

From Last Time:



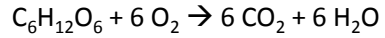
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Yeast

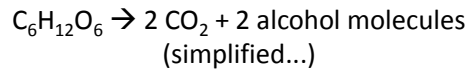
Ubiquitous microorganism

Many “yeasts”

Aerobic:



Yeast:



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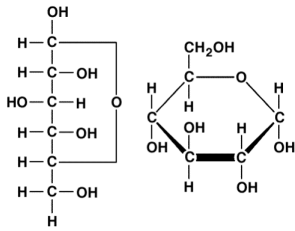
Aerobic

Aerobic digestion = “burning”

6 carbons

12 hydrogens

6 oxygens

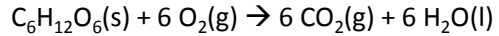
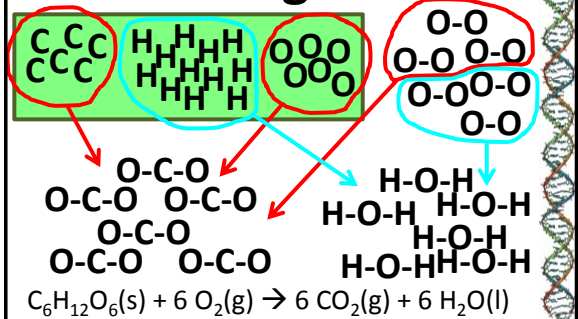


Glucose

Source: <http://imgarcade.com/1/66h1266-molecule/>

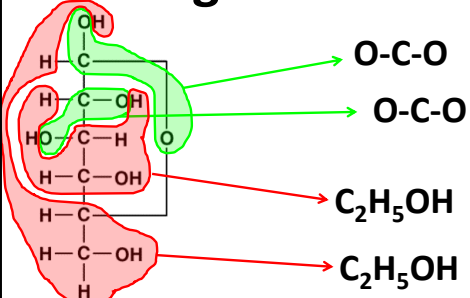
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Aerobic “Digestion”



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Yeast Digestion



Source: <http://imgarcade.com/1/66h1266-molecule/>

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Yeast leavening

Slower

Other flavors develop

Continuous yeast culture

“New kitchen” syndrome
“friendship breads”

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Amount of Gas...

Gas changes volume with amount
Avogadro's Law

Volume \propto Amount

$$V \propto n$$

$$V = kn$$

$$V / n = k$$



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Temperature...

Gas changes volume with temp.
Charles' Law

Volume \propto Temperature

$$V \propto T$$

$$V = kT$$

$$V / T = k$$



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Bread Structure

Glutens form a network to trap CO₂
Wheat flour is mostly starch...

Recall meringues set by heat...
Albumin proteins for a network
Sugar reinforces when water is removed



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Gluten and Starch

When baked, starch granules
absorb water, swell, and "set"

Starch pops
bubbles
Steam escapes



Image: <http://www.seriousseats.com/2011/06/the-food-lab-the-science-of-no-knead-dough.html>



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Modifying Gluten

Flour type – high protein (\uparrow gluten)
Oxidizing substances (\uparrow gluten)
"Wet" dough (\uparrow gluten)
Lots of kneading/mixing (\uparrow gluten)
Salt (\uparrow gluten)
Sugar (\downarrow gluten)
Fats & Oils (\downarrow gluten)
Acid (\downarrow gluten)



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Baking – Charles' Law

How big do bubbles get?
Assume a 1mL bubble @20°C
heating up to 65°C

Race between expanding gas &
stiffening gluten



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Steam in Baking

Phase changes
 Steam transfers heat better
 Keeps surface elastic longer
 Glossy crust



Image: <http://tic.howstuffworks.com/home/wash-and-dry-with-steam.htm>

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Stale...

Changes in the starch
 Gel loses water, crystallizes



Image: http://www.aroid.org/gallery/heid/starch_grains.php

Image: <http://sciencegirlsrock.wordpress.com/2011/05/30/women-of-outstanding-achievement/>

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Science to the rescue!

Stale bread can be “fixed”
 Consider the food molecules
 Starch – need to re-gel
 Heat
 Storage conditions



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