# High Altitude Food Preparation

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Pamphlet 41

**At altitudes above 3,000 feet**, preparation of food may require changes in time, temperature, or recipe. The reason: lower atmospheric pressure due to the thinner blanket of air above. At sea level, the atmosphere pressure on a square inch of surface with a weight of 14.7 pounds, at 5,000 feet with 12.3 pounds, and at 10,000 feet with only 10.2 pounds -- a decrease of about 1/2 pound per 1,000 feet. This decreased pressure affects food preparation in two ways:

1. Water and other liquids evaporate faster and boil at lower temperatures.
2. Leavening gases in breads and cakes expand more.

## BOILING

The boiling point is that temperature at which the pressure of the water vapor equals atmospheric pressure and the bubbles of water vapor are able to break through the surface and escape into the air. If the atmospheric pressure is less, the temperature required for water to boil is less (Table 1). Therefore, cooking food in water boiling at this lower temperature takes longer. A "3-minute" egg will take more time. Also, a bowl of boiling soup is not as hot.

**Table 1: Approximate boiling temperatures of water**

| Altitude: | Temperature: |
|---|---|
| Sea level | 212 degrees F |
| 2,000 ft. | 208 degrees F |
| 5,000 ft. | 203 degrees F |
| 7,500 ft. | 198 degrees F |
| 10,000 ft. | 194 degrees F |

### Canning

Fruits, tomatoes, and pickled vegetables may be canned in a boiling water bath. Because of the lower boiling point of water at high altitude, increase the processing time 1 minute for each 1,000 feet above sea level if this time is 20 minutes or less. If the processing time is more than 20 minutes, increase by 2 minutes per 1,000 feet.

Other vegetables, meats, and poultry (low-acid foods) **must** be heated at 240 degrees F for the appropriate time in order to destroy heat-resistant bacteria. A steam pressure canner **must** be used to obtain a temperature of 240 degrees F. At sea level, 10 pounds of steam pressure will produce this temperature, but

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at altitudes of 2,000 feet and above, steam pressure must be increased to reach 240 degrees F. The increase is 1/2 pound each l,000 feet above sea level, as illustrated in Table 2.

**Table 2: Pressure required to reach 240 degrees.**

| Altitude | Pressure required |
|---|---|
| Sea level | 10 lb. |
| 2,000 ft. | 11 lb. |
| 3,000 ft. | 11.5 lb. |
| 4,000 ft. | 12 lb. |
| 5,000 ft. | 12.5 lb. |
| 7,000 ft. | 13.5 lb. |
| 10,000 ft. | 15 lb. |

### Freezing

An important step in preparing vegetables for freezing is heating or "blanching" before packing. Heat 1 minute longer than the time given for sea level if you live 5,000 feet or more above sea level.

### Syrup and candy

To prevent excessive evaporation of water, cook the syrup to a final temperature lower than that given for sea level. Decrease the final cooking temperature by the difference in boiling water temperature at your altitude and that of sea level. This is an approximate decrease of 2 degrees F for each increase of l,000 feet in elevation.

### Jelly

Use the same temperature correction as with syrup.

### Deep-fat frying

The lower boiling point of water in foods requires lowering the temperature of the fat to prevent food from over-browning on the outside while being under-cooked on the inside. The decrease varies according to the food fried, but a rough guide would be to lower the frying temperature about 3 degrees F for each increase of l,000 feet in elevation.

### Pudding and cream pie filling

Above 5,000 feet, temperatures obtained with a doubler boiler are not high enough for maximum gelatinization of starch. Therefore, use direct heat rather than a double boiler.

## BAKING

### Bread

High altitude has its most pronounced effect on the rising time of bread. At high altitudes the rising period is shortened. Since the development of a good flavor in bread partially depends on the length of the rising period, it is well to maintain that period. Punching the dough down **twice** gives time for the flavor to develop.

In addition, flours tend to be drier and thus able to absorb more liquid in high, dry climates. Therefore, less flour may be needed to make the dough the proper consistency.

## Cakes made with shortening

Most cake recipes perfected for sea level need no modification up to an altitude of 3,000 feet. Above that, decreased atmospheric pressure may result in excessive rising which stretches the cell structure of the cake, making the texture coarse, or breaks the cells, causing the cake to fall. This usually can be corrected by decreasing the amount of leavening agent. Also, increasing the baking temperature 15 degrees to 25 degrees F "sets" the batter before the cells formed by the leavening gas expand too much. Excessive evaporation of water at high altitude leads to high concentration of sugar which weakens the cell structure. Therefore, decrease sugar in the recipe and increase liquid. Only repeated experiments with each recipe can give the most successful proportions to use. Table 3 is a helpful staring point. Try the smaller adjustment first--this may be all that is needed.

**Table 3: Cake recipe adjustments for high altitudes**.

| Adjustment | 3,000 ft. | 5,000 ft. | 7,000 ft. |
|---|---|---|---|
| Reduce baking powder, for each tsp., decrease | 1/8 tsp. | 1/8-1/4 tsp. | 1/4 tsp. |
| Reduce sugar, for each cup, decrease | 0-1 Tbsp. | 0-2 Tbsp. | 1-3 Tbsp. |
| Increase liquid, for each cup, add | 1-2 Tbsp. | 2-4 Tbsp. | 3-4 Tbsp. |

In making rich cakes at high altitudes, it is sometimes necessary to reduce shortening by 1 or 2 tablespoons. Fat, like sugar, weakens cell structure. Also, increasing the amount of egg strengthens the cell structure and may prevent the too-rich cake from falling.

## Angel food and sponge cakes

The leavening gas for these is largely air. Too much air should not be beaten into the eggs. Beat egg whites only until they form peaks that fall over--not stiff and dry, which would cause collapse of cells. Strengthen cell structure by using less sugar and more flour, and a higher baking temperature.

## Cake mixes

Adjustments usually take the form of strengthening the cell walls of the cake by adding all-purpose flour and liquid. Suggestions for high altitude adjustments are provided on most cake mix boxes. Follow these suggestions.

## Cookies

Although many sea-level cookie recipes yield acceptable results at high altitudes, they often can be improved by a slight increase in baking temperature; a slight decrease in baking powder or soda, fat, and sugar; and/or a slight increase in liquid ingredients and flour. Many cookie recipes contain a higher proportion of sugar and fat than necessary, even at low altitudes.

## Biscuits, muffins and quick breads

Quick breads vary from muffin-like to cake-like in cell structure. Although the cell structure of biscuits and muffin-type quick breads is firm enough to withstand the increased internal pressure at high altitudes

without adjustment, a bitter or alkaline flavor may result from inadequate neutralization of baking soda or powder. When this occurs, reducing the baking soda or powder slightly will usually improve results.

Quick breads with a cake-like texture are more delicately balanced and usually can be improved at high altitudes by following the adjustment recommendations given above for cakes.

**Pie crust**

Not generally affected by altitude. However, slightly more liquid may be used.

**Practical notes concerning baking**

1. Flour. Use any brand of enriched all-purpose flour (or cake flour, if called for by the recipe).
2. Do not assume that your sea level recipe will fail. Try it first. It may need little or no modification.

For further reference, the following is a list of publications available on food preparation at high altitude. Check first with your local Cooperative Extension office to purchase copies. Or, you may order from the Cooperative Extension Resource Center at Colorado State University, Fort Collins, Colorado 80523. When ordering from CERC, make checks payable to Colorado State University; add postage as listed below.) Prices are subject to change.

| | | |
|---|---|---|
| 415A | Quick Mixes for High Altitude Baking | $1.25 |
| 456A | Cookie Recipes from a Basic Mix for High Altitudes | $1.00 |
| 496A | Today's Sourdough at High Altitude including Microwave Supplement | $1.25 |
| 497A | High Altitude Baking | $1.25 |
| 513A | Making Yeast Breads at High Altitude | $1.30 |
| 516A | Mile High Cakes | $1.25 |
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