



High Elevation Cooking, Baking & Canning

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Arizonans new to cooking at high elevations often find that their tried-and-true recipes are not as dependable as they once were. There are several steps to take when cooking at high elevation and these adaptations may not be included in your recipe. Arizona's topography has a great range in elevation from nearly sea level to over 12,000 feet.¹ Elevations at or above 3,000 feet above sea level are considered by most cookbooks to be "high altitude/elevation".² Elevation can significantly influence the way foods cook. The following key elements have an impact on high elevation cooking or baking:

- Water boils at a lower temperature as elevation increases.²
- Often the ambient air has lower moisture (humidity) and moisture evaporates quickly.³
- Gases expand at greater speeds due to the reduced atmospheric pressure.²

These factors can be accounted for by understanding the effect they have on food preparation. It is important to note that without proper elevation adjustments, the quality and safety of prepared food may be compromised.

Understanding the science behind elevation and the atmosphere will help frame the need for adjustments when cooking. Atmospheric pressure is the weight and number of molecules in the air. As elevation increases, atmospheric pressure and therefore air density decreases. Consequently, the air exerts less pressure on the surface of objects at higher elevations. Lower pressure allows liquids to vaporize at lower temperature because it takes less energy (heat) to overcome the pressure. The reduction in pressure means that water boils at a lower temperature as elevation increases.¹ This fact ultimately influences cooking time, because it takes longer for food to reach the desired internal temperature.³ Although the water is boiling and vaporizing, the water isn't as hot and therefore food doesn't cook as

Arizona Elevations ¹	
Yuma	131
Lake Havasu City	735
Phoenix	1,124
Tempe	1,174
Sun City	1,199
Fountain Hills	1,642
Tucson	2,589
Page	4,117
Wilcox	4,167
Sedona	4,423
Sierra Vista	4,513
Winslow	4,850
Prescott	5,034
Flagstaff	6,903
Greer	8,525

quickly. Additionally, high elevation areas tend to have lower humidity and less moisture and this is particularly true in Arizona. When there is less moisture in the ambient air, moisture from food and surfaces evaporates faster.³ The reduction in atmospheric pressure also impacts the speed of expanding gases. This is especially relevant for baking with leavening agents like baking soda.²

Cooking

Following the general guidelines for high elevation cooking, especially stove top cooking, will ensure the food is cooked thoroughly and maintains optimal flavor and texture. As stated, water and liquids evaporate readily at higher elevations and water boils at lower temperature. It may be necessary to increase liquid to avoid drying out foods or boiling a pot dry. Covering food while it is cooking will help hold in moisture and reduce evaporation. When boiling food like pasta or vegetables add plenty of water to account for the extra water boiling off and increase cooking time.¹

Consider the internal temperature that must be achieved when cooking eggs and meat. The designated internal temperature must be met for the food to be considered done and safe for consumption. When cooking hard boiled eggs checking the internal temperature is not possible, however the eggs must be cooked longer to account for the lower boiling point of the water. The size of the egg and the elevation will determine cook time and may require some experimenting, try increasing cooking time by 25% to start.³

Pastas and vegetables often require a longer cooking time to obtain the desired texture. Successful high-altitude cooking will require some trial and error to get the desired result.

Baking

As elevation increases, air pressure decreased. When it comes to baking, the lower air pressure allows the bubbles in batter to rise faster.³ Faster rising could lead to excessive

Water Boiling Temperature by Altitude ²	
Altitude	Temperature
Sea Level	212
2,000	208
6,000	200
8,000	198
10,000	194

General Cooking Guidelines
Increase cooking time.
Cover food while cooking to retain moisture.

rising and possible collapse, or dry baked goods.^{1,3} Baking at high elevations often requires experimentation and keeping notes of incremental adjustments. Try making a single adjustment at a time until the desired result is achieved. Generally, pie crust, cookies, muffins, and quick breads are less effected by elevation^{1,6} though these products benefit from minor changes when made in our highest elevation communities. Yeast breads and cakes are more susceptible to failure without proper adjustments.^{1,3,6}

General Baking Guidelines ^{3,5}									
Ingredient	Guideline	3,000 ft.	4,000 ft.	5,000 ft.	6,000 ft.	7,000 ft.	8,000 ft.	9,000 ft.	10,000 ft.
Baking Powder & Soda	Reduce each tsp.	1/8 tsp.	1/8 tsp.	1/8-1/2 tsp.	1/8-1/2 tsp.	1/2-3/4 tsp.	1/2-3/4 tsp.	3/4 tsp.	3/4 tsp.
Sugar	Reduce each cup	0-1 Tbsp	0-1 Tbsp	0-1 Tbsp	0-2 Tbsp.	0-2 Tbsp.	1-3 Tbsp.	1-3 Tbsp.	1-3 Tbsp.
Liquids	Increase each cup	1 - 2 Tbsp.	1 - 2 Tbsp. + 1 1/2 teaspoons	2-3 Tbsp.	2 - 3 Tbsp. + 1 1/2 teaspoons	3 - 4 Tbsp.	3 - 4 Tbsp. + 1 1/2 teaspoons	4 - 5 Tbsp.	4 - 5 Tbsp. + 1 1/2 teaspoons
Flour	Increase each cup	0-1 Tbsp.	-2 Tbsp.	2-3 Tbsp.	3-4 Tbsp.	4-5 Tbsp.	5-6 Tbsp.	6-7 Tbsp.	7-8 Tbsp.
Oven	Increase oven temperature 15 to 25°F; use the lower increase for chocolate or delicate cakes.								
Baking	Decrease baking time by 5-8 minutes per 30 minutes of baking time.								

Canning

Canning at high elevation will require adjustments to pressure and processing time. Be sure to always use a tested and reliable recipe as recipes found online may not adequately tested or safe. When preserving meat, poultry, fish, vegetables, and thick sauces a steam pressure canner must be used.⁷ Water bath canning is acceptable for most fruits, jellies, and tomatoes, and for pickling.⁷

If using a dial gauge pressure canner, increase the pressure by 1 pound for each 2,000 feet above sea level.⁷ Elevations above 10,000 feet require use of the 15-pound weight.⁷ If the pressure in the canner is appropriately adjusted, no additional processing time is required. Always check your recipe and look for elevation adjustments. Electronic pressure canners are not recommended due to variations in pressure during processing.

Extra processing time is required for high elevation water bath canning.⁷ Since water boils at a lower temperature in high elevation, it will take longer for the preserve to reach a high enough temperature to kill all the pathogens within the jar. Failure to increase processing time may result in undesired pathogens surviving the canning process.

Elevation	Pressure ³
Sea Level-2,000 ft.	11 lbs
2,001-4,000 ft	12 lbs
4,001-6,000 ft	13 lbs
6,001-8,000 ft	14 lbs
8,001-10,000 ft.	15 lbs

General Canning Guidelines³

Processing time of under 20 minutes - add 1 minute to processing time per 1,000 feet

Processing time of more than 20 minutes - add 2 minutes to processing time per 1,000 feet.

Preparing food at high elevation requires extra attention, some adjustment, and experimentation. The most successful result will be achieved using high elevation recipes that have been perfected. However, it is possible to achieve a delicious and safe result by making a few minor alterations during preparation.

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Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Ed Martin, Associate Dean & Director, Extension & Economic Development, College of Agriculture Life Sciences, The University of Arizona.

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