

# It's all about the chemistry with electronic cigarettes

## Commentary

Did your eyes glaze over as soon as you saw the word “chemistry”? Mine certainly would have. Chemistry 101 in college was the only class I ever received a “C” grade, otherwise I was pretty much a straight “A” student. So it’s not like I’m dumb but chemistry and I - we just didn’t get along. So if you’re like me, trust me that if you understand the difference between ice, water and steam, that is all the chemistry you’ll need to understand this article.

(Water is liquid at room temperature, lower the temperature to 32 degrees and it will freeze into ice. Heat it to 212 degrees and it will turn into steam).

Proponents of vaping often will say that the flavorings in e-juice, the liquid that is heated into an aerosol, are safe. They will point out that they have the GRAS (generally recognized as safe) designation. This is true.

Flavorings are issued a GRAS designation by the Flavoring Extract

Manufacturers Association (FEMA) for food products. For more information: <http://www.femaflavor.org/gras>

Here is what FEMA has to say about the flavoring in electronic cigarettes:

*The manufacturers and marketers of e-cigarettes and all other flavored tobacco products, and flavor manufacturers and marketers, should not represent or suggest that the flavor ingredients used in these products are safe because they have FEMA GRAS status for use in food because such statements are false and misleading.*

An example of this would be cinnamon. Eating cinnamon is safe but when cinnamon is heated and inhaled, it turns into a different chemical which is toxic to living cells.

Another important factor is that a flavoring added to food, will go to your stomach which is a very harsh environment. It is mixed with stomach acid before entering into your intestines. Here the nutrients pass through to your blood system and then that blood is filtered through your liver before that nutrient rich blood is circulated throughout your body. One of the main functions of your liver is to detoxify chemicals; it cleans out toxins and wastes.

When a chemical is inhaled, it goes into your lung which consists of very delicate tissue, not at all like your stomach. Your lungs are created as the most efficient and fastest way to get oxygen to your brain. As you breathe in, oxygen goes into small air sacs (alveoli) which are only one cell thick to allow the exchange of oxygen from your lungs into your blood system. From there it takes less than 10 seconds for the oxygen rich blood to reach your brain. Inhalation is faster than mainlining a drug into your veins in getting a chemical to your brain.

You might have seen some headlines lately that some liquids for electronic cigarettes contains “diacetyl”. This chemical was used in microwave popcorn to give it a buttery flavor until it was discovered

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that the workers in the microwave popcorn factories were developing a disease called “bronchiolitis obliterans”, also now called “popcorn lung”. This disease destroys the lungs tiniest airways leading to the buildup of scar tissue which blocks the flow of air. It is irreversible and eventually leads to death. It was caused by inhaling diacetyl.

Proponents of electronic cigarettes defend vaping by pointing out that traditional cigarettes also contain diacetyl and in higher amounts. Dr. Konstantinos Farsolinos, a cardiologist and researcher says that the amount of diacetyl is too small to cause any harm but to be on the safe side, diacetyl should not be added to e-liquids. For more information: <http://www.ecigarette-research.org/research/index.php/whats-new/whatsnew-2015/236-da2>

*The dose makes the poison. Paracelsus*

We know that if you smoke only one cigarette that it will not kill you or do any permanent damage. It is the accumulation of toxins over time that damages your body. So with electronic cigarettes the question becomes what is a minimum dose of diacetyl that will not cause any harm? And over what period of time? It will be decades before we know the long-term consequences (if any) of vaping.

The question involving chemistry is: Is there a chemical difference in diacetyl when it is burned at a high temperature (smoking cigarettes) versus when it is inhaled at room temperature, like with the workers in the popcorn factory versus the lower temperature used when heating e-liquid for vaping?

In other words is diacetyl like ice/water/steam, the same substance yet it acts differently with a change in temperature?

The easy solution is to eliminate diacetyl and cinnamon from e-liquids and then we also don’t need to worry if there is a minimum amount that could be harmful. But these are just two chemicals. What about the thousands of different chemicals and combinations of chemicals that are being used in e-liquids today?

So even if someone vaping isn’t using a nicotine solution, are they

still harming themselves by inhaling chemicals that are meant to be eaten, and not inhaled?

These are just some of the questions that need to be answered in understanding whether vaping is safe or not.

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## **Conflict of interest**

The author declares no conflict of interest.