The Intricacies of Artificial Sweeteners

Have you ever been to a restaurant that serves breakfast and seen the many different colored sugar packets sitting in the little white dish at the end of the table? Have you ever wondered if there is a difference between them or what they do to your body compared to regular old table sugar? Lets learn more about what these artificial sweeteners are so you can impress your peers at the dinner table.

These pretty color sugar alternatives are called non-nutritive sweeteners because they are artificial, or a chemically crafted sugar. To elaborate, non-nutritive sweeteners are not found in our natural environment but are chemically created to sweeten foods without packing on many calories. According to the Cleveland Clinic, these artificial sweeteners can be hundreds of times sweeter than natural sugar. Due to this, very little sugar substitute is required to sweeten foods compared to natural sweeteners such as table sugar, honey, or corn syrup. Artificial sweeteners are used in many foods, medications, and oral products to create a more desired taste. These sweeteners look generally the same from the human eye but let's discuss them on a deeper level.

Zooming in on each non-nutritive sweetener on the molecular level, we can see more clearly where they differ from natural sugar. Table sugar, or sucrose, is the natural sugar that sugar substitutes will be compared to. Sucrose is composed of a glucose molecule, a 6 carbon sugar, linked with a fructose molecule, a 5 carbon sugar. Sucralose is the most similar chemical sugar to sucrose because it has almost an identical structure but two chloride ions are replacing two hydroxide ions. Saccharin is also similar to sucrose and sucralose but its 5 carbon sugar and 6 carbon sugar are more closely packed together. Stevia, which is derived from the leaves of a stevia plant, is made up of a branched three sugar unit. Aspartame, which is most commonly found in diet sodas, chewing gum, and processed desserts, is made up of two amino acids, aspartic acid and phenylalanine.

Now we will discuss more about what these artificial sugars do in the human body. When these sugars are consumed, they come into contact with the microbiome in the gastrointestinal tract. The microbiome is made up of many different types of microorganisms such as bacteria, viruses, and fungi that exist in the human intestines contributing to a symbiotic relationship. In other words, these microorganisms help to break down our foods to aid in digestion, harvesting energy, and immune defense. Non-nutritive sugars are not digested or broken down by these microbiota, hence why they have little to no calories. This can affect glucose tolerance which is how efficiently the body utilizes the sugars we ingest and transfers them to parts of the body that need these nutrients such as muscles and tissues. The microbiome contains good bacteria that helps to break down these sugars so that the body can use these smaller sugar molecules in other processes. However, these sugar substitutes are not always able to be broken down by the microorganisms in our microbiota so these molecules will just keep traveling down the digestive tract into waste. The body is not able to harvest any nutrients from these sweeteners.

An experiment was organized to test and analyze the effects of non nutritive sugars on processes in the body. Several individuals were selected that had no prior exposure to artificial

sweeteners. These subjects were split into groups given packets of non nutritive sweeteners each day or served as a control group. The artificial sugars being analyzed were sucralose, saccharin, aspartame, and stevia. At set intervals, these individuals underwent certain tests to measure their glucose tolerance and bacteria microbiome. Once all the data was collected, it was analyzed to try and draw conclusions based on the findings.

The first experimental value discussed is glucose tolerance. A baseline glucose tolerance is measured, a glucose tolerance is measured after week one and week two of exposure to their appropriate sugar, and a follow-up tolerance is measured. Saccharin and Sucralose appear to have an adverse impact on glucose tolerance because the glucose tolerance levels for these two non nutritive sugars increased in weeks one and two compared to the other values from other sugars or control groups that did not spike significantly. This spike with Saccharin and Sucralose means that the body was not able to break down the sugar as well which resulted in an increased sugar level. These sugars' impacts were also measured on bacterial diversity.

As previously discussed, humans and animals have bacteria living in a symbiotic relationship in the gastrointestinal tract. The bacteria levels were observed before and after the interference with the non nutritive sugars to observe the effects. The data showed that consuming any of these four artificial sugars will alter the gut and oral microbiome (Suez, 2022). However, there was a significant disruption in the microbiome in the sucralose and saccharin trials. The process that helps create proteins that serve as antimicrobial, antiviral, and anticancer agents were disrupted in sucralose; the methylerythritol phosphate pathway II. Glycolysis VI was the process most disrupted in the saccharin trial. Glycolysis is the process in which sugar gets broken down in the body. L-argenine biosynthesis II was disrupted in the microbiome exposed to aspartame, meaning amino acid metabolism was disrupted. Stevia affected the microbiome differently than the others. Phospholipid biosynthesis I was increased in this microbiome, meaning the creation of lipid structural components were increased. The effect of these sugars were also observed on mice.

The gut bacteria from the individuals that were exposed to artificial sugars were transplanted into sterile, germ-free mice to observe the mice's glucose tolerance. The way the mice processed sugar was very similar to the person who's microbiome the mouse received. Stevia showed the most positive test results in the Glucose Tolerance Test. Sucralose and Aspartame also showed a few positive results for glucose tolerance. Sucralose and Saccharin showed a decrease in gut bacteria. There was an increase in glucose tolerance in the gut microbiome for Aspartame, Saccharin, Sucralose, and Stevia.

This experiment demonstrated that there are significant changes in glucose metabolism that result from the changes in the gut microbiome from consuming non nutritive sweeteners. Consuming any of the four artificial sweeteners examined, will alter the microbiome in the gastrointestinal tract which will consequently alter routine processes that the bacteria perform such as glycolysis and synthesis of biomolecules. None of the non nutritive sweeteners are beneficial but Sucralose and Saccharin are two to stay away from. These two sugars showed the

highest rates of glucose tolerance. A diet full of fresh, unprocessed foods is ideal but if sugar is necessary, a natural form of sweetener will be the best choice.

Works Cited

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