



Why this Cola very di?

Fizziks and Chemysteries of soft drinks

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Why this Cola very di

Thank you all for waking up on a Sunday morning for science!

Disclaimers!

- This has nothing to do with the *kolaveri-di* song, Dhanush etc. (I couldn't resist stealing the title)
- I'm not an expert in soft (or other ☺) drinks, or even a chemist!
- Beverages shown are representative, no brand endorsements here!...

Looking only at the carbonated beverages today!



Resources Galore!

Lots of fantastic resources available online

- Wikipedia: http://en.wikipedia.org/wiki/Soft_drink
http://en.wikipedia.org/wiki/Carbonated_water
- Overview: http://inventors.about.com/od/foodrelatedinventions/a/soft_drinks.htm
- e-News: <http://esciencenews.com/dictionary/carbonated.beverages>
- Caffeine: <http://www.energyfiend.com/the-caffeine-database>
<http://www.cspinet.org/new/cafchart.htm>
- Myths and legends: <http://urbanlegends.about.com/> (search “soda”)
<http://www.snopes.com/cokelore/cokelore.asp>
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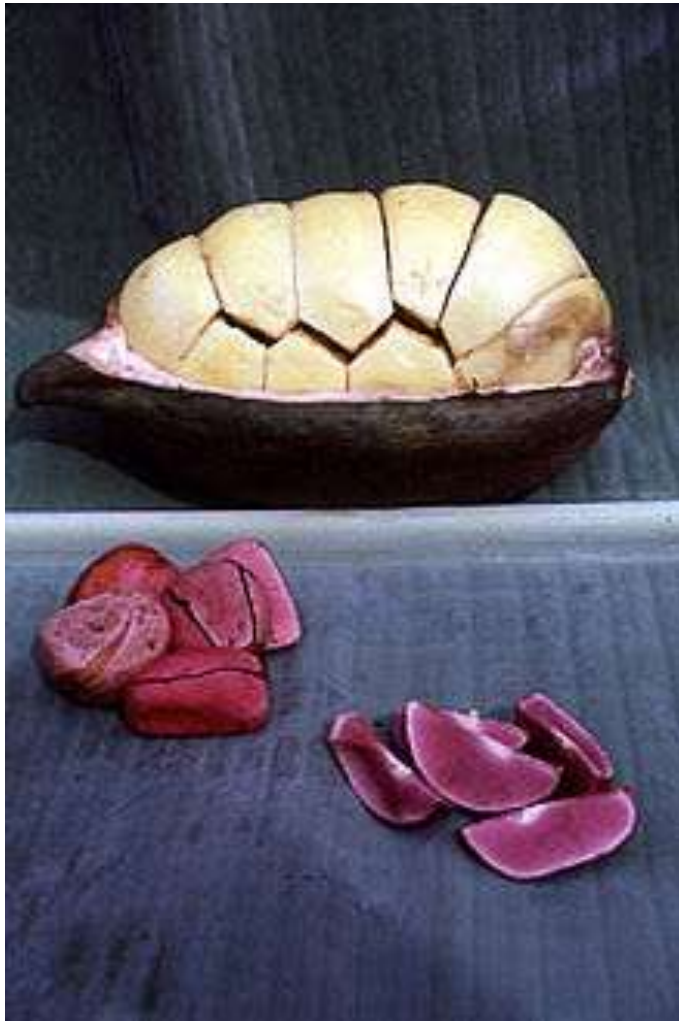


Some history

- Various natural “mineral” waters...
- Joseph Priestley (of oxygen fame) experiments with carbonating water
- Hung water cups over fermenting beer vat...
- (might cure scurvy – water for sailors on Cook’s ships)
- did not exploit the commercial potential of soda water, but published “Directions for Impregnating Water with Fixed Air” (1772)
- others such as J. J. Schweppe made fortunes from it !

Quiz: Identify these!

??



??



Popular beverages

Mate de coca



Vin Mariani



- John Pemberton (1831-1888)



- April 1865, wounded in battle, addicted to morphine, wants cure, expts with coca wines
- Created own version of Vin Mariani (with kola nut) "Pemberton's French Wine Coca"
- Advt: beneficial for "ladies, and all those whose sedentary employment causes nervous prostration, irregularities of the stomach, bowels and kidneys, who require a nerve tonic and a pure, delightful diffusible stimulant."
- 1886, Atlanta "temperance legislation"
- Needs non-alcoholic alternative !



- John Pemberton (1831-1888)



- Along with Atlanta druggist Willis Venable develops recipe blending the base syrup with carbonated water
- Frank Mason Robinson: name "Coca-Cola" and hand wrote the Spencerian script
- New advt: "delicious, refreshing, exhilarating, invigorating", a "valuable brain tonic that would cure headaches, relieve exhaustion and calm nerves".





Coca-Cola

- Asa Griggs Candler (1851-1929) bought the formula for Coca-Cola from its inventor John Pemberton and other share-holders for \$2,300 in 1887
- Aggressive publicity and marketing campaign pushed it to world dominance
- “Secret Recipe”
- [Santa Claus...](#)
- Pepsi vs. coke...



The world's most secure vending machine



Coca-Cola

- So what is in there??
- Only 2 people know... !
- Suspected compositions:

OpenCola

7X flavoring formula: **OpenCola syrup:**

3.50 ml orange oil	2.00 tsp. 7X formula
1.00 ml lemon oil	3.50 tsp. 75%
1.00 ml nutmeg oil	phosphoric acid or
1.25 ml cassia oil	citric acid
0.25 ml coriander oil	2.28 l water
0.25 ml neroli oil	2.36 kg plain
2.75 ml lime oil	granulated white table
0.25 ml lavender oil	sugar
10.0 g gum arabic	0.50 tsp. caffeine
3.00 ml water	(optional)
	30.0 ml caramel color

The recipe:

Fluid extract of Coca: 3 drams USP
Citric acid: 3 oz
Caffeine: 1 oz
Sugar: 30 (unclear quantity)
Water: 2.5 gal
Lime juice: 2 pints, 1 quart
Vanilla: 1 oz
Caramel: 1.5 oz or more for color

The secret 7X flavor

(use 2 oz of flavor to 5 gals syrup):

Alcohol: 8 oz
Orange oil: 20 drops
Lemon oil: 30 drops
Nutmeg oil: 10 drops
Coriander: 5 drops
Neroli: 10 drops
Cinnamon: 10 drops



Lots of soft drink types...

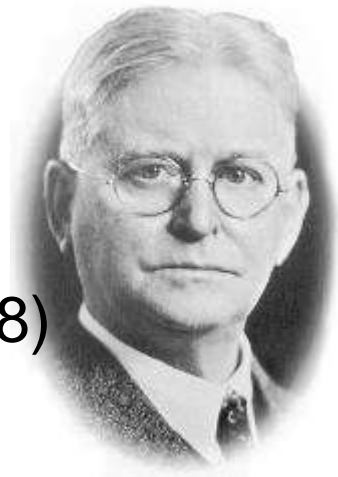
- Cola flavour
 - Lime/Lemon
 - Orange
 - Other fruit
 - Icecream
 - Root beer
 - ...
-
- Energy drinks
 - Sport drinks

(please ask me if you have specific questions)



7-up

- Charles Leiper Grigg, 1929 invention
- Bib-Label Lithiated Lemon-Lime soda
- Patent medicine, cure for hangover
- Contained lithium citrate, a mood-stabilizer (till 1948)
- Renamed 7-up
- Controversy - “100% Natural”
(removed EDTA, replaced Na-citrate with K, but uses high-fructose corn syrup)





Crown Caps

Simple innovations can be quite critical!



- Invented by William Painter, 1891, in Baltimore
- The first highly successful disposable product (it can be resealed but not easily)

Aside: inspiration King C. Gillette, salesman for the Crown Cork Company to invent the disposable razor

- Earlier, soda bottles had ordinary cork bottle stoppers and rounded bottoms to prevent being stored standing up.
- Corks tend to dry out and shrink → gas pressure in the bottle to cause the cork to "pop." Storing bottles on their side prevents the corks from drying out
- The crown cork allowed bottles to be stored standing upright!



Myths, tales, and urban legends...

- Coke does X (cleans bathrooms, dissolves teeth, removes grease, loosens rusty bolts, cures hangovers, makes a good marinade for ham,...)
- Coke + X (Aspirin, Mentos...)
- Soft drinks have X : Cocaine traces, phosphoric acid, ethylene glycol, ...
- “Non-veg” stuff in coke... (there is a Kosher coke!)
- Rat urine on soda cans gives <<disease>> (lepto?)

(Mostly) bad chain letters forwarded by good people ☺



Some simple experiments...

- Density of drinks... (some problem here?!)
- Instant Freezing
- Dancing Raisins
- Acidity measurement
- Tooth experiment...
- Coke + Mentos
- ...

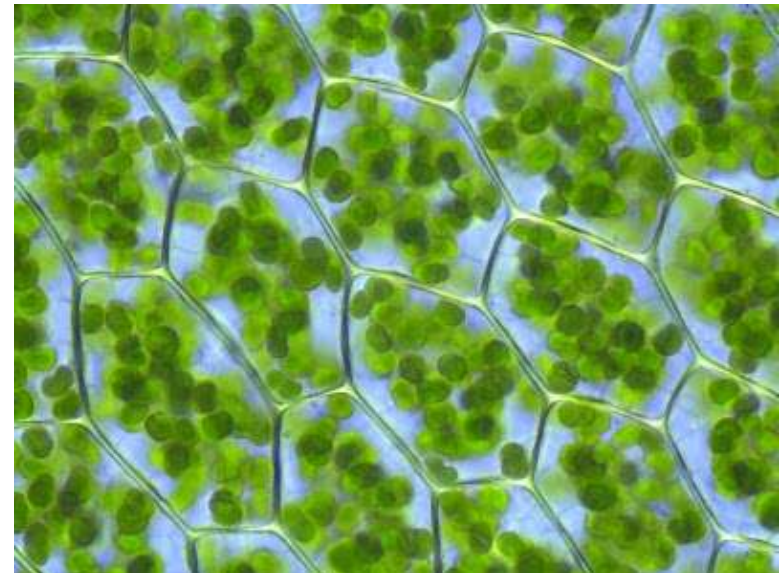
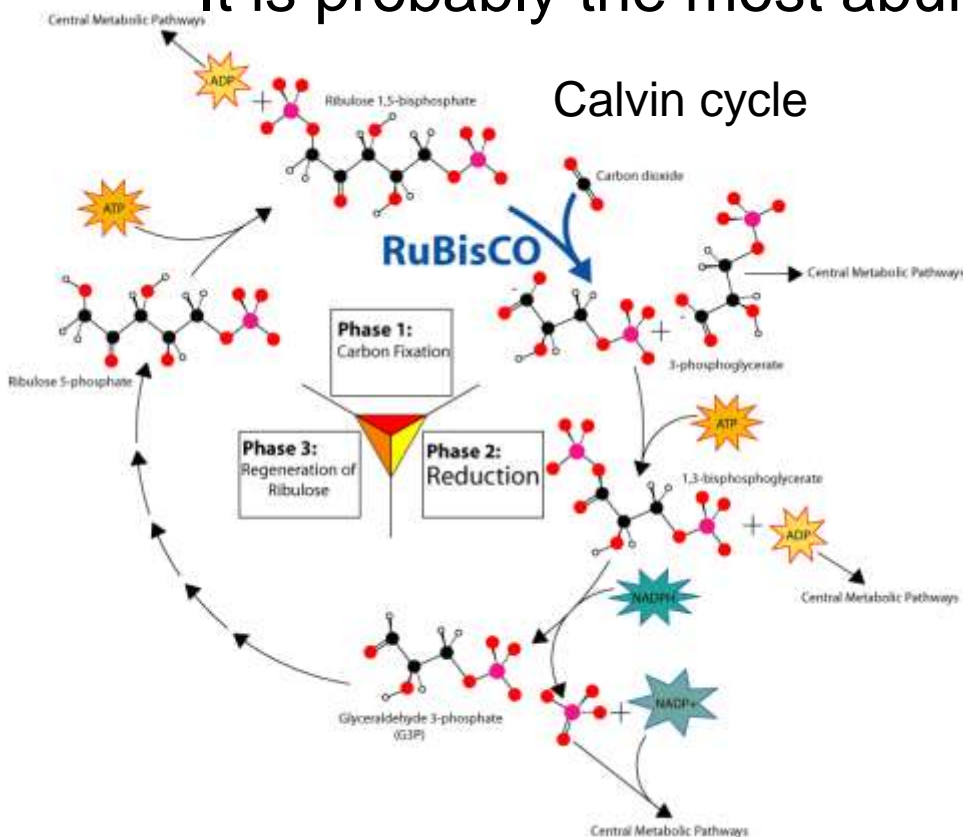


Carbonation

- $\text{CO}_2 + \text{H}_2\text{O} = ?$
- Carbon dioxide dissolves very sparingly in water (1.45g/l at 100kPa pressure)
- Plants have a completely different agenda!
$$n\text{CO}_2 + n\text{H}_2\text{O} \rightarrow (\text{CH}_2\text{O})_n + n\text{O}_2$$
- A marvellous process, catalyzed by enzymes, that works at room temperature!
- Life on earth depends on the carbonation reaction!

Meet RuBisCO!

- *Ribulose-1,5-bisphosphate carboxylase oxygenase*, (thankfully known by the shorter name RuBisCO!)
- Enzyme in plant leaf involved in the 1st step of converting carbon dioxide to energy-rich molecules like glucose
- It is probably the most abundant protein on Earth!





Summary

- $\text{CO}_2 + \text{H}_2\text{O} + \text{flavour} = \text{a world of possibilities...}$
- Nice to experiment with, perhaps not so nice to frequently drink (not so much all the scary stuff, but just the sugar content and empty calories)
- Hope you had some bubbly fun!



Thank you!

- If you are in Mumbai or have friends in Mumbai, do drop in at a Chai and Why? session!
 - 1st Sunday: Prithvi Theatre, Juhu (11am)
 - 3rd Sunday: Ruparel College, Matunga (11am)
- www.facebook.com/chaibandwhy
- if you have questions send us an email, or post a message!



Coca-Cola and Santa Claus

Is the modern day image of Santa Claus thanks to Coca Cola?

- Santa Claus: Portly, bearded, red-and-white... all a product of CocaCola ads?
- Only partially true!
- Coke was a summer drink – get it to be an all season's beverage – associate with Christmas
- Commissioned Haddon Sundblom in 1931 to illustrate Santa Claus in ad series.
- Sundblom expanded on then recent “red/white” themes, and created the larger-than-life Santa





Soft-drink cans: weight data

Where's the sugar???

<i>Drink</i>	<i>Vol. (ml)</i>	<i>Weight (g)</i>
7-up	250	258.5
Mirinda	250	271.4
Pepsi	250	274.5
Diet Pepsi	250	264.5
Diet Pepsi (L)	330	342.5
Coca Cola	330	356.2
Diet Coke	330	341.7
Cloud 9	330	353.6
RedBull	355	383.7
Empty coke can	330	24.9



Energy drinks

Combination of stimulants to boost energy? Or just sugar!

- Carbonated water + methylxanthines (including **caffeine**), B vitamins, and herbs
- Guarana, yerba mate, açai, and **taurine**, ginseng, maltodextrin, inositol, carnitine, creatine, glucuronolactone, and ginkgo biloba.
- Usually high levels of sugar and caffeine (3x usual cola)
- Lipovitan (1960, Japan) → Krating Daeng (1970s, Thailand) → Red Bull (1987)

