Food Quality & Entrepreneurship
UtahStateUniversity
COOPERATIVE EXTENSION

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Understanding High Altitude Cooking

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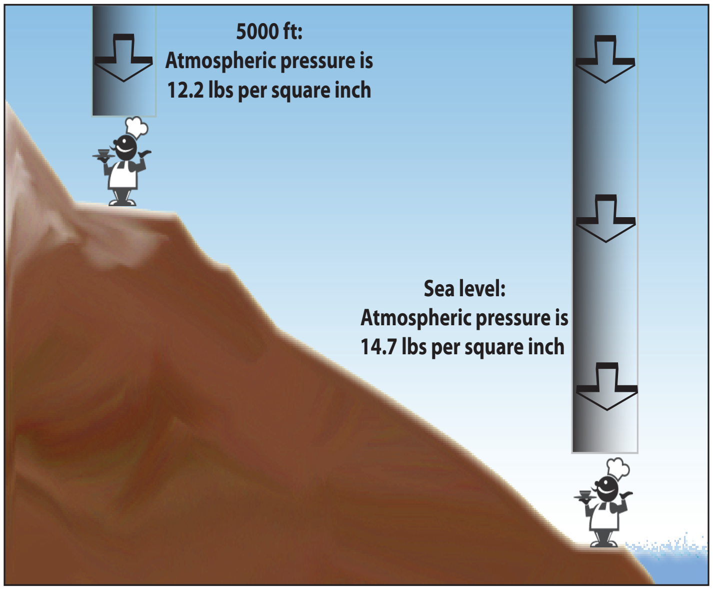
Why Elevation Matters

At high altitudes, there is lower atmospheric pressure simply because there is less atmosphere above us. Picture a column of air above you. When you're standing at sea level, this column is much taller than when you're standing on a mountain. The difference in the amount of air above us affects our breathing, our heart rate, and even how quickly we sunburn.

After a few weeks at a new altitude, our bodies adapt to the change in atmospheric pressure. Unfortunately, our recipes do not. Foods cook differently at high altitudes for two reasons: water boils at a lower temperature, and gasses are more likely to over-expand.



Two Main Consequences of Cooking at High Altitudes

Lower Boiling Point

For every 500-foot increase in elevation, the boiling temperature of water drops by about 1° Fahrenheit. This affects all types of food:

- Water reaches a boil more quickly, so there is more time for evaporation to occur during cooking. This can cause food to dry out.
- The food doesn't get as hot, so it has to be cooked for a longer time.
- Increased evaporation and a longer cooking time can result in very dry foods.
- ***Exception*** - microwaved foods actually cook in less time at high altitudes!

Over-Expansion of Gasses

Baked goods rely on leavening gasses (air, steam, and carbon dioxide) for their shape and texture. Baking at high altitudes has the following effects:

- Lower atmospheric pressure means gasses can keep expanding.
- It takes longer for starches and proteins to "set," so expanding bubbles will begin to pop and merge.
- Too many large bubbles cause baked goods (especially cakes) to have a coarse texture.
- Too many popped bubbles cause baked goods (especially cakes) to collapse.

Recommended Baking Adjustments for 5000 ft	How the Adjustment Works
Increase the oven temperature by 15-25°F	By increasing the temperature, proteins and starches begin to set sooner. The cake will not be as dry and is less likely to collapse.
Add 2-3 Tbsp water for each cup of liquid	Gluten sets at a lower temperature when there is enough moisture. Adding extra water also keeps the cake from drying out.
Decrease the sugar by 2-3 Tbsp per cup	Sugar is very effective at "holding" water. With less sugar present, more moisture is available so gluten will set at a lower temperature.
Increase the flour by 1-2 Tbsp per cup	Adding more flour adds more protein. This helps strengthen films around the expanding bubbles and keeps them from popping.
Substitute All-Purpose flour for cake flour	All-purpose flour contains more protein than cake flour. This allows more gluten to be developed, without adding extra starch that can dry the cake out.
Decrease the leavening by ¼ tsp per teaspoon	By using less of the leavening agent (baking soda or powder), less gas is produced. This counteracts the effect of the gas over-expanding.
Decrease the fat by 1-2 Tbsp per cup	During mixing, the proteins in wheat flour form gluten. Fat (especially oil) interferes with gluten development, so films around the bubbles are very weak.

- Start by trying only one adjustment at a time.
- If you are above 5000 ft, start at the high end of the range given. You can increase gradually from there.
- Every recipe is unique - you will probably end up using different adjustments for different recipes.
- For more information visit http://www.fsis.usda.gov/PDF/High_Altitude_Cooking_and_Food_Safety.pdf

References

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Utah Counties Elevation Guide

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County	County Seat	Boiling Point at County Seat (˚F)	Elevation of County Seat (ft)	Highest Point in County (ft)	Lowest Point in County (ft)
Beaver	Beaver	201˚	5,891	12,173	4,645
Box Elder	Brigham City	203˚	4,439	9,920	4,087
Cache	Logan	203˚	4,535	9,979	4,386
Carbon	Price	202˚	5,550	10,452	4,386
Daggett	Manila	200˚	6,375	12,276	5,364
Davis	Farmington	204˚	4,302	9,706	4,192
Duchesne	Duchesne	202˚	5,510	13,528	4,409
Emery	Castle Dale	201˚	5,771	10,743	3,940
Garfield	Panguitch	200˚	6,624	11,522	3,700
Grand	Moab	204˚	4,042	12,391	3,940
Iron	Parowan	201˚	5,990	11,307	5,039
Juab	Nephi	202˚	5,133	12,087	4,235
Kane	Kanab	202˚	4,973	10,027	3,080
Millard	Fillmore	202˚	5,135	10,222	4,419
Morgan	Morgan	202˚	5,064	9,688	4,812
Piute	Junction	201˚	5,978	12,173	5,800
Rich	Randolph	200˚	6,289	9,255	4,632
Salt Lake	Salt Lake City	204˚	4,331	11,489	4,137
San Juan	Monticello	199˚	7,066	12,721	3,690
Sanpete	Manti	202˚	5,530	11,285	4,993
Sevier	Richfield	202˚	5,308	11,633	4,770
Summit	Coalville	202˚	5,586	13,442	5,282
Tooele	Tooele	202˚	5,050	11,031	4,064
Uintah	Vernal	202˚	5,315	12,276	4,609
Utah	Provo	203˚	4,549	11,928	4,422
Wasatch	Heber	202˚	5,595	10,743	4,215
Washington	St. George	207˚	2,860	10,365	2,175
Wayne	Loa	199˚	7,050	11,328	3,736
Weber	Ogden	203˚	4,617	9,764	4,199