

From Recipe to Formulation

How do you?

Go from



To this.....

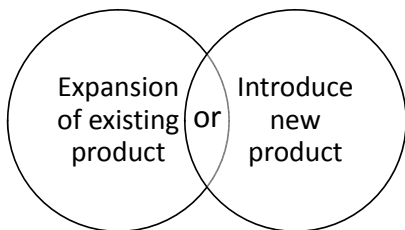


Scale-up considerations



- What is the goal?
- Recipe to formula
- Raw material needs
- Equipment needs
- Watch outs

What is the goal?



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How many do you plan to make?

Product	Production Rate		Packaging
	Minimum	Maximum	
Current needs (in 6 months to a year)	What is the minimum rate you want to make?	What is the maximum rate you want to make?	What type of packaging are you going to need for your product?
<i>Example cupcakes</i>	<i>10 dozen per day</i>	<i>30 dozen per day</i>	<i>Plastic clamshells (1/2 and full dozen)</i>
Future needs (in 2 to 3 years)		How much do you anticipate making in the future?	



Shelf-life considerations

- How long of a shelf-life do you want?
 - Days, weeks, months...
- How are you going to distribute?
 - Fresh, refrigerated, or frozen
 - Retail or wholesale



Scale-up considerations



- Recipe to formula



From Recipe to Formulation

Terminology

Ingredient	Weight	Volume
35T cream	250g	9.08 oz
3T milk	30g	1.06 oz
1/4 cup water	60g	2.12 oz
3 eggs	150g	5.29 oz
1/2 cup flour	60g	2.12 oz
1/2 cup sugar	60g	2.12 oz
1/4 cup butter	30g	1.06 oz

Ingredient	Weight	Volume
1 cup milk	240g	8.45 oz
1/2 cup water	120g	4.23 oz
1/4 cup oil	60g	2.12 oz
1/2 cup flour	60g	2.12 oz
1/2 cup sugar	60g	2.12 oz
1/4 cup butter	30g	1.06 oz

Recipe

- In volume measurements
- Cups, tablespoons, etc.

Formula

- In weights and percents
- Flour (baker's) percent

Convert from Volume to Weight

- Conversion charts are available
 - List common volumes with weights

Food Substance	cup = oz	tblsp = oz	tblsp = oz
Milk (Malted or Powder)	1 4.750	1 0.100	1 0.300
Molasses	1 11.000	1 0.250	1 0.750
Nuts (Ground)	1 4.250		
Nuts (Shelled)	1 4.000		
Onions (Chopped or Juice)	1 8.000		1 0.500

- Available online
 - This one is on our website
 - USDA nutrient database



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Baker's percent vs. True percent

Ingredient	Weight	Baker's %	True %
Flour	200	100	56.818
Water	124	62	35.227
Yeast	6	3	1.705
Salt	4	2	1.136
Sugar	8	4	2.273
Shortening	6	3	1.705
Milk Solids	4	2	1.136
TOTAL	352	176%	100.000



From Recipe to Formulation

Things to consider...

- Recipe/formula is a starting place
 - Will require verification (TESTING)
- Altitude adjustments - breads
 - Expect greater oven kick and shorter proof times
 - Use less yeast
 - Expect greater baking loss
 - Increase water
 - Baking takes longer
 - Increase temperature and time



*At Elevations above 2,500 ft

From: AIB technical bulletin, V. 1 iss. 9 (1979)

Things to consider...

continued

- Altitude adjustments - cakes
 - Expect greater oven kick
 - Use less chemical leavening
 - Less aeration needed
 - Higher specific gravity
 - Less mix times
 - Baking takes longer
 - Increase temperature and time
 - Expect greater baking loss
 - Increase liquids (eggs)
 - Decrease sugar



*At Elevations above 2,500 ft

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Scale-up considerations



- Raw material needs
 - Ingredients
 - Packaging

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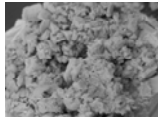
Ingredients

- Key questions to ask:
 - Are the ingredients available?
 - Are less expensive ingredients available?
 - What quantity of ingredients will be needed?
 - What form is the ingredients?
 - Liquid, dry, etc.

Ingredients

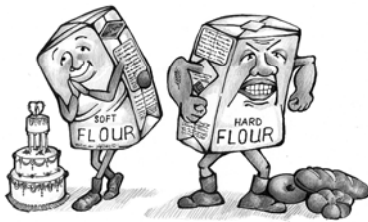
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- Some ingredients that you need to pay attention to:



Ingredient choices: Flour

- Flour types are all different



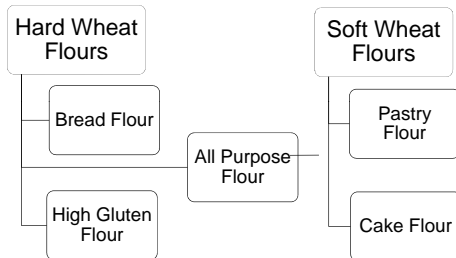


From Recipe to Formulation

Types of wheat

Hard Red Winter Hard Red Spring Hard White	Breads, rolls, tortillas, and other yeast-raised products (some crackers)
Soft Red Winter Soft White	Cakes, cookies (sweet biscuits), pastries, crackers
Durum	Macaroni, spaghetti, and other pasta products

Types of flour



Ingredient choices: Eggs

- For eggs you can choose
 - Shell eggs, frozen whole eggs, or dried whole eggs
- Each will have different storage needs
 - Refrigeration, freezer, or dry storage





Ingredient choices: Fresh yeast

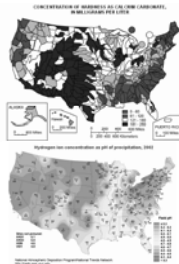
	Cream Yeast	Compressed Yeast
Storage temperatures	36-45°F (2-7°C)	36-45°F (2-7°C)
Shelf life	10 days	2-3 weeks
% water	80%	70%
Converting from Compressed	1.5-1.8 times	

Ingredient choices: Dry yeast

	Active Dry Yeast	Instant Dry Yeast
Storage temperatures	Ambient (unopened)	Ambient (unopened)
Shelf life	2 years (vacuum)	2 years (vacuum)
Using the yeast	Must be pre-hydrated in 105°-110°F (41°-43°C) water	Does not need to be pre-hydrated
Converting from Compressed	40-50%	33-40%

Ingredients: Water

- Varies in hardness
 - Minerals in water
 - Measured in PPM
- Varies in pH
 - Either acidic or alkaline
- Location differences





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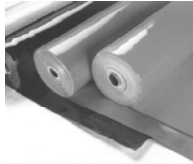
Packaging choices

- Packaging is important
 - Ensures product quality
 - Adds appeal for consumers
 - Protects product
 - Communicates with consumers
- Can add significant cost to your product

Packaging choices

continued

- Poly bags
- Cardboard cartons
- Individual or multiple
- Different films
- Plastic clam shells
- Modified atmosphere
- Environmental foot print



Scale-up considerations



- Equipment needs



From Recipe to Formulation

Equipment questions

- What are the necessary equipment that you are going to need?
- Do you have any of the equipment?
- How many do you want to make a day?
- Used vs. new
- Manual vs. highly automated

Equipment

- | | |
|--|---|
| <ul style="list-style-type: none"> ● Starting with an existing bakery or equipment <ul style="list-style-type: none"> ● Calculate the capacity of each step in the process ● The lowest is your limiting piece of equipment. | <ul style="list-style-type: none"> ● New bakery or product line <ul style="list-style-type: none"> ● Start with how much you forecast making (per day, per week, per minute, etc.) ● Calculate the needed equipment capacity at each step |
|--|---|

Equipment choices

- | | |
|--|---|
| <ul style="list-style-type: none"> ● Mixers ● Ovens ● Dividers ● Depositors ● Sheeters ● Proof boxes ● Fryers ● Enrobing | <ul style="list-style-type: none"> ● Retarders ● Freezers ● Conveyors ● Filling injector ● Cooler ● Depanner ● Slicer ● Packaging |
|--|---|



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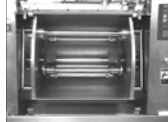
Mixers



Spiral



Vertical



Horizontal

Mixer considerations

$$\text{Mixer capacity (\# of units)} = \frac{\text{Largest batch size}}{\text{Scaling weight}}$$

- Recommend batch sizes for dough
 - 60-90% of largest size
- Larger mixers will mix dough and batter different than smaller mixers
- Does mixer capacity change with the type of product we are making?

Oven Types



Reel Ovens



Impingement Ovens



Hearth / Deck Oven



Rack Ovens

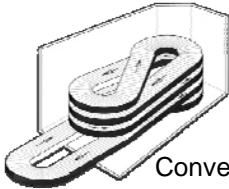


From Recipe to Formulation

Oven Types

continued

Tunnel Ovens



Conveyor Oven

Oven considerations

- Oven capacity
 - How much product can you fit in the oven?
 - Depends on size and bake time
- Steam or not
- Physical foot print



Oven capacity

- Rack oven

$$\frac{\text{Pieces}}{\text{per pan}} \times \frac{\text{Pans per Shelf}}{\text{Shelf}} \times \frac{\text{Shelves per Rack}}{\text{per Rack}} \times \text{Number of Racks}$$
- Tray oven

$$\frac{\text{Pieces}}{\text{per pan}} \times \frac{\text{Pans per Trays}}{\text{Trays}} \times \text{Number of Active Trays}$$



From Recipe to Formulation

Building considerations

- Correct utilities
 - Electrical (proper voltage), natural gas, water, sewer, etc.
- Storage
 - Ingredients
 - Packaging
 - Supplies
 - Finished product



Scale-up considerations



- Watch outs

Test bake

- New ingredients or equipment need to be tested
 - Best to start small
 - Test multiple times
- Often overlooked is proper mix times and absorptions



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Test bake

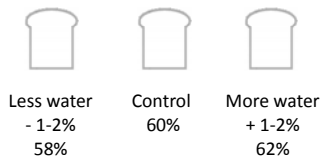
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● Mix Time Series



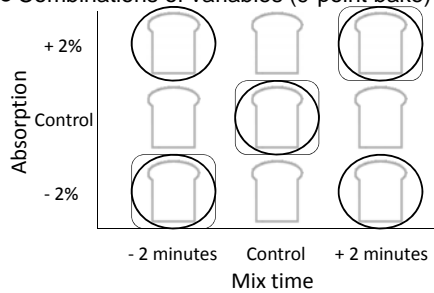
Conducting Bake Test (cont.)

● Absorption Series



Conducting Bake Test (cont.)

● Combinations of variables (9-point bake)





Watch out: Batch sizes

- As batch sizes increase surface area to volume decreases
 - Mixing changes
 - Less aeration (specific gravity increases)
 - Heat transfer slows
 - Hydration rate changes



Watch outs: Mechanical action

- Different equipment may have different mechanical action
 - Lead to changes in
 - Viscosity
 - Gluten development
 - Batter or dough temperatures
 - Color of batter

Watch outs: Time

- Larger batches can lead to longer processing times
 - In batters
 - More leavening released over time
 - Changing viscosity over time
 - In doughs
 - Yeast becomes more active
 - Dough gets more elastic







From Recipe to Formulation

Watch outs: Pans

- Make sure you have enough pans
- Different pan sizes may require different scaling weights
- Keep weight to volume ratio the same

$$\text{Pan to dough or batter ratio} = \frac{\text{Pan volume}}{\text{Scaling weight}}$$

$$\text{Scaling weight} = \frac{\text{Pan volume}}{\text{Pan to dough or batter ratio}}$$





Converting Volume to Weight

Most home recipes are given in volume measurements. One cup of flour, one cup of water, a tablespoon of sugar, and maybe a pinch of this or that. To be accurate and to more readily adjust formulas (recipes) to suit the tastes of your customers, the baker should convert volume measurements to weight measurements.

To convert conventional volume measurements to weight measurements, just weigh the amount of each ingredient normally used or consult the conversion chart, "U.S. Weights and Measures for Common Ingredients".

U.S. Weights and Measures for Common Ingredients

Food Substance	cup = oz		tsp = oz		tbsp = oz	
Applesauce	1	8.000				
Baking Powder			1	0.125	1	0.375
Butter	1	7.750	3	0.500	1	0.500
Catsup	1	10.250				
Cheese (Cottage)	1	7.000				
Chocolate (Cut Fine)	1	3.750				
Chocolate (Melted)	1	8.750	1	0.500	1	1.500
Cocoa	1	4.000	1	0.083	1	0.250
Coconut (Shred)	1	3.500				
Coconut (Ground)	1	2.375				
Coffee (Ground)	1	3.000			1	0.125
Corn Meal	1	5.500				
Cornstarch	1	7.500			1	0.500
Cream	1	8.375	1	0.125	1	0.375
Cream of Tartar			1	0.125	1	0.375
Crumbs (Cake)	1	3.000				
Currants	1	4.750				
Dates (Pitted)	1	5.000				
Flavoring Extracts (Misc.)			1	0.125	1	0.375
Figs	1	5.000				
Flour (Cake Unsifted)	1	4.250	1	0.125	1	0.312
Flour (Cake Sifted)	1	3.750				
Flour (Bread Unsifted)	1	4.750	3	0.250	1	0.250
Flour (Bread Sifted)	1	4.750				
Garlic (Chopped)					9 cloves	1
Honey	1	12.000	1	0.250	1	0.750
Lemon Gratings			1	0.125	1	0.375
Milk	1	8.500	1	0.125	1	0.375

Food Substance	cup = oz		tsp = oz		tbsp = oz	
Milk (Malted or Powder)	1	4.750	1	0.100	1	0.300
Molasses	1	11.000	1	0.250	1	0.750
Nuts (Ground)	1	4.250				
Nuts (Shelled)	1	4.000				
Onions (Chopped or Juice)	1	8.000			1	0.500
Orange Gratings			1	0.125	1	0.375
Paprika					1	0.375
Potatoes (Mashed)	1	8.000				
Prunes (Pitted or Boiled)	1	5.000				
Raisins	1	5.250				
Rolled Oats	1	2.375				
Salad Oil	1	7.750			1	0.500
Salt	1	7.750	1	0.125	1	0.375
Shortening	1	7.000	1	0.125	1	0.375
Soda	1	6.000	1	0.125	1	0.375
Spices	1	4.000	3	0.250	1	0.250
Sugar (Brown)	1	5.500	1	0.125	1	0.375
Sugar (EFG)	1	7.000	1	0.125	1	0.375
Sugar (Powdered)	1	5.000	3	0.250	1	0.250
Syrup	1	12.000	1	0.250	1	0.750
Water	1	8.000	1	0.125	1	0.375
Worcestershire Sauce	1	9.125			1	0.625

1 square chocolate = 1 oz, or in substituting cocoa for chocolate, use 4.5 tbsp.

5 whole eggs = 1 cup or 8 oz, 5 oz dry

8 egg whites = 1 cup or 8 oz, 1 oz dry

12 egg yolks = 1 cup or 8 oz, 3.5 oz dry

(Dry whole eggs contain 30% dried whites and 70% dried yolks)

1 pint = 2 cups

1 cup = 8 fluid oz

1 fluid oz = 2 Tbsp (Tablespoon)

1 Tbsp = 3 tsp (Teaspoon)

Adapted from Baker's Digest