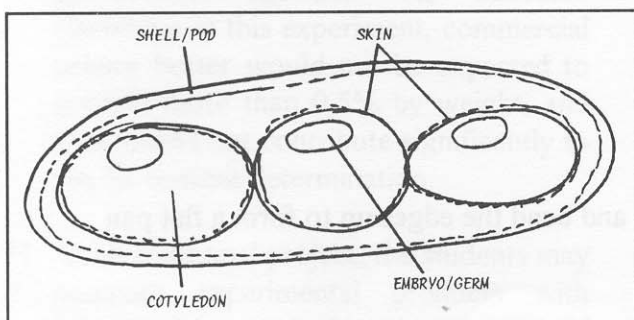


## STUDENT ACTIVITY GUIDE

# Effect of Roasting on Color, Flavor, and Texture of Peanut Butter

About 10 million tons of peanuts (groundnuts) are grown in the world each year. About 1 million tons are grown in the United States, mostly along the coastal region from Virginia to Texas. Peanut plants grow to a height of about 3 feet. The fruit of the peanut plant matures beneath the surface of the soil. Each pod or shell of the fruit contains 1–3 seeds (peanuts) at maturity. The major structural components of the peanut are shown in the following diagram.



Peanut butter is the most popular peanut product in the United States. It is formulated and produced by blending roasted peanuts with peanut oil or other vegetable oil, a carbohydrate source, emulsifier, and salt.

Federal standards of identity require that peanut butter contain at least 90% peanuts by weight and no more than 55% fat (oil from the peanuts plus added oil). It contains no added preservatives, no artificial colors or flavors, and

no added vitamins.

The types of commercial peanut butter vary greatly to suit the taste preferences of consumers. One may buy smooth or chunky products with either light or dark color and mild or heavy flavor intensity. Roasting time and temperature are adjusted to produce the desired properties in the final product. Higher temperatures and shorter roasting times result in a light-colored and mild-flavored product, whereas higher temperatures and longer roasting treatments result in darker products with a stronger flavor. Chunky peanut butter is produced by adding and blending small chunks of peanut into the product just before packaging.

Commercial peanut butter also contains emulsifiers, which are added to keep the oil from separating in the jar during storage and use. Use of partially hydrogenated peanut oil, which is present as a solid in the product, rather than a liquid, is also effective in preventing separation of oil during storage.

In this experiment, you will roast whole or shelled peanuts at 350°F for 20, 30, or 40 min to produce variable degrees of color and flavor. Each lot of heated peanuts will be used for producing peanut butter. You will then evaluate the peanut butter products for color, flavor, and texture. You will also be given an opportunity to compare your experimental peanut butter products with those produced commercially and available in your local grocery or supermarket.

## MATERIALS REQUIRED

Peanuts  
Peanut oil  
Lecithin (emulsifier)  
Unsalted soda crackers  
Oven with 350°F thermostat  
Mortar and pestle  
200-g-capacity balance  
Timer or wall clock  
Heavy-duty aluminum foil  
100- to 250-mL beakers or small plastic cups  
Spatulas  
¼-, ½-, and 1-teaspoon (tsp) measures

## EXPERIMENTAL PROCEDURE

1. Cut 12-inch × 12-inch sheets of aluminum foil and bend the edges up to form a flat pan.
2. Label the pans 20, 30, or 40 min.
3. Spread about 250 g of unroasted peanuts over the bottom of each pan.
4. Preheat the oven to 350°F.
5. Roast the peanuts in the oven for the prescribed time, stirring them occasionally to provide uniform roasting.
6. Remove the shells and skins from the peanuts and discard them.
7. You will be assigned to one or more groups (A, B, C, or D) by the teacher and will work with one or more of the roasted peanut conditions (20, 30, or 40 min).
8. Each group will grind enough peanuts to obtain 45 g of ground peanuts. Grind the peanuts in the mortar, adding only 6–8 peanuts at a time and grinding them thoroughly, using pressure and a circular motion. Place the mortar on a moist, flat sponge to keep it from slipping. It is very important to do a thorough job at this stage to produce a smooth final product. You will note that the peanuts take on a dark and moist appearance as the grinding proceeds. This change is due to melting and release of the peanut oil by the grinding. This oil then coats the solid fiber, protein, and carbohydrate components to provide a smooth, sticky mass.

9. Weigh or measure out the following ingredients and combine them as follows:

| Material       | Group A                        | Group B        | Group C      | Group D      |
|----------------|--------------------------------|----------------|--------------|--------------|
| Ground peanuts | 45 g                           | 45 g           | 45 g         | 45 g         |
| Peanut oil     | 5 g or 1¼ tsp                  | 10 g or 2½ tsp | 4 g or 1 tsp | 8 g or 2 tsp |
| Lecithin       | —                              | —              | 1 g or ¼ tsp | 2 g or ½ tsp |
| Salt           | ----- (add salt to taste)----- |                |              |              |

10. For those products containing added lecithin, combine the peanut oil and lecithin in the mortar and mix them before adding the other ingredients.
11. Add all remaining ingredients to the mortar and thoroughly blend them by using pressure and a rotary motion of the pestle.
12. Spread a small amount of each peanut butter on separate crackers and evaluate them for color, flavor, and texture (smoothness).
13. Cover the remaining peanut butter in beakers or small plastic cups and store at room temperature overnight. Examine them the next day for degree of oil separation.
14. Record all data and observations in Table 1 below.
15. Assume that your peanuts contain 50% oil (fat) and calculate the expected total fat content. For this exercise, assume also that the total fat added is equivalent to the weight of peanut oil plus emulsifier. Identify which of your peanut butter products were within the legal standards of the Food and Drug Administration.

### ADDITIONAL PROJECT

1. Go to your local grocery or supermarket and make a list of the different kinds and brands of peanut butter available.
2. Make a list of the various ingredients listed on the labels and group these into peanuts, oil, emulsifier, carbohydrate or sugar, and salt.
3. Purchase representative commercial products and compare them with those that you prepared in the laboratory in terms of color, flavor, and texture, as well as oil separation after standing overnight.
4. Record your observations in Table 2 below and discuss possible reasons for the observed differences between commercial and experimental peanut butter products.

## QUESTIONS

1. What are the legal requirements for composition of peanut butter in the U.S.?
2. Where are peanuts grown in the U.S.?
3. What are the reasons for roasting peanuts?
4. What are the major processing steps in producing peanut butter?
5. Why is commercial peanut butter smoother than that produced in the laboratory?
6. What are the major chemical components of the peanut?
7. About how much fat (oil) and protein are in the peanut?
8. What are the major anatomical (structural) parts of the whole peanut?

**Table 1—Comparison of Experimental Peanut Butter Products**

| <b>Roasting time/<br/>peanut butter product</b> | <b>Color<br/>(0 = light,<br/>5 = dark)</b> | <b>Flavor<br/>(0 = mild,<br/>5 = strong)</b> | <b>Texture<br/>(0 = smooth,<br/>5 = coarse)</b> | <b>Oil separation<br/>(0 = none to<br/>slight, 5 = large<br/>amount)</b> |
|---|--|--|---|--|
| <b>20-minute roasting</b><br>A<br>B<br>C<br>D   |  |  |   |  |
| <b>30-minute roasting</b><br>A<br>B<br>C<br>D   |  |  |   |  |
| <b>40-minute roasting</b><br>A<br>B<br>C<br>D   |  |  |   |  |

**Table 2—Comparison of Commercial Peanut Butter Products**

| <b>Peanut butter product</b> | <b>Color<br/>(0 = light,<br/>5 = dark)</b> | <b>Flavor<br/>(0 = mild,<br/>5 = strong)</b> | <b>Texture<br/>(0 = smooth,<br/>5 = coarse)</b> | <b>Oil separation<br/>(0 = none to<br/>slight, 5 = large<br/>amount)</b> |
|------------------------------|--|--|---|--|
| A                            |  |  |   |  |
| B                            |  |  |   |  |
| C                            |  |  |   |  |