Cakes

HIGH ALTITUDE FACTS ABOUT MAKING AND BAKING CAKES

High altitude has the greatest effect on cake making and baking. An ingredient-balanced, altitude-adjusted, time- and family-tested recipe is the best way to bake a perfect cake at elevation over 2,500 feet. Many elements in a recipe can be adjusted to produce a moist and fine-textured cake at high altitudes, but not all the adjustments possible need be made in any individual recipe.

The first adjustment is to decrease the amount of leavening agent: baking powder, baking soda, cream of tartar, and the air beaten into egg whites. The lower atmospheric pressure at high altitudes allows leavening agents to expand faster during baking and to push cake batter higher—often too high. The result is a fallen, coarse and crumbly cake. For suggested reductions in the amount of leavening agents, see High Altitude Adjustments for Sea-Level Cake Recipes, page 45.

Fresh cream of tartar and *fresh* baking powder work best at high altitudes. Double-acting baking powder (sodium aluminum sulfate) was used in testing the recipes in this collection. It is recommended for high altitude use because it reacts in two stages, and therefore more slowly: only slightly in the batter, then releasing its leavening power during the actual baking. Substitute 1½ teaspoons of any other type baking powder (tartrate or calcium phosphate) for 1 teaspoon double-acting baking powder.

When the egg is the leavening agent, avoid too much beating of the whole eggs, yolks or whites. Beat egg whites just until stiff and satiny,

but not dry. Egg whites resembling soap suds will dry out the cake and toughen its texture. In some recipes, too much air beaten into egg whites can cause the cake to fall.

The second adjustment in high altitude cake baking is to increase the liquid. Additional liquid offsets the rapid evaporation that causes cakes to dry out. It also compensates for the dryness of flour, dilutes sugar concentrations, and properly dissolves and distributes the other ingredients. Buttermilk, sour cream and soured milk add much needed moisture and vitality to cakes baked at elevations over 2,500 feet.

The third suggested adjustment is a reduction in the amount of sugar. (This, however, is applicable only when a recipe calls for the maximum amount of sugar relative to the other ingredients.) Too much sugar makes a coarse and crumbly cake because the sugar becomes too concentrated in the cake batter, weakening the cell structure. See High Altitude Adjustments for Sea-Level Cake Recipes, page 45.

Pioneer cooks relied on eggs to solve their high altitude cake-baking problems. One early cookbook recommended the addition of an egg as the only change in converting a sea-level recipe for high altitude. Today, the recommendation is to always use extra-large eggs in all baking. The protein in the eggs strengthens the cell structure and makes up for dryness in the air, creating velvety, moist cakes.

Very rich cake batters sometimes call for large amounts of shortening, butter or margarine. Like sugar, these fats can become too concentrated at high altitudes, weakening the cell structures and causing a tough, crumbly cake. For successful high altitude cakes it is often necessary to decrease the fats in sea-level recipes by 1 or 2 tablespoons.

Some ingredients perform better at high altitude than others. Cake flour is preferable to all-purpose flour for cakes. Self-rising flour should not be used for cakes at increased elevations because of the overexpansion of their leavening agents. "Wonder" flours that have been moistened, heated and dried to a powder produce adverse results.

The substitutions of margarine for butter or shortening can negatively affect the texture and the taste in cakes and other baked products. Only high-grade margarines should be used. Always use high-quality emulsified or hydrogenated-type shortenings (finest all-vegetable), which are also interchangeable cupful for cupful with butter. When a recipe calls for shortening, use half shortening and half butter for extra flavor.

Though more expensive, pure vanilla extract, peppermit oil and other natural flavorings should never be replaced with imitations. Substitutes for real chocolates, other than carob exchanges, fail to satisfy.

The handling of ingredients is as important in high altitude baking as adjusting their amounts. Do not undercream shortening and sugar. Too little creaming results in a coarse-textured cake. If eggs are overbeaten at high altitude, the cake will be dry. Excessive mixing when adding flour and liquids or after adding them will dry out the cake and toughen

its texture. Remember, the retention of moisture is crucial to successful high altitude baking.

Low altitude recipes often require a temperature adjustment. It is recommended that the baking temperature be increased by 25°F. so as to set the batter before the cells formed by the leavening agent have a chance to expand too much.

Use the correct size of cake pans and generously grease or line them with waxed paper to prevent sticking. The minute cakes are turned out onto a rack they begin to dry out quickly, so cool cakes in pans, then frost immediately to preserve moisture.

Angel Food and Sponge Cakes

When making angel food or sponge cakes, do not overbeat eggs, yolks or whites. Use a little less leavening if any other than air is included in the recipe. The addition of an extra egg often strengthens and stabilizes these delicate, light batters. Have eggs at room temperature before beginning to mix a sponge or angel food cake.

Cupcakes

Cake batters make excellent cupcakes, especially creamed cake batters. Keep cupcakes from sticking to the pan by generously greasing muffin pan cups or, even better, by using paper baking cups. Fill each muffin pan cup one-half to two-thirds full. A standard-size ice cream dipper usually holds the correct amount of batter and is a handy tool for neatly and accurately filling cups. Bake cupcakes according to directions for each cake recipe, reducing baking time to about 20 minutes and pressing the center lightly with fingertip to test for doneness. An average cake-batter recipe yields about 2 to 3 dozen cupcakes.

High Altitude Adjustments for Cake Mixes

The special directions for high altitude on packaged cake mixes should always be followed. These usually include extra additions of flour and liquid. After making the recommended adjustments, add 2 tablespoons cooking oil to small packages of cake or brownie mix and 4 tablespoons to larger packages. Adding an egg yolk will also improve the texture and quality of packaged mixes.

HIGH ALTITUDE ADJUSTMENTS FOR SEA-LEVEL CAKE RECIPES

Decrease each measurement the lesser amount at the lowest altitude and the larger amount at highest altitude within the given range.

Adjustment	At 2,000 to 3,500 feet	At 3,500 to 5,000 feet	At 5,000 to 6,500 feet	At 6,500 to 8,000 feet
For each teaspoon of baking powder, baking soda, or cream of tartar, decrease by:	¼ to ⅓ teaspoon	⅓ to ½ teaspoon	½ to ⅔ teaspoon	⅔ to ¾ teaspoon
For each cup of sugar, decrease by:	1 to 1½ tablespoons	1½ to 2½ tablespoons	2½ to 3 tablespoons	3 to 3½ tablespoons
For each cup of liquid, increase by:	0 to 2 tablespoons	2 to 3 tablespoons	3 to 4 tablespoons	4 to 6 tablespoons
Increase cake flour by:	—	1 tablespoon	2 tablespoons	3 tablespoons
Increase baking temperature by:	—	15° to 25°F.	15° to 25°F.	25°F.

Begin adjustment for your altitude by reducing baking powder, baking soda, or cream of tartar. Liquid and flour adjustments may not be necessary after adjusting the leavening; this can be determined by experience. Very rich cake batters may be better if shortening is decreased 1 to 2 tablespoons.

HIGH ALTITUDE LEAVENING (BAKING POWDER AND BAKING SODA) ADJUSTMENTS FOR SEA-LEVEL CAKE RECIPES

Recipes Used Above 2,000 Feet

Use larger amount of leavening at lower altitude.
Use smaller amount of leavening at higher altitude.

Sea-Level Measurement	At altitudes 2,000 to 3,500 reduce to:	At altitudes 3,500 to 5,000 reduce to:	At altitudes 5,000 to 6,500 reduce to:	At altitudes 6,500 to 8,000 reduce to:
1 teaspoon	¾ to ⅔	⅔ to ½	½ to ⅓	⅓ to ¼
1½ teaspoons	1¼ to 1	1 to ¾	¾ to ⅔	⅔ to ½
2 teaspoons	1¾ to 1½	1½ to 1¼	1¼ to 1	1 to ¾
2½ teaspoons	2 to 1¾	1¾ to 1½	1½ to 1¼	1¼ to 1
3 teaspoons	2¼ to 2	2 to 1½	1½ to 1¼	1¼ to 1
3½ teaspoons	3 to 2½	2½ to 2	2 to 1½	1½ to 1
4 teaspoons	3 to 2½	2½ to 2	2 to 1½	1½ to 1

WHY HIGH ALTITUDE BAKING AND COOKING ARE DIFFERENT

High altitude baking and cooking are *different*. The reason: lower atmospheric pressure due to a thinner blanket of air. As altitude increases, atmospheric pressure decreases, and this in turn causes:

- water to boil at 202.6°F. at an altitude of 5,000 feet rather than at 212°F. as it does at sea level.
- leavening (baking powder, baking soda, cream of tartar) to expand more.
- yeast doughs to rise too rapidly and too high.
- sugar solutions to become more concentrated in frostings, candies, jellies and baked products.
- faster evaporation of liquids in all cooking processes.
- drying out of normal moisture in most food products.

Baking

High altitude has the greatest effects on baking. In baking recipes, each ingredient bears a definite relationship to the others, and the quality of the finished product depends on a delicate balance of ingredients achieved through the proper quantity of each.

The reduction of atmospheric pressure at high altitude allows leavening agents—air, steam and carbon dioxide—to expand more than at sea level. Air can be controlled most easily, simply by not overbeating egg whites. Carbon dioxide and steam, however, get their volume from given weights of their respective sources and depend on existing atmospheric pressure and temperature. One teaspoon of baking powder at 5,000 feet produces 20 percent more volume than at sea level. Bread rises faster and must be watched. At 5,000 feet, steam expands to an approximately 20 percent greater volume than at sea level, causing popovers to puff out too rapidly and thereby lose their steam. Cakes rise excessively, which stretches the cell structure and makes the cake coarse-textured or, worse, breaks the cell walls, causing the cake to fall.

It is important to have a correct ratio of sugar to the other ingredients. Liquids evaporate more quickly at high altitudes, and if a solution contains too much sugar—or not enough liquid—it will become overly concentrated during baking, weakening the cell walls of cakes, desserts, quick breads or cookies.

Shortening, like sugar, can be a problem for the high altitude cook. Too much in a rich cake batter will weaken the cell structure. The substitution of margarine for butter or high-grade hydrogenated or emulsified shortening can noticeably affect the texture in cakes as well as produce an inferior taste.

At high altitude, liquids work in two contradictory ways. On the one hand, their rapid evaporation rate creates the problem of overly concentrated sugar solutions. On the other, they offset the dryness of flour, dilute sugar concentration, dissolve and evenly distribute the other ingredients. Because the high altitude air is a thief of moisture, batter requires a greater proportion of liquid than at sea level.

Unless the cook uses extra-large eggs, the batter will be less stable and the final baked product will not be moist enough. Some cakes, especially angel food and sponge, require a greater number of eggs than at sea level.

Furthermore, unless oven temperatures are increased in baking cakes, yeast or quick breads, the batter will not "set" before the air cells formed by the leavening agent expand too much.

When baking casseroles or roasting meats, standard oven times and temperatures will fail to produce satisfactory results because the boiling point of water in the foods themselves will never exceed 202.6°F. More cooking time and/or higher temperature may be needed.

When baking yeast breads, the cook must carefully watch that the dough does not rise more than double its bulk. Because dough rises faster at high altitudes, flavor doesn't have time to develop. Punching down the dough twice will improve flavor as well as texture.

Cooking

At high altitudes, water boils at lower temperatures than at sea level. (See Boiling Point of Water from Sea Level to 14,000 Feet, page xvi.) At an altitude of 5,000 feet, for example, it will boil at only 202.6°F.—a difference of 9.4°F. from sea level. Foods cooked in or over boiling water —at these lower temperatures—require longer cooking times to become done or tender, and must be cooked according to special timetables and directions. This applies to vegetables, fruits, eggs, poultry, meat, stews, soups, beverages, fish, custards and sauces, as well as canning and preserving. At very high elevations, some boiled foods never become satisfactorily cooked. Oldtime cookbooks warned prospectors going up into the mountains never to cook beans "cuz they don't get done."

The reason for the lower boiling point of water at high altitudes is decreased atmospheric pressure. When a liquid is heated, vapor begins to form. The bubbles of vapor, being lighter than the surrounding liquid, rise upward, but they cannot reach the surface until the pressure within each bubble just exceeds the atmospheric pressure on the surface of the liquid. The temperature at which the bubbles of water vapor break through the surface and escape into the air is called the boiling point. This is why, as altitude increases and atmospheric pressure decreases, the boiling point also decreases, and to compensate for the lower cooking temperature, the cooking time for food must be increased.

You *cannot* cook food more quickly by turning the burner higher. The reason is the distinction between *heat* and *temperature*. The heat flow—from the burner to the saucepan to the water in the saucepan to the food immersed in the water—can be increased *only* until the water starts to boil. Water will not reach a temperature higher than its own boiling point, and consequently the food immersed in it cannot reach a temperature exceeding the boiling point of the water. Turning up the burner after water has started to boil will only boil it away faster.

SOME COMMON PROBLEMS OF COOKING AT HIGH ALTITUDES:
Food is often underdone because the moisture in the food itself and the water in which it is being cooked boils at a lower temperature.

Because of the rapid rate of evaporation, food can easily cook dry.

Unless special adjustments are made in the temperature of cooking oil, deep-fat-fried foods will be overbrowned on the outside, undercooked on the inside.

Because of the lack of moisture in the air, sugar syrups used in making candies, frostings and jellies concentrate much more rapidly than at lower elevations.

Canned fruits, tomatoes and pickled vegetables do not become thoroughly processed because of the lowered boiling point of water, and low-acid foods (vegetables, meat and poultry) can nurture heat-resistant bacteria unless processed longer and at higher poundage in a steam-pressure canner.

In summary, altitude has a great effect on food and food processes. It affects the flavor and taste of food, influencing three of our four basic tastes: sweet, sour and bitter. It affects processing time and moisture content. But there are solutions to the problems facing the high altitude cook. You will find these solutions in each and every chapter of this book, by reading the introductory material, using the guidelines in the charts, and carefully following the directions in the recipes.

BOILING POINT OF WATER FROM SEA LEVEL TO 14,000 FEET

Height above sea level	Boiling point of water (F.)
0	212.0
500	211.0
1000	210.0
1500	209.1
2000	208.2
2500	207.1
3000	206.2
3500	205.3
4000	204.4
4500	203.4
5000	202.6
5500	201.7
6000	200.7
6500	199.8
7000	198.7
7500	198.0
8000	196.9
10000	194.0
12500	189.8
14000	187.3

To determine the boiling point of water where you live:
Find the altitude at which you live on the bottom line. Using a ruler, draw a line from this point upward to meet the slanting line. Mark where your line meets the slanting line. Using the ruler, draw a straight line from the marked point to the Boiling Point of Water scale. Where the line joins the scale indicates the Centigrade and Fahrenheit temperatures of boiling water at your elevation (see example below).

Boiling Point of Water °C. 100° 96° 95°

90° 85° °F. 212° *Elevation* 0 1,000 Feet

205° 203° 200° 194° 4,000 5,000 Feet

190° 185° 10,000 Feet 15,000 Feet

HIGH ALTITUDE OVEN TEMPERATURE CHART
(Fahrenheit and Centigrade)

Oven	Degrees Fahrenheit	Degrees Centigrade
Slow	300°F. to 325°F.	149°C. to 163°C.
Moderate	340°F. to 375°F.	177°C. to 191°C.
Hot	400°F. to 425°F.	204°C. to 218°C.

HOW TO CONVERT OVEN TEMPERATURES

Fahrenheit into Centigrade:
Subtract 32, multiply by 5, divide by 9.
Example: 140°F. − 32 = 108
108 × 5 = 540
540 ÷ 9 = 60°C.

Centigrade into Fahrenheit:
Multiply by 9, divide by 5, add 32.
Example: 60° C. × 9 = 540
540 ÷ 5 = 108
108 + 32 = 140°F.

HOW TO CONVERT TO THE METRIC SYSTEM

Easy Comparisons:
A liter equals a little more than a quart (1 quart plus 3 tablespoons).
A kilogram equals a little more than two pounds (2.2 pounds).

Solid Measurements
Butter in solidly packed standard eight-ounce cups:
2 cups = 400 grams
1 cup = 200 grams
½ cup = 100 grams
¼ cup = 50 grams

Granulated sugar:
1 cup = 190 grams
⅔ cup = 125 grams
½ cup = 95 grams
¼ cup = 50 grams

All-purpose flour:
1 cup = 140 grams
⅔ cup = 100 grams
½ cup = 70 grams
¼ cup = 35 grams

Rice:
1 cup = 150 grams

Liquid Measurements

2 cups = ½ liter
1 cup = ¼ liter
¾ cup = 1/6 liter
⅔ cup = 1/7 liter
½ cup = 1/8 liter
⅓ cup = 1/15 liter
¼ cup = 1/16 liter

HIGH ALTITUDE FACTS ABOUT THE ELECTRIC SLOW COOKER

Because slow cookers use a very low temperature, it is important that the food inside gets hot enough to become properly done, avoiding spoilage and killing health-endangering bacteria. At high altitude, a minimum safe temperature is 200°F. You must take special care to get more heat into the slow cooker, since you are already cooking with a 10-or-more-degree drop in the boiling point.

Since temperature control units on slow cookers vary with each manufacturer's model, you should be careful to select a setting comparable to at least 200°F. Some adjustable heat controls on slow cookers have low temperature settings which should not be used for cooking at all. They are designed for warming. Also, allow for considerably more cooking and baking time at higher elevations.

Dried legumes *cannot* be cooked in a slow cooker at high altitude unless they have been precooked on the stove; then they may be satisfactorily finished and served in the cooker.

Avoid taking the lid off the slow cooker. It takes 20 to 25 minutes to regain the lost steam and temperature. Never remove the cover during the first 2½ to 3 hours when baking in a cooker. Follow high altitude directions for packaged mixes.

Aluminum foil on top of the foods being cooked or between the rim of the cooker and the cover reflects the heat downward into the food and is especially helpful at higher elevations.

Completely thaw all but the quickest-cooking vegetables before cooking them in a crockery pot.

HIGH ALTITUDE FACTS ABOUT ELECTRIC SKILLET AND WOK COOKERY

Successful use of the electric skillet and wok at high altitudes depends on increasing the cooking temperature by about 25°F. When browning a skillet-filling amount of meat or poultry, the cooking temperature may

fall off more quickly than at sea level, and you should turn the temperature control up from time to time to keep the heat constant. The same is true when you are cooking large quantities of vegetables.

You should always allow for more cooking time than is called for in accompanying instruction manuals and in sea-level recipes.

You can maintain or increase "cooking power" in ways other than by just turning up the temperature control dial. First, keep the vents tightly closed during cooking to keep all the steam possible inside the skillet or wok. Second, when braising foods that require long cooking times, secure aluminum foil over the skillet's rim, then place the cover on tightly. This optimizes the use of all available heat, reduces heat loss, and helps retain the proper moisture content.

Another way of keeping moisture from being lost to the dry high altitude air is to add water or other liquids in small amounts as needed. This will also prevent scorching.

HIGH ALTITUDE FACTS ABOUT MICROWAVE COOKERY*

High altitude affects most foods cooked in the microwave oven with the exception of vegetables.

Temperature of foods decreases as altitude increases, yet due to more rapid evaporation of liquids in high altitude areas, microwave cooking takes less time than at sea level.

The exceptions are meats and dense, low-moisture foods such as pasta and rice which require the maximum cooking time recommended in manufacturer's instruction manuals and nationally published microwave cookbooks. It is advisable to judge the doneness of the meat by the muscle, not the fat, since fat cooks more quickly than muscle.

Cake batters should stand fifteen minutes before baking to permit some of the leavening gas to escape. Fill baking dish only half full because cakes rise higher and more rapidly in the microwave oven. High altitude directions on package mixes should be followed.

Always to be considered are the variables that can affect cooking time: the temperature, size and shape, and amount of food, plus the power setting of the oven. It is best to underestimate cooking times and check foods during cooking.

* The information in this section has been adapted from materials compiled by Joan Gehle, Home Economist, Denver Public Schools, Emily Griffith Opportunity School.

HIGH ALTITUDE FACTS ABOUT THE PRESSURE COOKER

Every high altitude cook should own a pressure cooker. When you live at 5,000 feet above sea level, for example, the atmospheric pressure is 18 percent, or 2.1 pounds less than at sea level, and every increase in elevation decreases it further—thereby also decreasing the boiling point of water. By enabling you to increase the pressure inside the cooker to nearer that of sea level, the pressure cooker raises the temperature at which water boils and makes food cook more quickly and thoroughly. In very high areas (7,000 feet and above), the boiling temperatures are so low that the pressure cooker becomes the only means by which dried legumes can be completely cooked. Even at lower altitudes (3,000 feet and above), it is essential for canning, as it inactivates or kills harmful bacteria. And because it shortens the cooking time of foods, it is one of the best ways to prevent them from drying out during the cooking process—an all too frequent problem at high altitudes.

Wherever it is used, the pressure cooker has gained recognition for quick cooking and vitamin-and-energy-saving features, but at high altitudes it provides the additional benefit of accomplishing the otherwise impossible.

Using the Pressure Cooker at High Altitudes

To reach the same boiling temperature as at sea level, the pressure in the cooker must be increased by 1 pound for every 2,000 feet above sea level, and cooking time under pressure should be increased by 5 percent for every 1,000 feet after 2,000 feet above sea level. At sea level, the pressure cooker is normally set to 10 pounds. At higher altitudes (5,000 feet and above), where the atmospheric pressure is so much lower to begin with, the additional 10 pounds will not raise the boiling temperature to as high a point as they do at sea level, and the gauges of most home pressure cookers do not go above 10 pounds. To compensate, it is necessary to lengthen the cooking time recommended for sea level, *or* the gauge from your pressure cooker may be sent to the manufacturer and adjusted to the proper weight for the altitude at which you live.

In addition to altitude, the types of meat and the maturity and size of vegetables must be taken into consideration when determining cooking times under pressure. A 1-to-2-minute increase in cooking time is usually sufficient for most vegetables, except for such bulky roots as potatoes, beets and the like. At an altitude of 5,000 feet, these require an additional 5 minutes of cooking time.

When you are cooking recipes from this book in the pressure cooker,

adjustments in cooking time and amounts of liquid will be necessary. Consult the instruction booklet that accompanies your cooker.

To prevent evaporation, reduce heat when desired pressure is attained. This will not reduce the pressure but will help retain moisture.