BREATH TESTING FOR LACTOSE INTOLERANCE

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Introduction

Food intolerance can cause a range of gut and systemic symptoms [1]. The possibility that these conditions might be caused by intolerance to lactose has often been missed because it is not generally appreciated how widely lactose is used as a food additive: the addition of lactose to manufactured foods and drinks is not necessarily mentioned on the package label. Lactose has about one sixth of the sweetness of sucrose and, unlike sucrose or glucose, is not metabolized effectively by yeast. Thus lactose can be added to foods and drinks without causing a sickly sweet taste and without generating carbon dioxide or ethanol as a result of yeast metabolism [2]. Lactose is used as a browning agent in bread and cakes, is added to processed meats such as sausages and burgers, and is even injected into some chicken meat. It is also added to some soft drinks and lagers, breakfast drinks, and slimming products. As a result there is often confusion where dietary advice is confined to the avoidance of dairy foods.

Lactose absorption, lactose intolerance

Lactose, a disaccharide, is not normally absorbed directly from the gut, but is hydrolysed by the action of the brush border *lactase* into glucose and galactose, which are then absorbed by the enterocytes and passed into the hepatic portal blood supply. If the lactase is absent (or insufficient for the dietary load of lactose), then non-absorbed lactose will be the pass into the lower small intestine and the colon. This may result in an osmotic diarrhea of varying severity, along with cramps and flatulence, the symptoms of the condition known as "lactose intolerance", which is not an allergic condition but a digestive problem.

All adult mammals, except for northern Europeans and certain other ethnic groups (for example, African tribes such as the Masai) are normally hypolactasic, with low intestinal *lactase* activities. Even among these groups, much of the activity of this enzyme is normally lost soon after weaning [3]. "Lactose malabsorption" refers to the physiological consequence of lactase deficiency, which can be primary (i.e. genetic) or secondary (i.e. acquired, from intestinal damage caused, for example, by *Giardia lamblia* or *Rotavirus A* infections where which the integrity of the intestinal mucosa is compromised). Primary lactase deficiency in infants is a serious and rare condition, resulting in the inability to consume maternal milk or feeds containing lactose.

Without adequate intestinal lactase activity, consumption of lactose results in its passage into the large intestine, with hydrogen, methane and other metabolites being generated by colonic bacteria. These metabolites include toxins, such as acetaldehyde, dimethylglyoxal, formic acid, propane-1,3-diol, indoles, and skatoles. Lactose itself can also have toxic effects if absorbed directly into the blood stream without hydrolysis in the intestine. These toxins act on ionic signaling pathways in the nervous, cardiovascular, skeletal muscle and immune systems and it is now clear that their effects can cause a range of debilitating systemic symptoms, in addition to the well known gut symptoms, such as those associated with irritable bowel syndrome , eczema, asthma and osteoarthritis [4].

Lactose intolerance was formerly assessed by giving an oral dose of 50 gm of lactose (equivalent to the lactose load in 1 litre of cow's milk) and then monitoring the plasma glucose for 3 hours. A normal response in this test is a rather modest rise in the plasma glucose, of greater than 1.2 mmol/L. The "lactose tolerance test" is now rarely carried out. Even some control subjects, with no known relevant history, may

• The Stone House • 9 Weymouth Street • London W1W 6DB England • Tel: (+44) 020 7636 5959/5905 • Fax: (+44) 020 7580 3910 • Email: info@biolab.co.uk •
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exhibit some symptoms and fail to produce a significant rise in the plasma glucose, showing the high prevalence of the condition.

A trial lactose-free diet may also provide a useful initial assessment for lactose intolerance, but small bowel biopsy with the assay of brush border disaccharidase activities formerly provided the definitive diagnosis. Genetic testing based on an EDTA blood sample is now possible, but this gives information as to susceptibility, rather than the presence of the condition, which, being polymorphic in its genetics, requires the investigation of a number of gene loci.

Our experience is that the comparison of breath levels of hydrogen and methane before and after the consumption of a 25 gm lactose load provides a convenient and practical way of detecting the condition of *lactose intolerance*; this is of considerable importance in the investigation of a number of chronic conditions and its increasing prevalence reflects the dietary load of lactose from manufactured foods, as well as the extent of loss of brush border *lactase*.

Indications

The lactose breath test is used for the diagnosis of lactose malabsorption and lactose intolerance. This should be considered in subjects with gut symptoms and unexplained food allergies, as well as those with irritable bowel syndrome (IBS), eczema, asthma and osteoarthritis.

Patient preparation

The patient should not have eaten slowly digesting foods such as beans and bran on the day before the test and should have fasted for 12 hours prior to the test, with only water to drink. Alcohol should not be consumed in the previous 24 hours. Vigorous exercise, smoking or sleeping should be avoided immediately before, or at any time during the test.

Test Protocol

For the lactose breath test the patient is given 25 gm of lactose in 200 ml of water and alveolar air samples are collected at baseline and every 60 minutes for 3 hours (3 samples in all). If the patient is a child, the dose of lactose should be reduced to 1gm per kg body weight.

Specimen requirements: alveolar breath samples. Collection bags are available for postal samples.

Interpretation: in subjects who do not fully absorb lactose there is abnormally high production of hydrogen and sometimes methane as the lactose passes into the lower small intestine. A lactose breath test is *positive* if either the hydrogen peaks by ≥20 ppm compared to the basal sample or if the methane peaks by ≥12 ppm compared to the basal sample.

Methodology: Breath hydrogen and methane are measured by gas-liquid chromatography.

Turnaround time: Same day; the test must be booked in advance.

References

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