# Four sugars to distinguish

Glucose, fructose and maltose are reducing sugars. Sucrose is a non-reducing sugar. These labels describe chemical behaviour, not sweetness or molecular size.

| SUGAR | CARBOHYDRATE CLASS | DIRECT BENEDICT'S TEST |
|---|---|---|
| Glucose | Monosaccharide | Positive: reducing |
| Fructose | Monosaccharide | Positive: reducing |
| Maltose | Disaccharide | Positive: reducing |
| Sucrose | Disaccharide | Negative: non-reducing |

Direct means adding Benedict's reagent and heating without first hydrolysing the sugar. Results assume adequate concentration, working reagent and correct heating.

### 1. WHAT DOES REDUCING MEAN?

A reducing sugar can reduce copper(II) ions in Benedict's reagent while the sugar is oxidised. It is a chemical redox reaction, not a claim that the sugar reduces body mass or contains less energy.

### 2. SIZE DOES NOT PREDICT THE RESULT

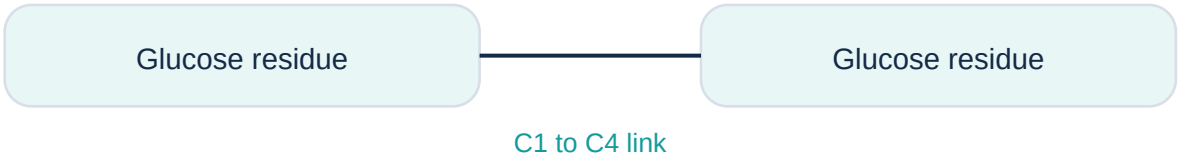
Maltose and sucrose both contain two monosaccharide residues, but only maltose gives a direct positive result. Do not equate disaccharide with non-reducing: learn the named examples separately.

Scope: Cambridge Biology 9700 syllabus, section 2.2, outcome 4, p. 17.

# Why the test results differ

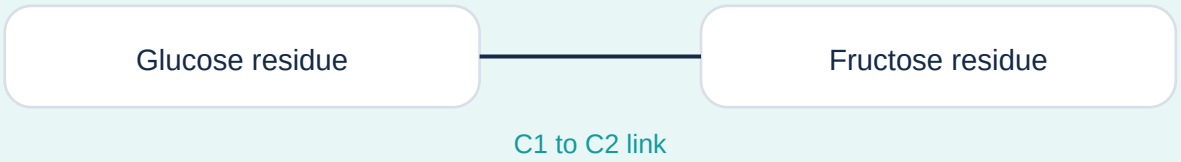
Supporting chemistry: a free reducing end allows a sugar to form a reactive open-chain structure. The positions involved in a glycosidic bond determine whether such an end remains.

### MALTOSE: ONE REDUCING END REMAINS




The second glucose residue has a free anomeric C1: a reducing end.

### SUCROSE: BOTH ANOMERIC CARBONS ARE LINKED




No free reducing end remains in intact sucrose.

These are connection maps, not structural formulas. The anomeric carbon is C1 in glucose and C2 in fructose; detailed mechanisms are extension material for this lesson.

### FRUCTOSE STILL COUNTS AS A REDUCING SUGAR

Fructose is a ketose, but in alkaline Benedict's reagent it can rearrange into aldose sugars. It therefore gives a positive test. Do not reject fructose simply because its open-chain form has a ketone group.

Core recall: glucose, fructose and maltose are reducing; sucrose is non-reducing. The structural explanation helps you understand the list.

Chemistry: OpenStax Organic Chemistry, 25.6 Monosaccharide reactions.

Bond positions: OpenStax Organic Chemistry, 25.8 Disaccharides.

# Connect names to observations

Benedict's reagent detects reducing behaviour. Hydrolysis changes sucrose into different molecules, so compare an untreated portion with a separately treated portion.

### SUCROSE HYDROLYSIS

**sucrose + water**

↓ dilute acid + heat

**glucose + fructose**

Both products are reducing sugars.

### 1. DIRECT TEST: ADD BENEDICT'S REAGENT AND HEAT

Use a hot water bath. A negative result remains blue; a positive result may appear green, yellow, orange or brick-red, with copper(I) oxide precipitate. Colour depends on concentration and test conditions.

### 2. FOR SUCROSE: HYDROLYSE, NEUTRALISE, THEN RETEST

Heat a fresh portion with dilute acid, cool and carefully neutralise it as instructed. Add fresh Benedict's reagent and heat again. Pure sucrose is negative before treatment but its hydrolysis products give a positive result.

### 3. WHAT YOU CAN AND CANNOT CONCLUDE

A direct positive result does not distinguish glucose, fructose and maltose. In a simple sugar sample, negative before treatment and positive afterwards supports a non-reducing sugar. It does not uniquely identify sucrose in a complex sample.

A negative result means no reducing sugar was detected under those conditions, not necessarily no sugar. Follow the teacher's safety method; use eye protection and care with hot tubes, acid and alkali.

Scope: Cambridge Biology 9700 syllabus, section 2.2, outcome 4, p. 17.