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An Analysis of Dairy and its Effects on Vocal Production

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ABSTRACT

Dairy is anecdotally known to create issues caused by increased mucus in the vocal performance profession. This article explores the scientific explanations behind the debate about whether or not that is true. It also uses scientific backing to recommend certain foods to avoid, if worried about that effect. It concludes with suggesting dietary choices to help alleviate the inhibition of the voice caused by the effect dairy may have on mucus.

Should people believe what they are told is true or what they feel is true? This question comes up during a common debate in the vocal performance occupation; whether or not dairy has an effect on the voice. One of the main disagreements is whether or not dairy causes excess mucus production. Overall, scientific studies are believed to have come to the conclusion that dairy cannot cause increased mucus production and yet people are still experiencing that exact symptom after consuming dairy. Regardless of studies or decisions made by the scientific world, people will still need help avoiding and alleviating possible symptoms of this phenomena. Throughout this paper I will be covering why dairy could cause mucus, why some scientific studies believe otherwise, and finally providing a diet that helps solve any mucus related symptoms the singer may encounter.

Many people are of the belief that dairy products do cause mucus. Many of those people take this stance based on personal experience. This is because, especially in the performing world, even one mishap can be extremely memorable and even career scarring. In order to support this idea, I will cover the scientific basis by talking about how dairy acts as a minor opioid and then move into how opioids have been seen to cause mucus.

Any dairy product made with cow's milk has 2 main types of proteins in it: Whey protein and Casein protein (McCleas 2018). While both are important and provide vital nutrients for bodily function, they act completely different. Casein is different because as your body digests it and breaks down the protein it releases a chemical called Beta-Casomorphine-7 (BCM-7) (Kapilla, 2014). After it is released into the blood stream, the BCM-7 molecules travel up to the Ventral Tegmental Area (VTA) of the brain. This is the part of the brain that creates dopamine through opioid receptors normally activated by activities such as eating, exercise and sex (Plants 2016). As the molecules travel through your brain they go through dopaminergic neurons, meaning that they travel across the neurons intended for dopamine in order to reach the VTA. As they hop from one neuron to another, they go through an area between neurons known as the synaptic clef (Plants 2016) This area is the home of tons of tiny opioid receptors. As the BCM-7 travels across the synaptic clef, some of the molecules attach to the opioid receptors and cause the release of dopamine into the brain (Kurek 1992).

As one may point out, the "pleasure" of eating dairy products is not nearly as noticeable as other dopamine releasing activities. This is because the opioid receptors in your brain normally pair with a full agonist. However, BCM-7 is a partial agonist (Haq 2014). Most common dopamine

releasing activities release an abundance of dopamine because, in those cases, the receptors are engaged by full agonists. However, due to the fact that BCM-7 is only a partial agonist it doesn't release nearly as much dopamine, therefore making the euphoria almost unnoticeable (Plants 2016). Although BCM-7 is a weaker chemical it can still have similar effects such as reinforcement. Reinforcement is what happens when a person's brain learns and makes connections between an action and a feeling. In other words, an addiction. Because BCM-7 is a weaker agonist the reinforcement is not nearly as noticeable, yet it still has a subconscious formation of that same reinforcement within your brain. Interestingly enough, it is theorized that BCM-7 has developed this natural tendency in order to help encourage infants to keep feeding on their mother's milk during infancy. Now that it is understood how dairy acts as a minor opioid, I will move on to explain how opioids have been shown to cause mucus production and therefore inhibit singing capabilities.

Due to its natural dopamine releasing tendencies, it has been postulated that BCM-7 causes an excess release of mucus. It has been shown that Beta Casomorphins can cause varying amounts of mucus release in rats digestive tracks (Claustre et al. 2003) Not only that but another study took it a step further and proved that specifically BCM-7 causes 169% increase of mucus production in human cells (Zoghbi et al. 2006). However, the issue is that most of these mucus cells are found in the digestive system inside of the intestines. Thus, they could not have any effect on the vocal folds or vocal production.

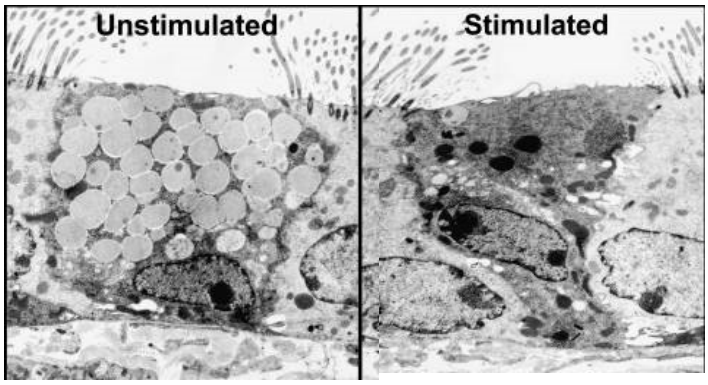

Figure 1 - Stimulated vs. Unstimulated Mucin Cells

A more recent study has found a solution to this issue. It shows that MUC5AC, a specific type of mucosa cell, has the ability to produce airway mucus from the secretion of goblet cells (Zhu 2015). This study also brought up a unique point with the idea that mucus secretion is limited by a time and quantity relationship. The study presents the idea that mucus cells have a certain amount of mucus stored up in them and as agonists are released into the body, they release said stores through a gigantic spike in exocytic events (EE). In the study it was measured that after the introduction of an agonist the EE/min jumped up to 118 in human cells (Zhu 2015). Then after a few minutes, when the storage of the cells was fully depleted the EE's dropped far below a normal rate to that of almost 2 EE/min (Zhu 2015). Figure 1 shows the relationship between an unstimulated cell which is full of mucin, in comparison to that of a stimulated cell which has released all of its mucin stores. Interestingly, the baseline or normal mucus secretion was measured to be significantly greater, on average in a 24-hour period, than that of a production spiked by agonists.

In theory, BCM-7 as a partial agonist could have similar effects as those that were measured in the study. The EE/min may not jump to as drastically high as a full agonist, but it could then have a longer impact on the individual due to the elongated secretion of the cells' mucin storages. This can also be used to explain why dairy consumption only effects some people on an

inconsistent basis. If the consumer of casein has already depleted or reduced their stores of mucus then the BCM-7 will have no effect on their mucus secretion because there won't be anything to secrete.

In comparison, many articles will claim that there is no correlation between dairy and mucus production. Many companies and groups such as the Dairy Council of California have posted articles adamantly defending this position (HealthyEating.com). When looking at said article it is made clear, through bold font, that no scientific research has shown that milk produces mucus. They support this claim by providing a slew of scientific sources supporting them beginning with a very commonly quoted Australian research study. This study took 60 volunteers and gave them all rhinovirus-2, also known as the common cold. The study then measured the weight of the subjects' nasal secretions over 10 days with milk consumptions varying from 0-11 cups of milk a day. They found no variance in nasal secretions among those that consumed milk to those that did not (Pinnock, C B, et al. 1990) Since 1990, many more researchers have conducted similar research to understand this effect and have come to similar conclusions. For example, a 2019 research project focused on the consumption of milk listed "milk leading to mucus production" as one of the myths they were going to dismantle (Aparicio 2019).

Although this study may seem fairly conclusive, if you take into account the previous research discussed, it only supports the theory that dairy does not produce mucus. However, due to the fact that the subjects were given the cold before measuring the effects of dairy negates any effect dairy may have on mucin secretion. Unless the subjects drank the milk directly after receiving the virus then their mucin stores would likely be fully depleted by the time the agonist was introduced into their system. It is widely accepted and supported that when an individual is fighting the cold their nasal secretions are significantly increased. Thus, the mucin stores among the goblet cells would likely be depleted to the point at which the milk would have no effect. Therefore, it is fair to claim that this study supports the idea that milk does not affect mucus production, but it cannot be claimed that milk does not affect mucus secretions.

To review, it is imperative to recognize the difference between mucus production and mucus secretion. The reason this debate has perplexed many investigators is that they assume the two are synonymous. However, if the two are separated then the debate can be supported from either side. The supporters of the connection between mucus and dairy can see and experience the effects that dairy has on mucin secretion whilst those against it can rightly claim that dairy has no effect on mucus production. When analyzed separately, a completely new idea can be seen in the effects that dairy can have on singing. Consuming dairy will affect the secretion rate of those that have large mucin stores in their cells but will not affect the production rate of those without that same storage built up at the time of consumption.

Regardless of which stance individual singers choose to take, it is likely that they will have a mucus related experience at some point during their career. Thus, it is important to know exactly how to avoid and relieve the symptoms of too much mucus. In this section of the paper I will cover specific dietary choices performers can make to help with the possible symptoms related to excess mucus. First off, the foods people should avoid before a performance are extremely broad and yet could be considered quite self-explanatory. As discussed, the origination of the problem is thought to be from cow's milk. Thus, the simple solution is to avoid cow's milk. However, cow's milk is

found in a plethora of food products. These include but are not limited to milk, yogurt, cheese, sour cream, ice cream, butter, mayonnaise, salad dressings, and some pasta sauces. As a part of U.S. law, products must put potential allergens on their products and thus products will say if they "contain milk ingredients" (Casein Free Diet 2019). Not only that but if there is an accessible ingredients list, normally casein or some form of casein will be listed. Be sure to look carefully at the ingredients list because casein can be listed in a variety of forms. Normally it is labeled as some form of caseinates, which include magnesium caseinates, sodium caseinates, and calcium caseinates ("Casein Free Diet" 2019).

If it becomes impossible to avoid dairy products as a whole the performer must make tactful substitutions in order to avoid potential consequences. One of the easiest substitutions for cow's milk is a milk with a different origination such as soymilk or almond milk. Both of these options don't contain casein and thus wouldn't affect the performer adversely. Replacing normal yogurts and cheeses with vegan option is also an ideal substitution. Finally, butter can be swapped with margarine made from vegetable oils in order to avoid any chance of consuming casein.

If a singer does end up in a situation where they find themselves with too much mucus and need to clear it quickly there are a couple of dietary tricks to help. Bromelain is a combination of 2 different enzymes that excel at breaking down proteins. Basically, bromelain takes the amino acids in the mucus and breaks the peptide bonds between them**.** By doing so, it has an effect similar to that of disintegrating your mucus (Walker, 2019). Two of the best foods to eat in order to utilize that aspect of bromelain are pineapple and papaya (Scheve, 2018). Both of these products have an abundance of bromelain and thus would have the desirable effect of lowering mucus levels. There are many other ways to help prevent mucus production over time such as developing your immune system. However, these other methods aren't as effective in an emergency situation as the more immediate solution of bromelain.

CONCLUSION

The dairy-mucus mystery is far from solved and the conclusion which has been presented requires much more research and support. Regardless of personal stance, until the mystery is solved the mucus affliction could strike anyone, at any time. The ideas presented are science backed suggestions to help the singer avoid and react to mucus overload in the vocal production field.

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