


Sauces, Gravy and Emulsions

Culinary Definitions

Sauce: Sauces are *liquids* of various thickness that enhance an ingredient (often meat, fish, or vegetable) by deepening and broadening the intrinsic flavor. The sauce should contrast or compliment the dish.

Gravy: A gravy is a *sauce* made from the juices created during cooking meats which is thickened with starch or other polymer

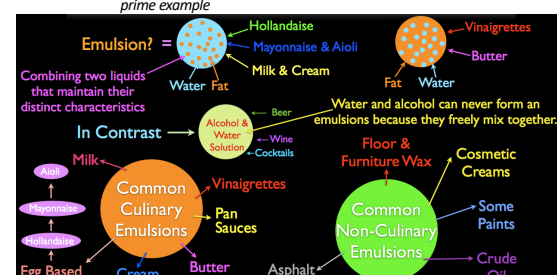
Emulsion: the combination of two immiscible fluids (oil/fat and water) into a dispersed into a colloidal homogeneous mixture. Culinary examples include hollandaise sauce, pans sauces, butter, vinaigrettes...



For some folks (you know who you are) this is a thing...

Sauces, Gravy and Emulsions

Emulsions – Colloid homogeneous mixtures of particles large enough to scatter light but small to stay “mixed”. Each phase remains its chemical character while dispersed. Small suspended particles use emulsifiers to keep the particles separate and forming into two phases (oil and water). *Milk is a prime example*



Emulsion? = Combining two liquids that maintain their distinct characteristics

In Contrast: Water and alcohol can never form an emulsions because they freely mix together.

Kinds of Emulsions

Defined by what is dispersed (the small particle) and the dispersing medium/continuous phase. Remember this is not solvent – non-interacting liquids.

Oil in Water (O/W): non-polar liquid (oil) dispersed in polar dispersing medium (water)- e.g. vinaigrette and mayonnaise

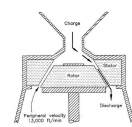
Water in Oil (W/O): a small volume of water dispersed in oil - e.g. butter, egg yolk
DEMO- oil and water with egg yolk and 6:2 W/O lemon vinaigrette

Remember – there remain two phases so the final appearance will be cloudy as the light is dispersed (bounced unevenly) – even blueish

- Tyndall effect - more scattering of blue than longer wavelength red light which continues through the sample.

The more droplets the more “thick” or viscous the emulsion will become

The nature of liquids to form into spheres to minimize their surface area is due to surface tension- thus two phases. Making droplets take energy in either mixing or sonication or colloid mills (shearing forces)

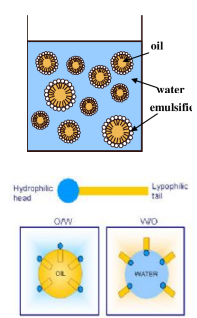


Emulsifiers & Stabilizers

Emulsifiers: a substance that stabilizes an emulsion i.e. keeps the parts apart... coating the particles to minimize interaction and reforming into a separate phase

- amphipathic molecules with polar, or charged (both cationic and anionic) head groups.
- Most common food emulsifiers include phosphatidylcholine (lecithin from egg yolk), cellulose, MAG and DAG, proteins like cellulose and sodium stearyl lactylate (fatty acid esterified with lactate).

Stabilizers: droplets in a crowded emulsions will still coalesce into a single phase even with emulsifiers. - Large bulky compounds will “get in the way” of surface tension - proteins (collagen, gelatin), starch, gums, pectin... hydrocolloids and gels form viscous water bound polymers in O/W emulsions stabilizing the food



Emulsifiers & Stabilizers

Stabilizers often added to make the dispersion medium more viscous before adding the dispersed phase

While smaller particles are more stable, stabilizers allow for larger particles

Emulsifiers

Two basic types of emulsifiers:

- 1) Amino acid chains →
- 2) Phospholipids like lecithin

Surfactant → decreases surface tension

Common Emulsifiers

- ★ Egg Yolks → Lecithin (S) + Protein (P)
- ★ Milk & Cream → Casein Protein (P)
- ★ Mustard → Muclage in seed coating (S)

Stabilizers

- ★ Proteins
- ★ Starch
- ★ Pectin
- ★ Plant Particles
- ★ Food Gums

Viscosity as a Stabilizer

A thicker continuous phase creates more drag on the dispersion phase, increasing shearing force, decreasing particle size.

Why Use Xanthan Gum?

- ★ Adds Viscosity
- ★ Wide PH Range
- ★ Works in Hot & Cold Water
- ★ Shear Thinning

Emulsion Formulas & Ratios

Name	Continuous Phase	Dispersed Phase	Emulsifier	Water : Em : Fat Ratio	Shelf Stability @ Serving Temp
Hollandaise	Egg Yolk + Vinegar/ Lemon	Clarified Butter	Egg Yolk - Lecithin/ Casein	1:1.5* (10k = Em)	140°F/60° > 2 hours
Mayonnaise & Aioli	Egg Yolk + Lemon	Oil	Egg Yolk - Lecithin/ Casein	~1:1:14** (10k = Em)	>40°F/4°C ~1 Week
Vinaigrettes	Oil	Vinegar	Unstable, Mustard, Gums	1:Em:3	>40°F/4°C 2-3 Weeks
Beurre Blanc	White Wine + Lemon	Whole Butter	None	1:NA:4	135°F/58°C Immediately
Sauce Verte	Tomatoes + Vinegar	Oil	Plant Particles	0.1:1:2***	>40°F/4°C >1 Week
Whole Butter	Butter Fat	Water	Milk Proteins + Viscosity	3NA:15	>40°F/4°C ~2-3 Months
Whole Milk (Pasteurized)	Milk	Butter Fat	Milk Proteins & Phospholipids	3.25:NA:100	>40°F/4°C ~1-2 Weeks
Heavy Cream	Milk	Butter Fat	Milk Proteins & Phospholipids	2NA:5	>40°F/4°C ~1-2 Weeks

Making an Emulsion – Order and Ratio

- Start with continuous phase (water for W/O, oil for O/W)
- Add emulsifier and/or stabilizer
- Then add dispersed phase
- Add dispersed phase slowly to avoid two phases from starting
- Low temp – avoid protein denaturation and driving droplet interaction – too low and surface tension forces will force coalescence
- Once the sauce becomes viscous, it is ok to add oil more quickly

Mayonnaise (W/O)

- 1 egg yolk
- 2 tsp lemon juice
- 1 tsp Dijon mustard
- ¼ tsp salt
- 1 tsp cold water

Mix then slowly add ¼ cup oil

Stabilize with 140°F of yolk @ 30 min or adding starch

My Sauce Broke!



Simple approach is to start with a small amount of continuous phase with a bit of emulsifier (egg yolk) and beat back into submission!

- Coagulation of denatured proteins – strain out lumps and then reemulsify.

Great Gravy!!!!



Simple gravy – use the fats and proteins (collagen) from roasted foods and add a starch (corn starch or flour) to form a thick gel

Great Gravy

What is Gravy Anyway?
The term 'gravy' is very culturally dependent. For Italian-influenced food, gravy can mean a tomato based 'sauce' while in other cultures, gravy is a thickened juice from some cooked meat or a cream-based thickened sauce.

Sauces and Roux

BASIC INGREDIENTS White Sauce


- Milk or cream
- Flour
- Butter
- Salt & Pepper
- Herbs & Spices (optional)

A basic white sauce (more formally Bechamel meaning medium thick sauce in French Cooking) is a classic starch based sauce that becomes a cream sauce when cream is added!

The fat in butter, milk or cream adds to the thickness of the sauce due to milk globules or butter fat. However the fat also serves to limit the interaction between flour particles - coating the carbohydrate polymers as they swell preventing the sauce from being too thick, lumpy or gooey.

Rule of thumb: per cup of starch-based gravy/sauce
Thin: 1 tablespoon
Medium: 2 tablespoons
Thick: 3 tablespoons

Flour serves as a starch source, some gravies, sauces or roux can use grain starches such as cornstarch or rice starch (use 1.5 as much of these for every 2 tablespoons of flour).



Remember the starch

Its all about the starches – H bonding

Amylose – branched
Amylopectin – long unbranched helix
Amylose with its shape is a better thickener
Amylose will form a firm opaque gel while amylopectin forms a clear glossy sauce

Go Slow
Slowly heat a starch while stirring – It takes time for starch granules to release starches and then to hydrate the carbohydrates...

- Add too fast and an immobile, impenetrable shell of water gel will form on surface making lumps.
- Make a cold slurry of flour and whisk while adding to a hot roux or liquid to keep granules apart as they fall apart

Branched or unbranched?
Grain starches like flour, rice and corn are higher in branched amylose – forming a moldable gel when cool.
- Amylose rich sauces will thicken just below the boiling point of water and are more easily re-heated without thinning. But lose water holding after cooling/reheating

Root and waxy starches (arrowroot, potato, and tapioca starches are mostly amylopectin (up to 99% helical starch)
- Will cool to a clear glossy gel at low temps and freeze-thaws well.

NOTE: Flour and egg yolk has enzymes which will degrade starch. Heating flour with butter coats protein and kills enzymes

Basic Brown Gravy and Roux

Brown Pan Gravy:
After roasting or frying turkey, chicken or beef, remove the meat from the pan and remove all but 4 tablespoons of fat from the pan.

- Mix in 24 ounces of a chicken, vegetable, or beef broth along with 8 ounces of red wine. Whisk while simmering
- continue for 2 - 5 min to slightly reduce the volume (~20%). Scrape the tasty bits from the pan while mixing.

Add 4 tablespoons flour (for a medium thick gravy) and whisk continuously to combine while simmering. Add salt to taste.

Roux:
For mac and cheese, chowder soups, and of course sauces, you need to make a flour/fat base called a roux. There are three versions of roux: white, blond and brown. Each version depends on the extent of the Maillard reaction you allow to happen.

A darker the roux will not thicken as well as a blond.

Heat oil, butter or clarified butter. Some recipes call for heating the butter until water mostly gone (bubbles decrease).


Add flour or another starch source to the butter while whisking constantly. Add cold liquid to a hot roux or a hot liquid to a cold roux to give enough time to disperse the starch before full swelling of the sugars.

A **pan sauce** is created when a sautéed protein produces caramelized bits that cling to the pan along with the juices that are rendered from the cooked items whether they are meat, poultry, or fish. The sauce is completed with a reduction of wine and aromatics (shallots, mushrooms, garlic, etc.), and finished with whole butter or cream.

The Five ? Mother Sauces

Five French sauces vs basic 3-7 sauces.

- Béchamel – White sauce, milk flour, butter, white roux
- Hollandaise – Emulsion of Clarified butter, egg yolk and acid
- Veloute – clear stock with white roux
- Espagnole – brown stock with roux
- Tomat – Tomatoes flour and white stock broth





Principles of Sauce Making


Sauce making begins with a flavor base of aromatics, reductions of wine, vinegar, or other spirits, the addition of flavorful liquids including stocks, milk, or cream, and a variety of seasonings

Start with a Flavor Base

Begin by sautéing or sweating (gently cooking in fat) an aromatic flavor base of vegetables (shallot and garlic, mirepoix, or soffritto) in butter, olive oil or other type of fat. This releases their flavors infusing it into the sauce as it cooks.



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Develop Consistency

Flour can be added at this stage (known as the *singer* method) or thickened later with a prepared roux, refined starch, or other thickening agent. Some preparations are thickened by suspensions, such as tomato sauces, and need no added starch, still others, including meat-based jus, may be left unthickened, relying on reduction to concentrate flavors while gelatin from the meats add body.



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Add Liquids, Season, and Simmer

Stock, milk, wine or other liquids are added and the sauce is brought to a simmer. If a prepared roux is used it is added at this stage. A sachet d'épice or bouquet garni is added to flavor the sauce. The sauce is simmered and reduced in volume for the appropriate amount of time to develop flavor and consistency.



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Skim the Sauce


Cleaning a sauce is a critical step in creating a clear sauce, a French term known as *depouillage*. Bring the sauce to a simmer and offset the pot on the burner so that, as the scum that rises to the top, it rolls to one side of the pot, and makes it easier to skim off the impurities. Repeat skimming throughout the sauce process

Strain/Puree

Sauces may be pureed in a food mill or blender and strained through a fine mesh strainer. If a refined starch is used (instead of a roux) the sauce is re-heated and a slurry is added to thicken the sauce.



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Evaluate and Adjust Consistency and Texture

A sauce should have a consistency that is light yet thick enough to coat the back of a spoon. Chefs use the French term *nappé*, meaning to top or coat with sauce, to describe the proper consistency. If the consistency of a sauce is too thin or the flavor too weak, adjust it by gently simmering the sauce to reduce, thicken and concentrate the flavors. Other alternatives include adding a thickening agent, cream, a swirl of butter, or a liaison of egg yolk and cream. If the sauce is too thick add water, stock, or other liquid to adjust consistency.



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Taste, Evaluate and Adjust

To balance the flavor and seasoning of your sauces consider all the basic taste sensations

- Salt is the most primal taste and reduces bitterness
- Bitterness is derived from herbs and spices including tarragon, sage and peppercorn
- Sweet is added with the addition of sugar, butter, and cream
- Butter also adds a savory sensation
- Acidity lifts and lightens the flavor of the sauce on the tongue; a little wine, vinegar, wine, or lemon can do the trick
- Umami is the savory taste found in meats, poultry, fish, cheese, tomatoes, and mushrooms





Béchamel White Sauce

Ingredients

- 2 tbsp butter
- 2 tbsp flour
- 1 ¼ cup warm milk
- Salt, pepper and cayenne


Melt the butter in a heavy-bottomed saucepan.

Stir in the flour and cook, stirring constantly, until the paste cooks and bubbles a bit, but don't let it brown — about 2 minutes.

Add the hot milk, continuing to stir as the sauce thickens. Bring it to a boil.

Add salt and pepper to taste, lower the heat, and cook, stirring for 2 to 3 minutes more.

Cheese Sauce: Add ½ cup grated Cheddar at end of sauce.



What's the difference between **béchamel sauce** and **alfredo sauce**? Both are dairy-based sauces, **Béchamel** is a French **white sauce** thickened with a roux made with butter and flour.

Alfredo sauce uses heavy cream that's thickened by reduction on the stovetop, then finished with Parmesan cheese