

From Last Time:



Science of Cooking – BCBT100
Fall 2016 – Bodwin/Tigges

What should yogurt contain?



INGREDIENTS: MILK (SKIM MILK, CONCENTRATED SKIM MILK, MILK SOLIDS), WATER, FRUIT 7.5% (STRAWBERRY), HALAL GELATINE, MODIFIED STARCH (1442), FRUCTOSE, NATURAL COLOURS (120, 163), FLAVOURS, SWEETENERS (951, 950), ENZYME (LACTASE), PRESERVATIVE (202), FOOD ACID (331), LIVE YOGURT CULTURES (CONTAINS ACIDOPHILUS AND BIFIDUS CULTURES), PHENYLETANOLINES, CONTAINS PHENYLALANINE

STRAWBERRY LOW FAT FRUIT YOGURT 200g



Image: <http://www.nestle.com.au/Nutrition-Health-Wellness/Fact-Sheets/Decoding-Food-Labels>
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What should yogurt contain?

INGREDIENTS: CULTURED GRADE A MILK. CONTAINS ACTIVE YOGURT AND L. ACIDOPHILUS CULTURES.

**** MEETS NATIONAL YOGURT ASSOCIATION CRITERIA FOR LIVE AND ACTIVE CULTURE YOGURT**

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KEEP REFRIGERATED

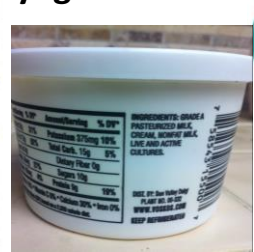


Image: <http://zbarsk.com/grocery-labelingredientsguide/>
Image: <http://gourmandgrammian.blogspot.com/2011/07/reek-yogurt.html>
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Why all the thickeners?

- Texture
- Smoother
- Limit separation
- Fat replacement



Image: <http://cheeseforum.org/forum/index.php?topic=266.0>
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Making Yogurt

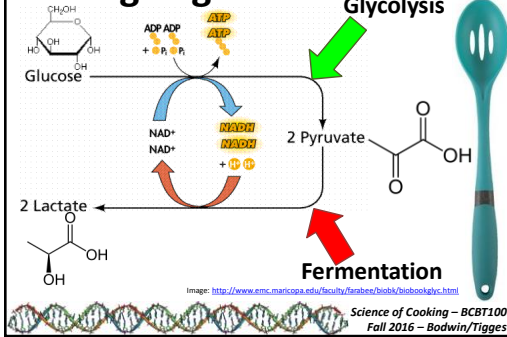


Image: <http://www.emc.maricopa.edu/faculty/darlene/bioch/biosbookqrz.html>
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Sugar Metabolism

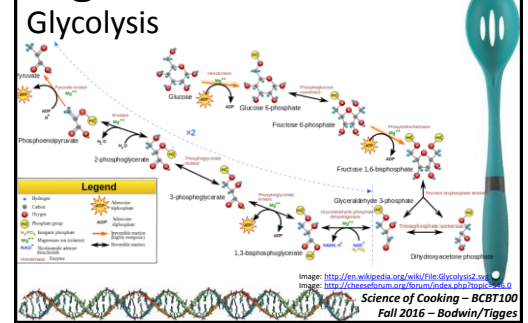
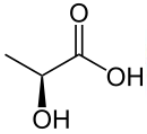


Image: <http://en.wikipedia.org/wiki/File:Glycolysis2.png>
Image: <http://cheeseforum.org/forum/index.php?topic=266.0>
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Making yogurt

Role of Lactic Acid

- Denatures casein micelles
- Re-form as protein networks
- Acidifies
- Preservative
- Sour flavor



{figure on p45 of McGee}

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Yogurt or Sour Cream?



Mesophilic

lactococci, leuconostoc
“particles of pasturage”
~85°F/30°C

Thermophilic

lactobacilli, streptococci
More lactic acid
~113°F/45°C

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Cheese

Curdled milk with most of the water removed

Add acid and salt

Discourages “spoilage microbes”

Enzymes hydrolyse fats and proteins

Smaller molecules = flavor, aroma



Image: <http://blog.fooducate.com/2011/06/26/if-milk-is-white-why-is-cheese-yellow/>
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Storage & transport

Waterproof “bags”

Animal parts...

Stomach → Rennet (enzymes)

Makes cheese more cohesive, pliable

This is (was) SCIENCE!



Image: <http://blog.fooducate.com/2011/04/05/10-things-to-know-about-rennet-its-in-your-cheese/>

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Rennet

The original Biotechnology!

Chymosin enzyme (digests milk) from the
4th stomach of a milk-fed calf

Calf <30 days old

Once off milk, chymosin stops



Image: <http://www.gustaf.com/blog/warning-babies-die-for-cheese/>

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Rennet

Modern rennets – “vegetable rennet”

Chymosin from yeast, mold, bacteria

From “genetic engineering”

Is that good or bad?



Image: <http://www.cheesesupply.com/>
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Rennet

What does it do?

- Very specific activity
- Attacks kappa-casein
 - Casein micelles merge/string together
 - Analogous to fat globules in whipping cream

Why not just use acid?

- Destroys casein micelles too much
- Lose some protein & calcium - nutrition
- Tangy cheese?



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Cheese Ingredients

Milk
Milk bacteria
Rennet
Salt
Time



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Cheese Microbes

Bacteria are what make cheese

- Lactococci (mesophilic, sour cream)
- Lactobaccilli & streptococci (thermophilic, yogurt)
- Propionibacteria (holes, variant causes acne)
- Brevibacterium linens (stronger flavors, salty environment, seashore & skin, “smear bacteria”)



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Cheese Microbes

Molds

Penicillium – large family

Blue molds – *roqueforti*

- Survive lower oxygen (inside cheese)
- Breaks down fats – “peppery”, aroma

White molds – *camemberti*

- Surface ripening
- Break down protein – creamy, flavor



Image: <http://www.gourmetleah.com/Dictionary/W/Maytag-blue-cheese-6166.asp>
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Making Cheese

Acidify (bacterial)

- Milk sugar to lactic acid

Curdle casein (rennet) and drain whey

- Stabilizes curd

Ripening

- bacteria + time = good



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Curdling

Acid

- Fine, fragile gel
- Formed over hours
- Retains moisture



Image: <http://jamsresearch.net/cheese/cheesemaking/>

Rennet

- Firm, rubbery curds
- Formed under an hour
- Cut to small grains, loses more water



Image: <http://www.betterhedgehacks.com/betterhedgehacks-make-souaky-cheese-at-home-16739>
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After the curd...

Draining – gravity, press, heat
 Salting – mix or smear, inhibit spoilage

Shaping – Why wheels?

Ripening – Let the bacteria work!



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Enjoying cheese...

Don't cut too soon

Aromatics lost
 Oxygen attacks!

Let it warm a bit

Humid & 55-60°F ideal
 Softens fats – Don't go too far!

Store loosely wrapped

Puddles of moisture are bad



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Cooking with cheese

Melting

~90°F – milk fats melt

~130-180°F – protein matrix breaks

Non-melting cheeses

Acid curdled – Why?

Stringiness

Casein strings stick together - crosslinking

Aging, acid, moisture, salt

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Cooking with cheese

Avoiding “stringiness”

Grate finely

Heat carefully

Minimize stirring

Add starch – coats protein and fat

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Measurements

How far is it from MSUM to NDSU?

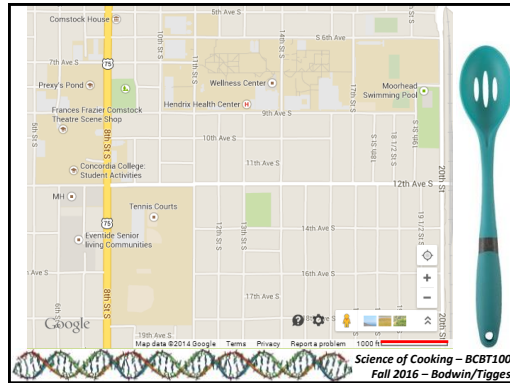
Units – miles, minutes, steps, etc

Start/End points

Uncertainty {“error”}

Significant Figures

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Uncertainty {"error"}

Indicates reliability of a number
or variability in repeated
measurements

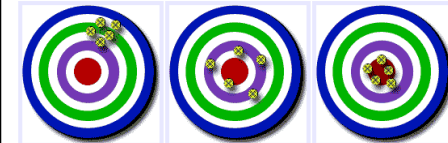
Communicates precision and
accuracy

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Precision & Accuracy

Accuracy = bullseye

Precision = tight grouping



Low Accuracy
High Precision

High Accuracy
Low Precision

High Accuracy
High Precision

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Significant Figures

Communicates error

Rounding numbers introduces
error – be careful!

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Significant Figures

Round error to a single digit
{unless it's "1", then keep two digits}

Round the reported value to the
same digit as the error is
rounded.

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Exam 1

"Good" science

Many fields involved in cooking

Food molecules

Water

Inorganics

Small organics

Macromolecules

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Exam 1**Small Organics**

Vitamins, sugars, metabolites

Macromolecules - Fats/Lipids

Long carbon/hydrogen chains

Hydrophobic

Fatty acids, triglycerides, phospholipids

Saturated vs. Unsaturated



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Exam 1**Proteins – polymers of amino acids**

Side chain/Side group tunes properties

Structure determines function

Formed by dehydration/condensation

Carbohydrates – C/H/O molecules

“Simple” sugars – monosaccharides

“Simple” sugars – disaccharides

Polysaccharides – sugar polymers



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Exam 1**Polysaccharides**

Starch – glucose polymer, plants

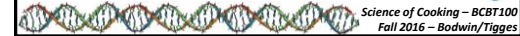
Amylose – unbranched

Amylopectin - branched

Binds water, thickening agent

Formed by dehydration/condensation

Broken down by amylase (hydrolysis)



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Exam 1**Polysaccharides**

Glycogen – glucose polymer, animal

Highly branched, compact

Binds water, thickening agent

Formed by dehydration/condensation

Broken down by hydrolysis



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Exam 1**Polysaccharides**

Cellulose – β -glucose polymer, plants

Rigid, tough, cross-linked fibers

Insoluble vs. soluble fiber

Binds water

Ruminant animals break down with
bacteria in their rumen



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Exam 1**Milk and Dairy**

Milk – aqueous phase

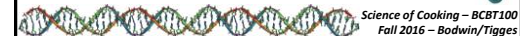
Milk – fat phase

Lactase & lactose intolerance

Milk proteins – whey & casein

Curdling

Acids and Bases



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Exam 1

Homogenization

Pasteurization

Milk foams – protein or fat

Butter – whip it good...

Fermentation – yogurt and others

Good luck!



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