alter health outcomes and thus identify populations who are particularly susceptible to its adverse health effects.

VII. The I love chocolate for its flavonoids story

A. Coca beans contain a lot of flavonoids: which are powerful antioxidants that neutralize free radicals
B. Dark chocolate has more flavonoids then milk chocolate and chocolate treats
C. Dark chocolate has more healthful phytochemicals (that fight off harmful chemicals)
D. Caution: people absorb flavonoids differently
E. Message to clients: enjoy in moderation

VIII. What is the best for weight loss? Low fat or low carb

A. Recent research shows that normoglycemic individuals lose most weight on low fat, high carbohydrate diet.
B. Pre-diabetic individuals are much more susceptible to lose weight on a diet with more focus on quality of the carbohydrate content (i.e., lower glycemic index, more fiber, and more whole gain foods.
C. For the overweight and obese diabetic population a reduction in carbohydrate (low CHO) amount is pivotal, and for this group a relatively higher amount of fat and protein in the diet is beneficial for weight control and glycemic status: Circuits Developed by Terence Moriarty, M.A.

#1: 30sec each ex: 2-3min active rest: Do 2x 1. Spiderman push-ups 2. Monster walk (bands) 3. Kettlebell Turkish get-up 4. TRX "Y" fly 5. Hamstring curl (ex. Ball) 6. Knee tucks (ex. Ball)	#2: 30sec each ex: 2-3min active rest: Do 2x 1. Seated row (bands) 2. D/bell goblet squat 3. Kettlebell swing 4. Balance push-up (ex. Ball) 5. TRX single leg hamstring pull-in 6. Stability ball plank w/ directional force
#3: 20sec each ex: 3min active rest: Do 2x 1. Plyometric push-up (bosu ball) 2. Plyometric front box-jump 3. TRX burpee 4. Barbell squat jumps 5. Jumping jack push press (med ball) 6. Clean (kettlebell)	#4: 30sec each ex: 3min active rest: Do 2x 1. TRX chest fly 2. Kettlebell lunge moving under legs 3. TRX sprinter start 4. Reverse fly (bands) 5. Reverse extension (ex. Ball) 6. Med ball Russian twists
#5: 30sec each ex: 2-3min active rest: Do 2x 1. Kettlebell high pull 2. Ex. Ball lunge 3. Bear crawl with dumbbells 4. TRX atomic push-up 5. Side to side squats (bosu ball) 6. Star plank	#6: 30sec each ex: 2-3min active rest: Do 2x 1. Triceps dips (ex. Ball) 2. 90 degree squat/squat jumps (bosu) 3. Kettlebell deadlift 4. TRX power pull 5. Wall squat (ex. Ball) - isometric 6. Russian twists (bands)
#7 Trainer/Client, 30sec each ex: 2-3min active rest: Do 2x 1. Chest fly with bands 2. Dynamic lunge (bodyweight) 3. Partner floor slams (med ball) 4. Push-up with shoulder tap 5. Lunge and full body rotation (bands) 6. Partner plank & single leg hip raise	

SPECIAL SUGGESTION: To make each circuit a 'circuit-HIIT' workout incorporate 30 seconds of high intensity (hard to very hard rating of perceived exertion) on any aerobic modality followed by 3 minutes of active recovery on the modality.

Complex Sets: Complex Sets work great for fat loss clients, for variety and even for athletes for conditioning days. If you have a team you can incorporate complex sets for team challenges for time. Highly effective and used regularly in private training facilities.
Complex Set Demo: Romanian deadlift {or regular} (3-6 reps)**;** Hang clean (3-6 reps)**;** Front squat (3-6 reps) Hang snatch and then Overhead press (3-6 reps); Barbell row (3-6 reps); 3-min active rest; repeat 2-3x