

BCH 447 Practical Metabolism

D-Xylose Absorption Test

Objectives

1. To learn the technique of D-xylose absorption test and its relation to the function of the upper small intestine.
2. To find out whether the malabsorption state of some patients is due to intestinal or pancreatic diseases.

Introduction

➤The small intestine can be studied in **two parts**, the upper small intestine (**jejunum**) and the lower small intestine (ileum).

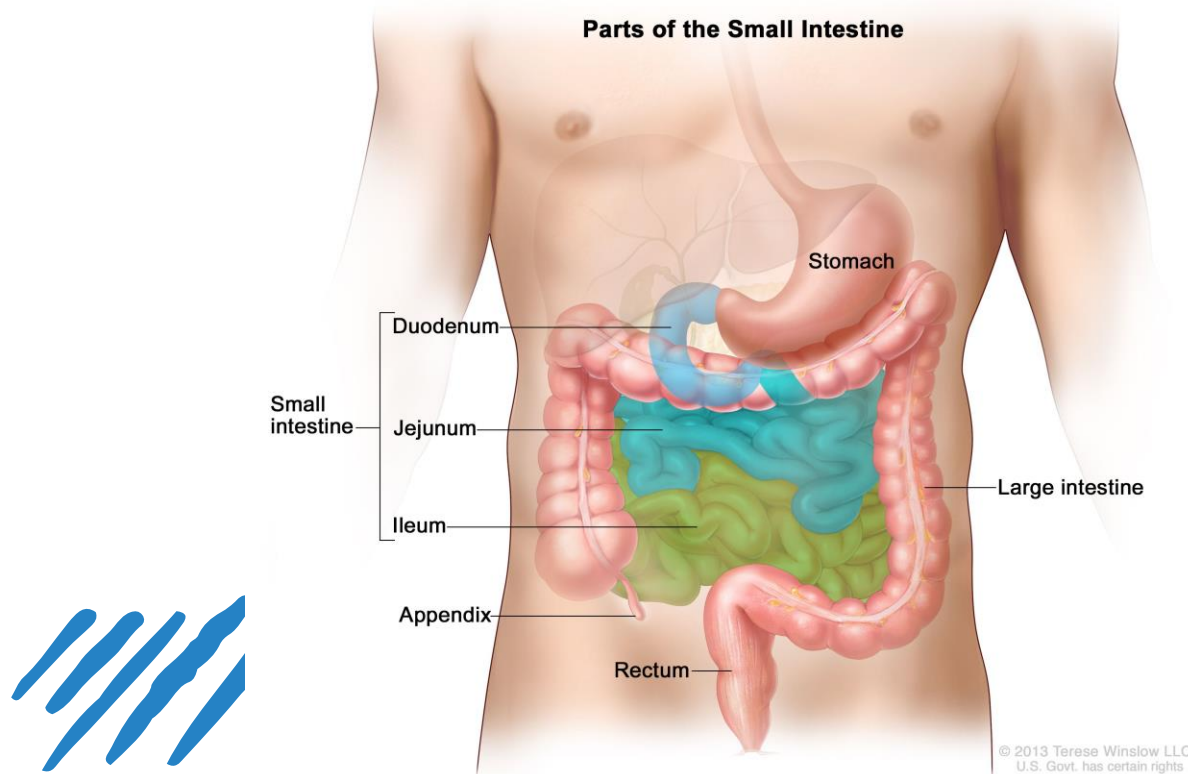


Figure 1. Small intestine anatomy. Source: cancer.gov

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- The best to test the function of the **upper small intestine** is →

(**D-xylose absorption test**)

- The best to test the function of the **lower small intestine** is →

(**Vitamin B12 absorption test**)

Impaired absorption of D- xylose occurs in conditions where there is *flattening of the intestinal villi* such as **celiac disease** and **tropical sprue** .

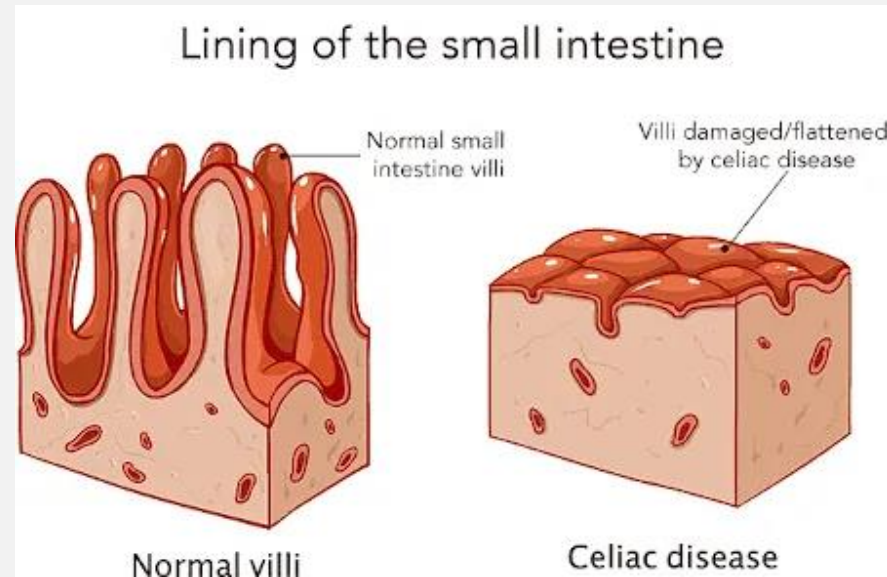
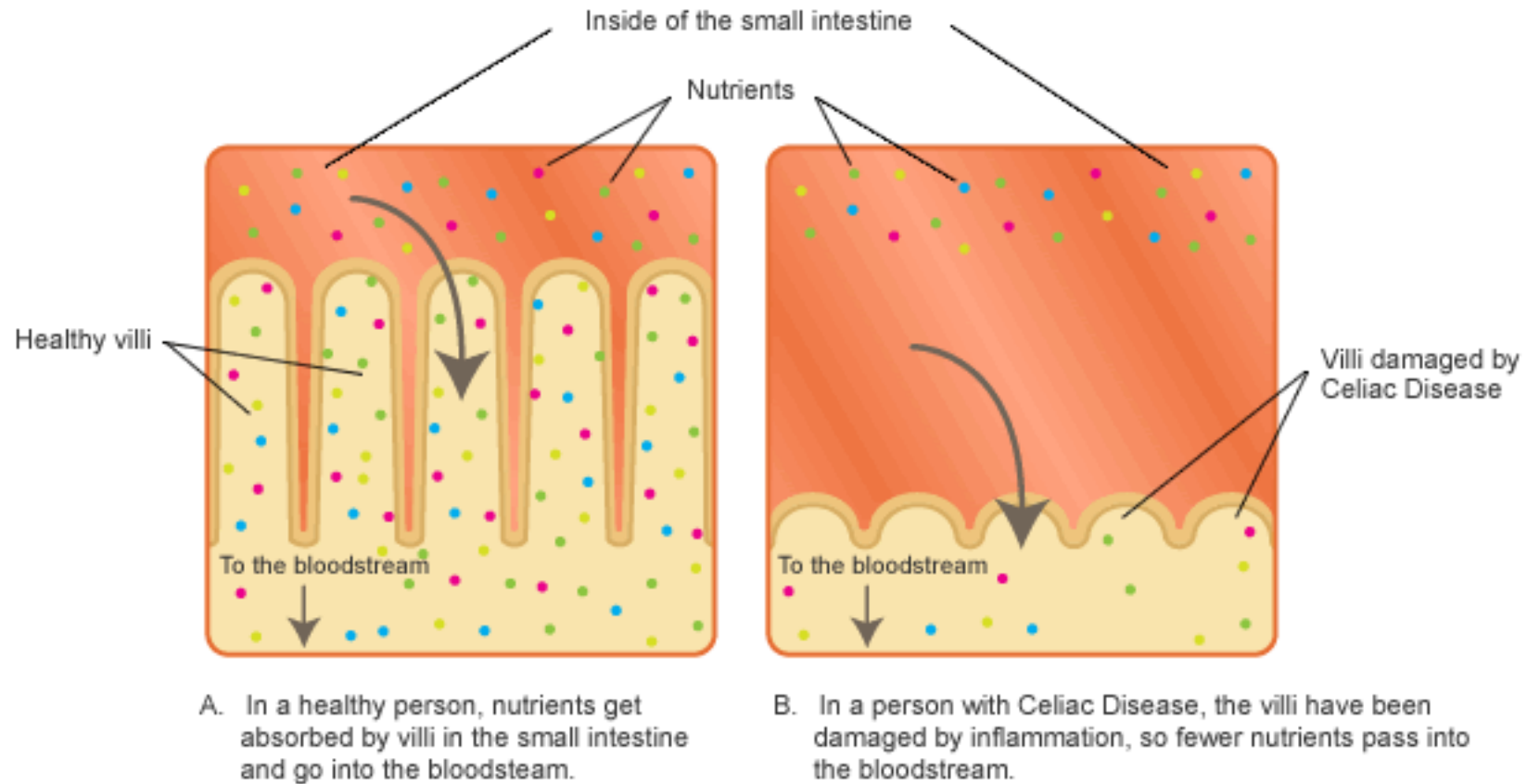


Figure 2. Flattening of intestinal villi in celiac disease. Source: beyondceliac.org

This results in → The test does of D-xylose **level in blood and urine will be low.**

- *Celiac disease* is a serious autoimmune disorder that can occur in genetically predisposed people where the ingestion of **gluten** leads to damage in the small intestine.
- *Tropical sprue* is a disorder of unknown cause (infection) affecting people living in tropical areas who develop abnormalities of the small intestine structure destruction of the villi.



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Figure 4. celiac disease affect on nutrient absorption. Source: youngmenshealthsite.org

D- Xylose Absorption Test

D-Xylose is a type of **aldopentose sugar** found in plants:

1. It is **not** metabolized in the body.
2. It is **not** normally present in significant amounts in blood.
3. It is normally easily absorbed by the intestine.

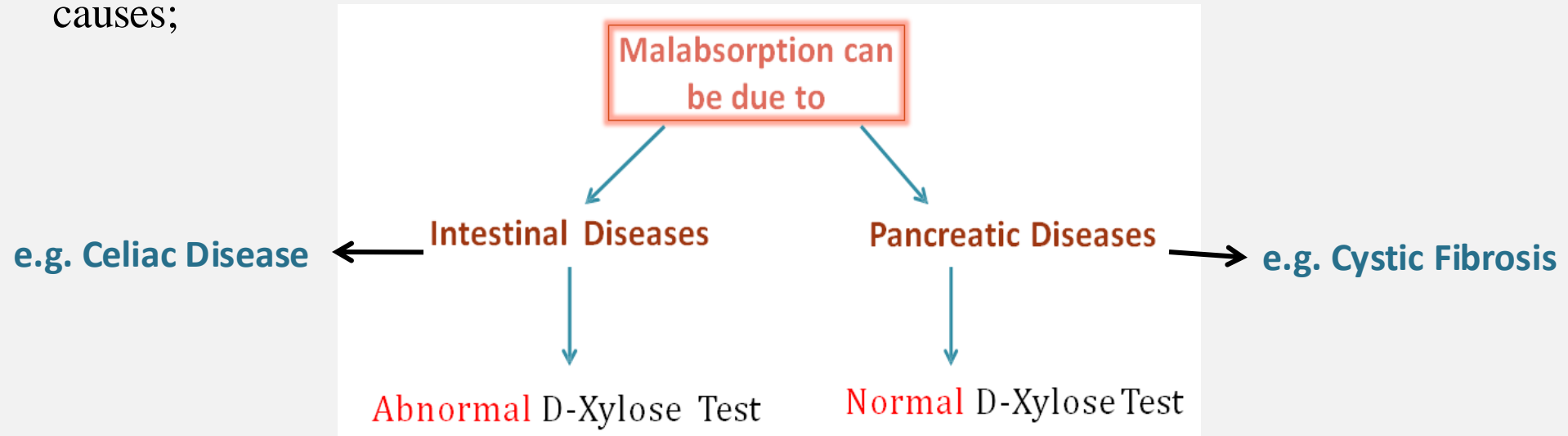
Note: Pancreatic digestive enzymes are **not** needed for D-Xylose absorption.

(this is noted to distinguish between celiac disease and cystic fibrosis)

How is the test preformed?

- To do the test, D-xylose is administrated orally, **60%** is absorbed in the **upper small intestine**, about **25%** of the dose is subsequently excreted by the kidneys.
- **In adults**, the standard oral dose is **25 g** after which *the urinary output during the next five hours is 5.8 g in normal subjects*
- Patient may have a blood sample collected after 2 hours of drinking the liquid.

- The amount of D-xylose detected in **urine** or **blood** in a specified time interval after administration of a measured dose of D-xylose, is used to evaluate *malabsorption*.
- Also, it can be used to differentiate between malabsorption's two main different causes;



The accuracy of the D-Xylose absorption test is affected by two factors:

1. Rate of Absorption by Intestine
2. Rate of Excretion by Kidneys

→ Thus, In case of impaired **renal function** the D-xylose level in a 5 hrs urine sample **is low**, which can lead to *false diagnosis of coeliac disease*.

In order to eliminate misinterpretations as a result of renal disease



A blood determination of D- xylose after 2 hours of the oral dose is carried out along
with the determination of D-xylose in urine



A normal high blood D-xylose level in the presence of decreased urine D-xylose
excretion suggest:

Normal Absorption due to normal intestine

Renal dysfunction

How to prepare the patient for the test?

- The patient/volunteer should keep **an over night fast**, in the morning empties the bladder and discards the urine.
- **Before breaking the fast, 25g of D-xylose in 250ml water is taken by mouth.**
- The patient /volunteer should then drink water at one and two hours after drinking the D-xylose solution.
- All urine passed during the next five hours is collected.

Principle

1. **D-xylose** is a **pentose** which produces a **brown complex** with maximum absorption at 475 nm when reacted with **O-toluidine** in the presence of **acetic acid** and **heat**.
2. **Hexoses** also reacts with O-toluidine *but produce a different complex* with an absorption peak at 622 nm, this ensures that interference with glucose is minimum.

Estimation of D-xylose in urine

Label 7 test tubes:

	T1	T2	T3	T4	S1	S2	Blank
Urine 'A'	0.1 ml	0.1 ml					
Urine 'B'			0.1 ml	0.1 ml			
Standard					0.1 ml	0.1 ml	
dH ₂ O							0.1 ml
O-toluidine reagent	7 ml						



Cover tubes by aluminum foil & mix the contents of each tube



Boiling water bath for 5 minutes



Cool the tubes for 1-3 min



Read absorbance at 475 nm against blank

Results and Calculations

Tubes	Absorbance at 475nm	Mean of abs
T1		
T2		
T3		
T4		
S1		
S2		

$$\text{Concentration of D_xylose in urine} = \frac{\text{Mean abs of test}}{\text{Mean abs of std}} \times \text{Conc. of std.} \times \text{D.f}$$

- **Normal value:** > 2.5 g / total volume collected
- **Abnormal value:** less than 2.5 g / total volume collected

Example

-Conc. Of Std.= 0.01 g/ml

Dilution factor= 10

Total volume = 150 ml

Mean Abs. sample = 0.0843

Mean Abs. std.= 0.558

- Conc. Of urine D-xylose= $\frac{0.0843}{0.558} \times 0.01 \times 10 = 0.0151$ g/0.1 ml

= 0.0151 g → 0.1 ml

? → 150 ml

- Conc. Of urine D-xylose = 22.6 g/ total volume

Normal

Homework:

- Mention **3 diseases** that can cause malabsorption (other than celiac disease and tropical sprue).
- Mention **3 lab tests** used for malabsorption assessment.