# Vickerstaff Health Services Inc.

**FACT SHEET**

## FRUCTOSE INTOLERANCE

Intolerance of fructose, especially in childhood, probably occurs more frequently than diagnostic figures currently suggest. The condition usually presents as loose stools or diarrhea after consumption of fruits such as apples and pears, or the juice of these fruits. Fructose intolerance is usually caused by impaired absorption of fructose. However, there are rare cases in which intolerance of fructose is due to a deficiency in one of the enzymes responsible for the digestion of fructose.

### The Mechanism of Fructose Malabsorption

Intestinal fructose absorption depends on an energy-requiring carrier mechanism which is facilitated by glucose. The process is not entirely understood, but when there is an excess of fructose, glucose is preferentially absorbed, resulting in inefficient absorption of the fructose. The resultant unabsorbed fructose moves into the large bowel where it causes an increase in osmotic pressure, and a net influx or reduced outflow of water, resulting in loose stool or frank diarrhea.

Sucrose contains both glucose and fructose in a 1:1 ratio. However, some sucrose-containing fruits such as apples and pears contain a higher fructose to glucose ratio than most other fruits. Diarrhea after eating apples, pears, or their juices, when no other cause for the loose stool is evident, is usually a sign that fructose malabsorption is the problem.

### Diagnosis

Diagnosis of fructose intolerance can be confirmed by challenge with fructose and measurement of the amount of hydrogen in the breath every fifteen minutes for up to two hours following.

When a sugar is not absorbed, it moves into the large bowel where it is fermented by the resident micro-organisms. A major product of fermentation is hydrogen. The hydrogen produced by fermentation of the sugar then passes from the bowel into circulation, is removed in the lungs, and finally excreted in the breath. This method of testing is often used to diagnose lactose intolerance, but malabsorption of any sugar can be tested in the same way.

The usual manner of testing is to provide a known quantity of glucose, lactose, and fructose individually in water. The patient takes each drink separately, and the amount of hydrogen in the breath after each test drink is measured. A significant increase in breath hydrogen will identify which sugar is not being absorbed.

The problem with this method of testing for fructose intolerance, however, is that if an excessive quantity of fructose is consumed, everyone will experience some degree of malabsorption, and will develop loose stool and an increase in breath hydrogen.

Usually the quantity of fructose used in the test is 2mg/kg body weight, which seems to be the amount tolerated by most people who do not have clinical fructose malabsorption.

**Management of Fructose Intolerance**

Management of fructose intolerance involves reducing the patient's intake of foods that contain fructose. A fructose-free diet inevitably means limiting the consumption of fruit, especially those with a high fructose:glucose ratio. Table 1 provides information on the levels of natural fructose and glucose in common foods.

Since fruit is an important source of vitamin C, supplementary vitamin C should be recommended on a low-fruit diet.

Fructose is sweeter than sucrose, and much sweeter than glucose. Hence, fructose is sometimes added to "reduced calorie" foods to increase the sweet taste, without the extra calories of sucrose that would be required to give the same amount of sweetness. Fructose is often used in foods recommended for diabetics to provide sweetness, while avoiding the insulin-dependent mechanisms required for metabolism of glucose. These additional sources of fructose need to be avoided by people who have a problem with the absorption of fructose.

**Inherited Conditions Causing Fructose Intolerance**

Although many people, especially children, develop loose stool and diarrhea after consuming a high dose of fructose, there are inherited conditions in which metabolism of fructose is impaired, and which require more careful avoidance of all sources of fructose. These diseases are more accurately described as inborn errors of metabolism, and are quite rare. The most well-known conditions include:

***Fructose-1,6-bisphosphatase deficiency***

Inheritance is through an autosomal recessive gene and the world-wide incidence of the condition is unknown. The enzyme deficiency leads to the accumulation of certain amino acids, lactic acid, and ketoacids. Symptoms include fasting hypoglycemia, ketosis and acidosis. It can be fatal to new-borns. Infections and other fever-inducing illnesses can trigger episodes throughout life.

***Hereditary Fructose Intolerance***

The inheritance of hereditary fructose intolerance is through an autosomal recessive gene. The condition is due to a deficiency in the enzyme aldolase B. The disease was first recognized in Switzerland, where the incidence has been estimated to be 1/20,000. The

condition is first noticed in infancy, usually after the first feeding of fruit juice or fruit. Symptoms include: hypoglycemia, sweating, tremor, confusion, nausea, vomiting, abdominal cramping pain, and in extreme cases, convulsions and coma. Prolonged consumption of fructose can lead to degeneration of renal function resulting in cirrhosis and mental deterioration. Ingestion of more than a very small amount of fructose or sucrose results in symptoms.

Diagnosis can be confirmed by a fall in blood glucose 5 – 40 minutes after giving 250 mg/kg body weight of fructose by intravenous delivery. Liver biopsy shows the absence of the enzyme.

Treatment involves the strict avoidance of dietary fructose, sucrose and sorbitol.

***Essential Fructosuria***

This condition is characterized by a deficiency in fructokinase, which results in excretion of fructose in the urine. It is inherited as an autosomal recessive gene and the incidence has been estimated to be 1/130,000. Since the fructose is excreted in blood and urine there is no effect of excess fructose in the digestive tract, and the condition is usually asymptomatic. Usually no treatment is required, but a false diagnosis of diabetes mellitus might occur due to the high level of fructose in the blood.

**Table 1. Fructose and Glucose Content of Fruits and Other Foods**

[Reproduced from David TJ. *Food and Food Additive Intolerance in Childhood.* Blackwell Scientific Publications 1993 page 164.

| Food Type | Fructose g/100g edible portion | Glucose g/100g edible portion |
|---|---|---|
| ***Fruits*** | | |
| Apple | 5.0 | 1.7 |
| Banana | 3.5 | 4.5 |
| Blackberry | 2.9 | 3.2 |
| Blackcurrant | 3.7 | 2.4 |
| Cherry | 7.2 | 4.7 |
| Date | 23.9 | 24.9 |
| Fig | 8.2 | 9.6 |
| Gooseberry | 4.1 | 4.4 |
| Grape | 7.3 | 8.2 |
| Grapefruit | 1.2 | 2.0 |
| Greengage | 4.0 | 5.5 |
| Lemon | 1.4 | 1.4 |
| Loganberry | 1.3 | 1.9 |
| Melon | 1.5 | 2.1 |
| Mulberry | 3.6 | 4.4 |
| Orange | 1.8 | 2.5 |
| Peach | 1.6 | 1.5 |
| Pear | 6.5 | 2.6 |
| Pineapple | 1.4 | 2.3 |
| Plum | 3.4 | 5.2 |
| Prune | 15.9 | 30.0 |
| Raspberry | 2.4 | 2.3 |
| Redcurrant | 1.9 | 2.3 |
| Strawberry | 2.3 | 2.6 |
| Tomato | 1.2 | 1.6 |
| White currant | 2.6 | 3.0 |
| ***Other Foods*** | | |
| Potato | 0.1 | 0.1 |
| Honey | 40.5 | 34.2 |
| Royal jelly | 11.3 | 9.8 |
| Molasses | 8.0 | 8.8 |