

## Sample Lab

### Muffins: A Study in Carbohydrates

Breads have a long history. Flat breads were a common diet feature even in the late Stone Age. They were similar to tortillas or pancakes. Raised breads developed around 4000 BC. Paralleling these were changes in the wheat, in yeast cultivation, and in cooking ovens. Moving from wheat that could not be easily husked, fermentation by chance contamination of airborne yeasts, and the open fire with griddle stones towards materials more similar to those of today. By the middle ages, bread making was wide spread. Below is a 14<sup>th</sup> century bread recipe

Take fayre Flower and the whyte of Eyroun and the yoke, a lytel. Than take Warme Berme, and putte al thes to-gederys and bete hem to-gederys with thin hond tyl it be schort and thikke y-now, and caste Sugre y-now ther-to, and thenne lat reste a whyle. An kaste in a fayre place in the oven and late bake y-now. And then with a knyf cutte yt round a-bove in maner of a crowne, and kepe the cruste that thou kyttest, and than caste ther-in clarifyd Boter and Mille the cromes and botere to-gederes, and kevere it a-yen with the cruste that thou kyttest a-way. Than putte it in the ovyn ayen a lityle tyme and than take it out, and serve it forth.

The basic recipes have changed little since the 1700's, but the location has. In 1900, 95% of all flour produced in this country was sold to families. In 1970, the figure was 15%.

### **The Lab**

**In this lab we will make Three muffin recipes and compare them to examine the roles of carbohydrates in foods.**

#### **1. Getting Ready:**

**Join a group** of about 4 and chose one of the muffin recipes below. Before you mix each ingredient, **write a description** of the properties of the carbohydrates, including as much as you can about their physical appearance. Take a small sample and examine its solubility in water.

<u>Carbohydrate</u>	<u>Description</u>
1.	
.	
2.	
3	
.	
4.	

### The Recipes

<b>Component and Role</b>	<b>Fruity Multigrain Muffins</b>	<b>Cranberry-Orange Muffins</b>	<b>Applesauce oatmeal Muffins</b>
<b>Features</b>	High fiber	Typical	Low fat, low sugar, High fiber
Fiber/Grains	<b>-3/4 cup wheat bran</b> <b>-1/4cup cornmeal</b> <b>-1/2cup oatmeal</b>		<b>1 1/2 c Uncooked oats</b>
<b>Liquid</b> - Moisturizer necessary for chemical leavening reaction to take place - Combines with the flour to form gluten	1 1/4cups plain fat-free yogurt  -also provides acid to react with leavening agents	1cup milk	1/4 c skim milk
<b>Fat</b> - Tenderizer; lubricates sheets of gluten making it easier to slide past each other and accommodate expansion of bubbles - Enhances the keeping quality of quick breads	1/4cup vegetable oil	1/4cup vegetable oil	<b>2 Tbsp, 2 tsp oil</b>
<b>Fat replacement – pectin of apples provides some functions of fat</b>			<i>*1 c unsweetened applesauce – replaces fat</i>
<b>Egg</b> - Leavening/color/flavor - Firmness/structure - Emulsifying	2egg whites	2 eggs	1 egg
Sugar - Browns the crust - Tenderizer, Moisturizer - Flavor	<b>1/2cup packed brown sugar</b>	<b>1/3cup sugar</b>	<i>3 Tbsp Brown sugar twin</i>
Flavoring	1/4tsp salt	1/2tsp salt	1/2 tsp cinnamon
<b>Flour (about 70% of it is starch)</b> - <b>Mechanical structure to baked products</b> - <b>Contains the proteins glutenin and glutenin which combine chemically when moistened to form gluten and give</b>	<b>11/4cups whole wheat flour</b>	<b>1cup flour</b>	<b>3/4 c flour</b>

<b>structure</b> - Muffins usually are mixed only minimally to avoid formation of gluten struct			
Leavening Agents - Produces gas (carbon dioxide)	1tsp baking powder 1/2tsp baking soda	3tsp baking powder	1 tsp baking powder 1/2 tsp baking soda
Fruit	1/2cup chopped dried fruit	1Tbsp grated orange peel 3/4cup cranberries, chopped	1/4 c raisins – if desired

## 2. Mixing the Batter:

In your group, stir up the batter for the muffins you've chosen above according to the directions that follow. **Describe the appearance of the batter at each stage of preparation and use the following chemical descriptions to explain what you've seeing**

### What Happens While You Mix the Batter?

1. The first step is usually to take a fat, such as butter or shortening, or a combination of the two, and beat it. This incorporates air bubbles.
2. Then, sugar is sprinkled slowly into the butter. As the sharp sugar crystals cut into the butter, tiny pockets are formed and fill with air as you pull more butter over the top of the hole to close it. This makes the butter double in volume and become creamy in texture, which is why this procedure is called "creaming."
3. Then, the eggs are usually added, which adds more volume and allows the mixture to hold even more air.
4. The dry ingredients including the baking soda or powder, are then added,  
Note: One of the most common mistakes in baking is to over-beat the batter after adding the flour. This makes the flour develop too much of the protein gluten, which is what makes the muffin hold its shape. If you get too much, the muffin will be tough.
5. When the baking soda or powder comes into contact with liquid, carbon dioxide is released. As the batter heats up, bubbles form and the batter rises.
6. As the carbon dioxide breaks down, the moisture in the muffin forms steam, which fills the air pockets our sugar made.
7. Eventually, the steam evaporates, but by this time the protein in the flour has had enough time to set, thus making the muffin hold its shape.

### Directions for Mixing the Batters

1. Heat oven to 400°F. Grease bottoms only of 12 medium muffin cups,
2. Beat liquid, sugar, oil, egg or egg white
3. Combine dry ingredients and add to the above creamed mixture; stir until flour is just moistened – it will be lumpy
4. Fold in fruit
5. Put into muffin tins and bake 20-25 minutes or until lightly browned

#### Describe Your Observations During Mixing

**Step 1** (Beat liquid, sugar, oil, eggs)

**Step 2** (combine and add dry ingredients)

**Step 3** (Fold in fruit, etc)

#### 3. Describe the finished Product: Characterize your baked muffin by the following criteria

- Browning
- Coarseness
- Sweetness
- Flavor
- Moistness

#### 4. Questions

1. What is the purpose of the eggs?
2. What is the purpose of the yogurt?
3. What is the purpose of flour?
4. What is the purpose of baking powder?
5. What does shortening or fat do in quick breads?
6. After perusing the recipes, identify the major differences in the ingredients. What effect do these difference in the ingredients have on the final products?
7. In the recipes in this lab, we used various carbohydrates as listed below.

##### Muffin Carbohydrates:

Sugar –white or brown

Flour – white or whole wheat

Corn meal

Bran

Oatmeal

Find out what you can about each to describe their chemical structure and nutritional role. In the case of flour, describe the key differences between white flour and whole wheat flour. In the case of sugar, describe the key difference between white and brown sugar.