

## EnzyChrom™ Starch Assay Kit (Cat# E2ST-100)

### Quantitative Colorimetric/Fluorimetric Starch Determination

#### DESCRIPTION

**STARCH**, chemical formula  $(C_6H_{10}O_5)_n$ , is a polysaccharide carbohydrate consisting of a large number of glucose units joined together by glycosidic bonds. All plant seeds and tubers contain starch present in the form of amylose and amylopectin. Starch is the most consumed polysaccharide in the human diet. Some starches are digested very quickly, and cause a rapid and large rise in blood sugar. Others are digested more slowly, and some starch, called resistant starch, is not digested in the small intestine at all, and thus causes little or no blood sugar rise.

Simple, direct and automation-ready procedures for measuring starch concentrations find wide applications in research and drug discovery. BioAssay Systems' starch uses a single Working Reagent that combines the enzymatic break down of starch and the detection of glucose in one step. The color intensity of the reaction product at 570 nm or fluorescence intensity at  $\lambda_{ex/em} = 530/585$  nm is directly proportional to the starch concentration in the sample. This simple convenient assay is carried out at room temperature and takes only 30 min.

#### KEY FEATURES

Use as little as 10  $\mu$ L samples. Linear detection range: 2 to 200  $\mu$ g/mL starch for colorimetric assays and 0.2 to 20  $\mu$ g/mL for fluorimetric assays.

#### KIT CONTENTS (100 TESTS IN 96-WELL PLATES)

<b>Assay Buffer:</b>	12 mL	<b>Dye Reagent:</b>	120 $\mu$ L
<b>Enzyme A:</b>	Dried	<b>Standard:</b>	50 $\mu$ L 50 mg/mL
<b>Enzyme B:</b>	120 $\mu$ L		

**Storage conditions.** The kit is shipped on ice. Store all components at -20°C upon receiving. Shelf life: 6 months after receipt.

**Precautions:** reagents are for research use only. Normal precautions for laboratory reagents should be exercised while using the reagents. Please refer to Material Safety Data Sheet for detailed information.

#### PROCEDURES

##### Reagent Preparation:

Reconstitute Enzyme A by adding 120  $\mu$ L Assay Buffer to the Enzyme A tube. Make sure Enzyme A is fully dissolved by pipetting up and down. Store reconstituted Enzyme A at -20°C and use within 1 month.

##### Sample Preparation:

**Soluble Starch.** Grind up 5-10 mg sample, wash off any free glucose and small oligosaccharides with 1 mL 90% ethanol, warm to 60°C for 5 min with occasional vortexing. Centrifuge at 10,000g for 2 min. Decant the supernatant. Repeat the wash twice. Remove ethanol.

Soluble starch in the pellet is extracted with 1 mL H<sub>2</sub>O incubated in a boiling water bath for 5 min. Spin 10,000g for 2 min. The supernatant is soluble starch and resistant starch is in the insoluble pellet.

**Resistant Starch.** After extracting soluble starch, extract the water insoluble pellet with 0.2 mL DMSO and heat in boiling water bath for 5 min. Dilute sample 1:100 in H<sub>2</sub>O prior to assay. Alternatively, resistant starch can be extracted with KOH/H<sub>3</sub>PO<sub>4</sub> or KOH/acetate method [1].

##### Colorimetric Procedure:

1. Equilibrate all components to room temperature. During experiment, keep thawed enzymes in a refrigerator or on ice.
2. **Standards and Samples:** Dilute standard by mixing 5  $\mu$ L Standard with 1.245 mL dH<sub>2</sub>O to give 200  $\mu$ g/mL standard. Dilute 200  $\mu$ g/mL standard in dH<sub>2</sub>O as follows.

No	200 $\mu$ g/mL STD + H <sub>2</sub> O	Vol ( $\mu$ L)	Starch ( $\mu$ g/mL)
1	200 $\mu$ L + 0 $\mu$ L	200	200
2	150 $\mu$ L + 50 $\mu$ L	200	150
3	100 $\mu$ L + 100 $\mu$ L	200	100
4	50 $\mu$ L + 150 $\mu$ L	200	50
5	0 $\mu$ L + 200 $\mu$ L	200	0

Transfer 10  $\mu$ L Standards and Samples into separate wells of a clear flat-bottom microplate. If the sample contains glucose, transfer an additional 10  $\mu$ L sample to another well for the Sample Blank.

3. **Working Reagent.** For each Standard and Sample well, Prepare **Working Reagent** by mixing 90  $\mu$ L Assay Buffer, 1  $\mu$ L Enzyme A, 1  $\mu$ L Enzyme B, and 1  $\mu$ L Dye Reagent. For Sample Blank wells, prepare **Blank Working Reagent** by mixing 90  $\mu$ L Assay Buffer, 1  $\mu$ L Enzyme B, and 1  $\mu$ L Dye Reagent (**No Enzyme A**). Transfer 90  $\mu$ L Working Reagent into each Standard and Sample well. Transfer 90  $\mu$ L Blank Working Reagent to each Sample Blank well. Tap plate to mix.
4. Incubate 30 min at room temperature. Read optical density at 570 nm (550-585 nm).

##### Fluorimetric Procedure:

For fluorimetric assays, the linear detection range is 0.2 to 20  $\mu$ g/mL starch. Follow steps 1-3 of the colorimetric procedure, but prepare 0, 5, 10, 15 and 20  $\mu$ g/mL Standards and use a black flat-bottom microplate. Incubate 30 min at room temperature and read fluorescence at  $\lambda_{ex/em} = 530/585$  nm.

#### CALCULATION

Subtract Blank reading (OD<sub>570nm</sub> or fluorescence intensity) from the standard reading values and plot the  $\Delta$ OD or  $\Delta$ F against standard concentrations. Determine the slope and calculate the starch concentration of the sample.

$$\text{Starch} = \frac{R_{\text{SAMPLE}} - R_{\text{BLANK}}}{\text{Slope}} \mu\text{g/mL}$$

R<sub>SAMPLE</sub> and R<sub>BLANK</sub> are the OD<sub>570nm</sub> or fluorescence intensity values of the sample and blank (water, or sample blank).

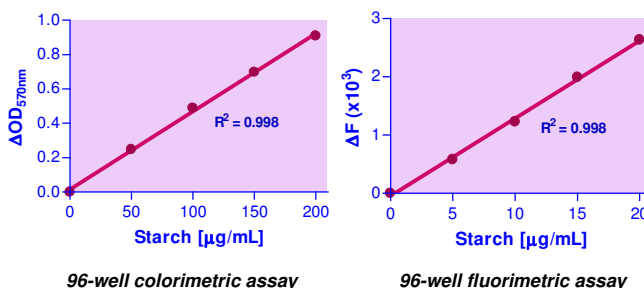
#### GENERAL CONSIDERATIONS

1. This assay is based on a kinetic reaction, the use of a multi-channel pipettor for adding the working reagent is recommended.
2. SH-group containing reagents (e.g., DTT,  $\beta$ -mercaptoethanol) may interfere with this assay and should be avoided in sample preparation.

#### MATERIALS REQUIRED, BUT NOT PROVIDED

Pipetting devices, centrifuge tubes, clear flat-bottom uncoated 96-well plates (e.g. VWR cat# 82050-760), optical density plate reader; black flat-bottom uncoated 96-well plates (e.g. VWR cat# 82050-676), fluorescence plate reader.

##### Starch Standard Curves



#### PUBLICATIONS

1. South, P. F., Cavanagh, A. P., Liu, H. W., & Ort, D. R. (2019). Synthetic glycolate metabolism pathways stimulate crop growth and productivity in the field. *Science*, 363(6422), eaat9077.
2. Liu, F., et al. (2020). An invasive beetle-fungus complex is maintained by fungal nutritional-compensation mediated by bacterial volatiles. *The ISME Journal*, 14(11), 2829-2842.
3. Gardner RD et al (2013). Comparison of CO(2) and bicarbonate as inorganic carbon sources for triacylglycerol and starch accumulation in *Chlamydomonas reinhardtii*. *Biotechnol Bioeng*. 110(1):87-96.