

Sweet study finds how to keep gummy bears chewable longer

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Those gummy bears from last Halloween might be hard as rocks, but a new study has used physics and chemistry to find out what factors put gummies at risk of becoming almost impossible to chew—and how to keep them gummy for as long as possible.

Keeping a gooey consistency

Gummies are all about texture. They shouldn't be too hard, soft, or sticky, but they can become any of those things depending on ingredient content or storage (often both). Keeping them fresh means preventing changes to their internal chemistry that would otherwise occur over time. The ingredients that go into gummy candy, and how much of each is used, will inevitably affect the chemical reactions that occur, as will the storage temperature and how long they stay in storage. So a team of researchers experimented with different formulas and storage methods to create the ultimate gummy.

The main ingredients of a gummy are glucose syrup, sucrose, starch, gelatin, and water. Led by Suzan Tireki of Ozyegin University in Turkey, the research team mixed eight batches with varying amounts of those main ingredients (flavor and color were low priorities for this work). The ratio of glucose syrup to sucrose was especially important because it has the

most influence on gummy texture. Glucose is also responsible for sweetness and acts as a preservative by absorbing excess water that could otherwise attract microbes. Gelatin and starch are polymers and gelling agents that help give gummies their iconic texture.

This is an exceptional research paper, as its methods include the recipe for making your own gummy bears. First, a mixture of glucose, sucrose, and water was brought to boiling in an open saucepan. Gelatin and starch were soaked in warm water for a while and then incorporated into the mixture. Finally, citric acid, color, and flavoring were added. The gummy ooze was poured in molds and stored until most of its water had evaporated. Any excess starch was brushed off the cooled gummies.

Tweaking for storage

From there on out, it was a matter of tweaking that recipe. “The most effective way to manipulate gel texture is to change the number of crosslinks per unit volume,” the researchers said in a study recently published in *Physics of Fluids*. “Polymer concentration and type can be changed or the amount of evaporated water can be adjusted to achieve this.”

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Gummy candies rely heavily on the polymers and the crosslinks within them for texture. Polymers are formed by chemical reactions among subunits called monomers, which can link up to create a gel like the type used in gummy candies. Crosslinks in the form of covalent bonds between polymer molecules keep the mixture of glucose and sucrose in place and result in a candy that is solid but potentially squishy—more crosslinks result in a harder final product. Changing the number of crosslinks, therefore, changes the texture.

The researchers also wanted to see how storage would affect different batches of gummies. Gummies from each batch were

divided into subgroups, and each subgroup was stored at one of three different temperatures over the course of a year.

Every batch showed stability at room temperature, but one stood out. The winner across all temperatures had the highest level of gelatin and was devoid of starch. It also contained the highest ratio of glucose to sucrose, which increased the distance between crosslinks, making it softer and stretchier. There was only a small difference in crosslink length when the gummies were stored at lower temperatures. While gelatin, glucose, and sucrose levels were determined while the candies were being made and crosslinks formed as the ingredients were combined, this batch really held up because of its ingredient percentages and molecular bonds, which kept things stable over time. After the batch was removed from storage, it still had the highest crosslink distance.

The researchers also found that some ingredients didn't really matter. "Our most surprising finding was that hardness and average crosslink distance were not affected by the amount of starch," Tireki said in a press release. While starch can modify some aspects of texture in gummy candies, it was found not to affect how hard or soft the gummies turned out and had no effect on molecular bonds, including the crosslinks that were especially important to how well they survived in storage.

Tireki's team also wants to investigate how to improve the shelf life of plant-based gummies, which are made not with gelatin but a soluble fiber derived from tapioca. In the meantime, asking a scientist might be the best way to find out if that bag of gummies will really last from one Halloween to the next.

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