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Altitude Adjusters

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Altitude Adjusters

Newcomers to Wyoming's mountain area, may wonder why potatoes take longer to cook or why cakes continually fall. Low altitude recipes usually need to be adjusted at altitudes above 3,000 feet. Time, temperature, and ingredients need to be adjusted.

Here's why:

High altitude results in lower air pressure, which decreases water's boiling temperature from 212 degrees Fahrenheit at sea level to 203 degrees Fahrenheit at 5,000 feet and to just 199 degrees Fahrenheit at 7,200 feet. This variation affects the way vegetables, eggs, and candies cook, and it alters the internal structure of baked products because water and liquids evaporate faster and leavening gases in breads and cakes expand more.

Do not assume all sea-level recipes will fail. Try them first because little or no modification may be needed. This is especially true of meats and vegetables cooked in dry heat (in the oven). They are less affected by altitude changes. Even after making the recommended altitude adjustments for sea-level recipes, the quality may never be the same as when they were prepared at sea level.

The following is a list of "Altitude Adjusters" that may be helpful in high-country food preparation.

* Altitude Adjuster 1: Cakes
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Altitude Adjuster 1: Cakes

The need for altitude adjustments for food preparation in Wyoming becomes most apparent when baking. The steps for baking a cake, from ingredient selection to baking temperature, become more critical to prepare a perfect cake at high altitudes.

The ingredients need to be selected carefully and measured accurately. Substitutions—such as using all-purpose flour when a recipe calls for cake flour can cause undesirable results. Mixing directions must be carefully standardized, and pan size should be correct.

Cakes made with shortening: Cake recipes perfected for sea level usually need no adjustment up to altitudes of 3,000 feet. Above 3,000 feet, the lower atmospheric pressure may cause the cake to rise too quickly, and the cell structure overexpands before the cake "sets." At best, the cake may have a coarse texture. At worst, the cell walls may overexpand and break, causing the cake to fall in the center. The cake batter may even rise so high during this expansion that it spills over the top of the pan.

These problems usually can be corrected by adjusting the baking temperature and one or more of these key ingredients: baking powder, baking soda, sugar, liquid, and fat. Only one adjustment should be made at a time and only in the order given on the table on page five.

Another adjustment is to increase baking temperature 15 to 25 degrees Fahrenheit. This helps "set" the batter before the cells formed by the leavening agent overexpand. Increasing the baking temperature also helps overcome the lighter crust color that occurs because of fast moisture evaporation at high altitudes.

Fast, excessive moisture evaporation leads to high sugar concentration, which weakens the cell structure in cakes. To compensate for this, decrease the amount of sugar or increase the amount of liquid in the recipe.

Fat, like sugar, weakens the cake's cell structure. Rich cakes made at high altitudes may need 1 or 2 tablespoons less fat than called for in the recipe. Eggs strengthen cell structure. Therefore, the addition of an egg may prevent a "rich" cake from falling.

Cake mixes: When baking cake mixes at high altitudes, follow the altitude adjustments given on the box. Adjustments usually strengthen the cell wall of the cake with the addition of all-purpose flour, egg yolk, or liquid.

Angel food and sponge cake: These present special problems at high altitudes. The leavening agent for these cakes is mostly air, but it is important not to beat too much air into the eggs. Beat the eggs until they form a peak that falls over, not until they are stiff and dry. Over beating expands air cells too much and causes cakes to fall. Using less sugar, more flour, and a higher baking temperature will strengthen the cell structure of angel food and sponge cakes.

Cake Recipe Adjustment Guide for High Altitudes

Adjustment	3,000 feet	5,000 feet	7,000 feet
Reduce baking powder; for each teaspoon, decrease	1/8 teaspoon	1/8 to ¼ teaspoon	¼ teaspoon
Reduce sugar; for each cup, decrease	0 to 1 tablespoons	0 to 2 table-spoons	1 to 3 table-spoons
Increase liquid; for each cup, add	1 to 2 table-spoons	2 to 4 tablespoons	3 to 4 table-spoons

Altitude Adjuster 2: Foods Cooked in Water or Steam

Foods cooked in boiling water or steam need to be adjusted for Wyoming's high elevations. As altitude increases, water boils more quickly but at a lower boiling point.

Because of this, a "three-minute" egg may not be done in three minutes, and a bowl of soup may come to a boil very quickly but not be especially hot. It takes longer for vegetables, eggs, dried beans, pot roasts, stews, and other foods cooked in liquid to become tender at high elevations. It is impossible to suggest the additional cooking time required at high altitudes because there is so much variation in the size and the ripeness of different foods.

In general, cooking time must be increased 4 to 11 percent per 1,000 feet, depending on the product.

A pressure cooker is perfect for cooking meats and vegetables that require long cooking at high altitudes.

By increasing the pressure, the temperature at which water boils is raised, and food cooks more quickly. However, relying on the manufacture's pressure cooker time tables does not always result in tender food at high altitudes. The steam temperature within the pressure cooker also is affected by altitude. When using a pressure cooker, the pressure must be increased by one pound per 2,000 feet of increased elevation to reach the same temperature required at sea level. For example, at 6,000 feet a pressure of 18 pounds is required for the same internal temperature as 15 pounds of pressure at sea level.

For pressure cookers with a dial gauge, altitude adjustments can be made easily. An increase in cooking time is necessary for pressure saucepans with a maximum weighted gauge of 15 pounds. An increase of one to two minutes is satisfactory at 5,000 feet for most vegetables. Beets, whole potatoes, and sweet potatoes may require an additional five minutes.

Altitude Adjuster 3: Quick Breads

Because of quick breads' firm structure, they can usually be prepared at high altitudes without change or with only a slight decrease in baking powder.

Using less baking powder or soda than called for in your recipe usually improves texture and prevents a bitter or alkaline aftertaste. Using 1 teaspoon of baking powder or ½ teaspoon of baking soda per cup of flour is usually enough leavening for most quick breads at 5,000 feet above sea level.

Quick breads with cake-like textures are delicately balanced and usually need adjustment. Quick breads not adjusted properly have a porous, sugary crust. They also have coarse, gummy, or oily textures and low volume compared with weight. This can usually be improved by a slight reduction in baking powder or soda.

It is generally recommended to reduce the baking powder or soda by ⅛ teaspoon per teaspoon called for, and reduce the sugar and fat by 2 to 4 tablespoons for each cup in the recipe.

When preparing quick-bread mixes, similar results can be obtained by increasing the flour and liquid by 2 to 4 tablespoons per cup in the recipe.

Only repeated experiments with favorite recipes will give bakers the most successful ingredient proportions. Try the smaller adjustments first. This may be all that is needed.

Altitude Adjuster 4: Candy, Syrup, and Jelly

Cooking to the right degrees of moisture evaporation is important when making syrups, candies, and jellies. Sea-level recipes that call for cooking to a certain temperature assume a boiling point of 212 degrees Fahrenheit. But, just as water boils at a temperature below 212 degrees Fahrenheit at high altitudes, all other liquids also boil at lower temperatures.

Boiling causes moisture loss through evaporation. The lower the boiling point, the sooner moisture evaporation begins. At high altitudes, when sugar mixtures, such as candies, syrups, and jellies, are cooked at the temperatures suggested in sea-level recipes, the faster loss of water causes the mixture to become too concentrated. Depending on the type of sugar mixture being prepared, the results may be "sugary" or hard.

To adjust sugar recipes for high altitudes, the syrup needs to be cooked at a lower temperature than the sea-level recipe indicates. When using a candy thermometer, follow these steps to calculate the correct final temperature:

1. Bring a pan of water to a rapid boil.

2. Place the thermometer in the water. Read the thermometer to see what water's boiling point is at the current altitude. Be careful not to let the bulb slip out of the water or touch the edge or bottom of the pan.

3. Subtract the boiling point of water at the current altitude from the boiling point of water at sea level (212 degrees Fahrenheit).

4. Then subtract the temperature reached in step 3 from the final temperature given in the recipe. This will be the final temperature for the recipe at the current altitude (the temperature at which the product should be removed from the stove).

For example, if the boiling point of water at the current altitude is 192 degrees Fahrenheit:

1. Subtract 192 degrees from 212 degrees Fahrenheit (water's boiling point at sea level)
   212° Fahrenheit boiling point of water at sea level
   -192° Fahrenheit boiling point of water at current altitude
   = 20° Fahrenheit difference in the boiling point of water at sea level and the boiling point of water at current altitude

2. Next, subtract this temperature difference from the finished temperature given in the recipe. For example, if the recipe says to cook the product to 252 degrees Fahrenheit, obtain the finished temperature of the recipe at current altitude by making an adjustment of
   252° Fahrenheit finished recipe temperature
   - 20° Fahrenheit temperature difference
   =232° Fahrenheit finished recipe temperature at your altitude (removed from heat)

When a candy thermometer is not available, the cold water test works well at all altitudes. Certain recipes mention cooking until ½ teaspoon of the syrup dropped into cold water forms a soft, firm, or hard ball when removed. If the syrup separates into hard, but not brittle, threads when dropped, it has reached the "soft crack" stage. If these threads are brittle, as well as hard, it has reached the "hard crack" stage. Be sure to remove the pan from heat while testing candy, so the candy doesn't overcook.

In the case of jellies, the "sheet" test with a metal spoon can be reliably used at all altitudes. For this test, dip a cool metal spoon in the boiling jelly mixture. Then raise the spoon at least a foot above the kettle, away from the steam, and turn the spoon so the syrup runs off the side. If the syrup forms two drops that flow together and fall off the spoon as one sheet, the jelly should be done.

Altitude Adjuster 5: Cookies

Although many sea-level cookie recipes give acceptable results at high altitudes, they can usually be improved by increasing the baking temperature 15 to 25 degrees Fahrenheit. A soapy aftertaste in cookies means that the amount of baking soda or baking powder should be decreased by 1/8 teaspoon than the recipe calls for.

If cookies spread too much during baking, reduce the sugar or fat content by 1/8 to ¼ the recommended amount.

Many cookie recipes call for more amounts of sugar and fat than necessary even at low altitudes. For more nutritious cookies with fewer calories, replace up to ¼ of the sugar called for in the recipe with nonfat dry milk powder.

Altitude Adjuster 6: Pudding and Cream Pie Filling

Pudding and cream pie fillings thickened with cornstarch have special problems at high altitudes. Above 5,000 feet, temperatures reached in the top of a double boiler are not high enough for starch to thicken enough. Use direct heat rather than a double boiler to achieve better results.

Also, when making puddings and cream pie fillings, be careful not to overcook the products. Overcooking may cause the starch mixture to break down and become watery.

Altitude Adjuster 7: Deep-fat Frying Temperatures

The lower boiling point of water found at high altitudes not only affects foods cooked in water but also foods cooked in deep fat. To prevent deep-fat-fried foods from over browning on the outside while being under-cooked inside, the temperature of the fat must be lowered.

Temperature decrease varies according to the food being fried. A rough guide to follow is lowering the frying temperature approximately 3 degrees Fahrenheit for each 1,000 foot increase in elevation. For example, at 5,000 feet, a sea-level recipe calling for frying doughnuts at 370 degrees Fahrenheit should be lowered to 355 degrees Fahrenheit.

Altitude Adjuster 8: Yeast Breads

Baking yeast breads in the high country can be a pleasurable and successful experience by using a few tips. In the high, dry Wyoming climate, flour tends to be dryer and absorbs more liquid. A little less flour, or slightly more liquid, may be needed to maintain proper dough consistency. Because humidity changes affect flour's dryness and the amount needed in the same recipe on different days, there is no hard and fast rule to follow.

A good method is to add only 1/3 of the flour at a time until a soft dough that pulls away from the sides of the bowl is formed.

High altitude affects the yeast's rising time because leavening gases expand more quickly. Bread dough doubles in size faster at high altitudes than at low altitudes. The higher the altitude, the shorter the time required for dough to rise.

This faster rising time speeds the bread-making process, but it also causes problems. A certain length of rising time is necessary for good flavor and a lightly textured bread. Using less yeast or letting the dough rise twice before shaping into loaves or rolls, usually allows enough rising time for good flavor. It is important that the dough be allowed to rise only until double its original size before punching the dough down or before baking. Letting bread rise too long may cause over fermentation and a coarse, open-textured bread with a yeast-like flavor.

Test yeast dough by quickly pressing a fingertip into the center of the dough. If a dent remains in the dough, it is ready to be punched down.

Because of Wyoming's dry atmosphere, bread dough may become dry and form a crust on the surface of the dough during rising time. To prevent this crust from forming, the dough can either be placed in a warm, closed cupboard with a pan of hot, steaming water or covered with a damp cloth.

At altitudes over 3,500 feet, increase baking temperature by 25 degrees Fahrenheit. Most sea-level recipes require baking temperatures between 375 degrees Fahrenheit and 400 degrees Fahrenheit. At higher altitudes the best baking temperature is 400 degrees to 425 degrees Fahrenheit. This higher temperature sets the cell walls quickly and stops further rising, preventing the dough from becoming too light.

The following publication is available for more information about high altitude cooking.

B-427 Baking at High Altitudes, 1965 — $1

Send orders to:
University of Wyoming
Cooperative Extension Service
Office of Communication and Technology
Resource Center
PO Box 3313
Laramie, WY 82071-3313

Sources:

High Altitude Food Preparation, Pamphlet 41, Pat Kendall/Food Science and Human Nutrition, Cooperative Extension Service, Colorado State University, Fort Collins CO 80523.

"Teletip Messages," Food Science and Human Nutrition, Cooperative Extension Service, Colorado State University, Fort Collins, CO 80523

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