

# FACT SHEET: FUNCTIONS OF INGREDIENTS AND PRINCIPLES OF FOOD SCIENCE IN BAKING, COOKING, AND GRILLING

## Baking Ingredients & Their Functions

- **Flour** Provides structure through gluten or starch.
- **Sugar** Sweetens, tenderizes, aids in browning (Maillard reaction).
- **Brown Sugar** Adds moisture and a deeper flavor due to molasses content.
- **Eggs** Bind, leaven, emulsify, and add moisture and richness.
- **Butter** Adds flavor, richness, and tenderness.
- **Oil** Moistens and tenderizes; used in cakes and quick breads.
- **Baking Powder** Chemical leavening agent (acid + base) for rise.
- **Baking Soda** Needs acid to activate; helps with browning and leavening.
- **Milk/Buttermilk** Adds moisture, activates leavening agents, and tenderizes.
- **Salt** Enhances flavor and strengthens gluten.
- **Yeast** Biological leavening; ferments sugars to produce CO<sub>2</sub>.
- **Cornstarch** Lightens flour mixtures, thickens fillings.
- **Gelatin** Stabilizes and thickens desserts like mousse or marshmallows.
- **Vinegar/Lemon Juice** Acidic agents that react with baking soda for leavening.

- **Cocoa Powder** Adds chocolate flavor and color; can be acidic or neutral.
- **Cream of Tartar** Stabilizes egg whites and activates baking soda.
- **Vanilla/Flavor Extracts** Add aroma and depth of flavor.

## Cooking Ingredients & Their Functions

- **Oil/Fat (olive, canola, etc.)** Transfers heat, adds flavor, and prevents sticking.
- **Salt** Enhances and balances flavor.
- **Pepper** Adds heat and complexity.
- **Acids (vinegar, citrus)** Brighten flavors, tenderize proteins, balance richness.
- **Herbs (fresh/dried)** Add freshness, aroma, and complexity.
- **Spices (cumin, paprika, etc.)** Add flavor, aroma, color, and regional character
- **Onions/Garlic/Shallots** Aromatics that build foundational flavor.
- **Tomatoes (fresh, paste, canned)** Provide acidity, umami, and color.
- **Broth/Stock** Adds moisture and a savory base.
- **Wine/Beer** Adds acidity and depth; used in deglazing and braising.
- **Soy Sauce/Fish Sauce** Adds umami and saltiness.
- **Butter/Cream** Adds richness and smooth texture.

- **Starches (rice, pasta, potatoes)** Provide bulk, texture, and energy.
- **Flour/Cornstarch** Used for thickening sauces and soups.
- **Honey/Maple Syrup** Sweeteners that also aid in browning and flavor.

## Grilling Ingredients & Their Functions

- **Marinades** Tenderize and flavor meats using acids, oils, and seasonings.
- **Dry Rubs** Add crust, flavor, and texture.
- **Oil** Prevents sticking and promotes browning.
- **Salt** Enhances flavor and helps form crust.
- **Sugar (in rubs/marinades)** Aids caramelization and browning.
- **Mustard** Acts as a binder for rubs and adds tang.
- **Worcestershire Sauce** Adds umami and depth to marinades.
- **Chili Powder/Smoked Paprika** Adds heat and smoky flavor.
- **Wood Chips/Charcoal** Impart smoky flavor and heat.
- **Vegetables (peppers, onions, corn)** Add variety, texture, and flavor when grilled.
- **Citrus Zest/Juice** Brightens grilled dishes and balances richness.



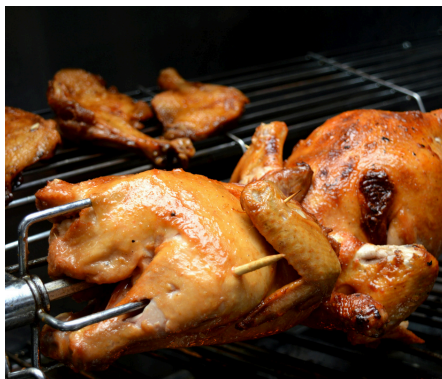
## Boiling

- **Salt** Enhances flavor and raises boiling point slightly.
- **Water/Broth** Acts as the cooking medium; broth adds flavor.
- **Acid (vinegar, lemon)** Helps retain color in vegetables and firm texture in proteins.
- **Aromatics (onion, garlic, herbs)** Infuse flavor into the boiling liquid.
- **Starch (pasta, rice, potatoes)** Absorbs water and softens during cooking.



## Frying

- **Oil (high smoke point)** Transfers heat quickly and evenly; creates crisp texture.
- **Flour/Breading** Forms a crust and protects food from direct oil contact.
- **Eggs (in batter)** Bind breading and add richness.
- **Salt/Spices** Enhance flavor and contribute to crust formation.
- **Cornstarch** Adds extra crispiness to coatings.



## Roasting

- **Oil/Fat** Promotes browning and prevents sticking.
- **Salt** Draws out moisture and enhances flavor.
- **Herbs/Spices** Infuse flavor during dry heat cooking.
- **Vegetables/Meats** Caramelize and develop deep flavors through Maillard reaction.
- **Acid (lemon, vinegar)** Balances richness and brightens flavor.



## Steaming

- **Water/Broth** Generates steam for gentle cooking.
- **Aromatics (herbs, citrus, ginger)** Infuse subtle flavor into food.
- **Vegetables/Seafood** Retain nutrients, color, and texture.
- **Soy Sauce/Sesame Oil (post-steaming)** Add flavor without overpowering delicate foods.



## Air Frying

- **Oil Spray** Aids in browning and crisping with minimal fat.
- **Breading/Coating** Creates a crispy texture similar to deep frying.
- **Spices/Seasonings** Enhance flavor and aroma.
- **Starch (cornstarch, flour)** Helps achieve a golden, crunchy exterior.
- **Marinades** Add flavor and moisture before air frying.

### Dr. Julie Gardner

Extension Specialist  
Texas A&M AgriLife Extension  
Service

979.321-5332

[julie.gardner@ag.tamu.edu](mailto:julie.gardner@ag.tamu.edu)

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# Principles of Food Science

Cooking is both an art and a science. While creativity and personal taste make food fun, there's also a lot happening behind the scenes every time you cook. This guide is designed to help you understand the basic food science principles at work in your kitchen, such as the chemical and physical changes that happen when ingredients are mixed, heated, cooled, or stored. These reactions play an important role in a food's final flavor, texture, and appearance, and learning about them can help you become a more confident, curious, and creative cook.

| Principle                   | The Big Idea                                                                                                                                                                                                                     | Examples At Home                                                                                                                                                                                                                                        | Why it Matters                                          |
|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|
| <b>Maillard Reaction</b>    | When heat meets protein and sugar, a chemical reaction occurs that develops complex flavors and brown colors in foods.                                                                                                           | Searing meat<br><br>Golden crust of baked goods such as cookies or breads                                                                                                                                                                               | Develops complex flavors and brown colors in many foods |
| <b>Caramelization</b>       | When sugar is heated, it's molecules break down and reform into other flavor molecules.                                                                                                                                          | Caramel sauces and candies<br>Caramelized Onion<br>Toasted Marshmallow                                                                                                                                                                                  | Creates complex flavors                                 |
| <b>Emulsions</b>            | Suspension of 2 liquids that would not normally mix (ie: oil and water)                                                                                                                                                          | Mayonnaise<br>Salad Dressing<br>Cheese Sauces                                                                                                                                                                                                           | Creates stable, smooth creamy textures.                 |
| <b>Emulsifier</b>           | Ingredients that help suspend 2 liquids that would not normally mix in order to create an emulsion                                                                                                                               | Egg yolk<br>Mustard<br>Lecithin                                                                                                                                                                                                                         | Maintains the stability of the emulsion.                |
| <b>Protein Denaturation</b> | Heat, Acids, and Mechanical Force can change proteins, creating foods to change forms                                                                                                                                            | Eggs turning solid<br>Meat cooking and turning red to brown<br>Milk curdling<br>Kneading Dough                                                                                                                                                          | Transforms food's texture, flavor, and digestibility    |
| <b>Gelatinization</b>       | When carbohydrates are combined with liquid and heat, they begin to swell                                                                                                                                                        | Jellies/Jams Pudding Thickening sauces (gravies) Marshmallows                                                                                                                                                                                           | Provides desirable textures and mouthfeels              |
| <b>Acidification</b>        | Adding an acid to food to lower the pH                                                                                                                                                                                           | Lemon Juice<br>Vinegar<br>Lactic Acid<br>Buttermilk                                                                                                                                                                                                     | Acid changes taste, color, and safety of foods.         |
| <b>Leavening</b>            | When gases are formed creating bubbles making food rise.                                                                                                                                                                         | Baking soda<br>Baking Powder<br>Yeast                                                                                                                                                                                                                   | Makes foods light and fluffy, rather than dense.        |
| <b>Foaming</b>              | When proteins unfold and trap air, a foam is created                                                                                                                                                                             | Whipped cream<br>Meringue<br>Angel Food Cake<br>Souffle                                                                                                                                                                                                 | Creates creamy and airy textures.                       |
| <b>Water Activity</b>       | Water can either be:<br><br>Bound= stuck to sugar, salt, or protein<br><br>Free= not bound to anything meaning it is available for microbes<br><br>The lower the water activity, the less likely microbial spoilage is to occur. | Fresh Fruit: high water activity and can spoil quickly<br><br>Bread: moderate water activity and can spoil within a few days<br><br>Jam: low water activity and can last longer<br><br>Dry pasta: very low water activity and can last a very long time | Foods with more free water spoil faster                 |