



321 FIA TECH BULLETIN FRUCTOSE 02 © 2007

The patented FIA™ test for fructose intolerance, exclusively from SpectraCell, is a unique biochemical test to assess carbohydrate metabolism, with important clinical implications. This test is performed in the FIA™ Comprehensive Profile and may also be ordered individually.

FACTS ABOUT FRUCTOSE

Fructose is a monosaccharide, also known as fruit sugar, and is widely available in honey, fruit and some vegetables. Table sugar is one-half fructose which represents the major dietary source of fructose in the average American diet. High-fructose corn syrups and fruit concentrates are also major dietary sources of fructose. The average daily adult intake of fructose is 100 grams (approximately one-fourth pound).

FRUCTOSE PHYSIOLOGY

- **Readily absorbed:** Whether fructose is eaten as sucrose or as fructose itself, it is readily and completely absorbed.
- **Minimal effect on Insulin:** Fructose is metabolized in a unique manner to produce mostly glucose, lactate and uric acid. Unlike glucose, fructose does not require insulin to enter cells and it has only a minimal effect on the stimulation of insulin secretion. For these reasons, fructose is recommended as a dietary sweetener for type II non-insulin-dependent diabetics.
- **Unique Metabolism:** As soon as fructose enters the cells, it is quickly metabolized to fructose-1-phosphate. ATP- the major energy compound in cells – is used to phosphorylate fructose. In doing so, ATP and inorganic phosphate are depleted by fructose in preference to other biochemical reactions. The greater the dietary fructose load, the greater fructose entry into the cells, and the depletion of ATP and phosphate. Thus, it is likely that excess fructose commandeers metabolic pathways and their nutrients, possibly suppressing other important functions in susceptible individuals.

CLINICAL EFFECTS OF EXCESS FRUCTOSE

Ingesting large amounts of fructose is known to cause health effects in a subset of the general population. These effects include:

- *Increased triglyceride blood levels*
- *Depletion of copper*
- *Hyperuricemia (increased uric acid levels in serum)*

Not everyone is susceptible to adverse metabolic effects from the ingestion of excess fructose. However, fructose is so prevalent in the American diet, it becomes important to identify those persons with an intolerance to it.

It is quite clear – and must be stressed – that the level of fructose from whole foods (fruits and vegetables) are generally safe and do not cause an increase in triglycerides or uric acid, nor do



they cause a copper deficiency in humans. The adverse effects were only seen after large amounts of fructose were ingested in a subset of the entire population studied.

FIA™ FRUCTOSE INTOLERANCE TEST

FIA™ test for fructose intolerance involves the manipulation of SpectraCell's patented serum and protein-free media in the following way:

1. The usual glucose amount is decreased to 10% of the optimal value. This amount of glucose in the media typically results in 90% of optimal lymphocyte growth.
2. In a separate test containing the low-glucose media, fructose is added for a final concentration of 72 mg/dL. The ratio of growth in the fructose-containing media, divided by the growth of the low-glucose media, is the value listed in the FIA™ test report as *fructose intolerance*. Thus, the intracellular function of lymphocytes (DNA synthesis), with and without large amounts of fructose is measured.
3. Values below the reference range indicate a metabolic intolerance to excess fructose. The decreased availability of ATP and phosphate in certain persons is severe enough to affect overall growth.

CLINICAL APPLICATIONS

Fructose intolerance may indicate:

- Increased susceptibility to gout
- Fructose-1, 6-biphosphatase deficiency
- Hyperinsulinemia
- Low copper status
- Susceptibility to corneal damage from fructose (cataract formation)

Clinical symptoms associated with fructose intolerance include:

- Hyperactivity and/or behavioral disorders – Decreased cellular ATP in brain cells can account for these symptoms
- Hypoglycemia – A classical symptom of fructose intolerance
- Immunosuppression – It is likely that many clinical symptoms may be caused by fructose intolerance, since fructose affects all cells and causes decreased cellular energy which may be manifested according to each person's own unique genetic individuality.

REPLETION SUGGESTIONS

Persons exhibiting intolerance to fructose should avoid concentrated sources as much as possible. This includes foods sweetened with high-fructose corn syrup, fruit juice concentrate, honey, and table sugar; and the reduction of the ingestion of sweet cream, to name a few.

Carefully read food labels for the words: corn sweetener, corn syrup, high-fructose corn syrup, sucrose, fructose, levulose, invert sugar, and sugar. Since sorbitol is converted by the cells to fructose, its ingestion should also be reduced.

Fortunately, even though fruits (and some vegetables) are sweet by their fructose content, the content is not as high as sweetened foods. Therefore, do not decrease the ingestion of fruits and vegetable, these foods contain other important micronutrients and enzymes which are not found in other foodstuffs. Remember, the *fructose intolerance* test detects those persons who are unable to adequately metabolize excess amounts of fructose.

