APPLICATION NOTE

Food – Dynamic-Mechanical Analysis

The Influence of Humidity on Gummy Bears

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Introduction

Fruit gummies are sweet and sour at the same time, taste good and are probably somewhat addictive. Do you know anyone who can resits them? Their taste and bite behavior are affected by temperature and humidity, which influence their elasticity and firmness. This, in turn, influences consumer perception during mastication.

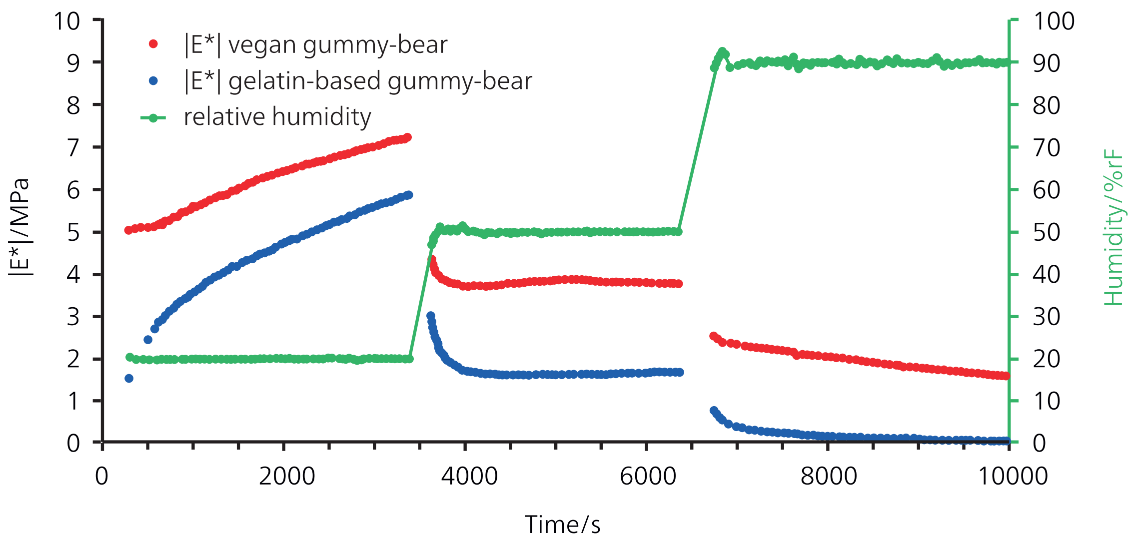
Measurement Conditions

In this investigation, the dynamic-mechanical behavior of a vegan and a gelatin-based gummy-bear were studied during drying and under moisture absorption. The High-Force DMA EPLEXOR®, equipped with a humidity generator (Hygromator, optional), was used. The device is able to provide data about hardness during biting (complex modulus) and viscous taste feeling (damping properties tan delta). Both properties depend on temperature and humidity. Since fruit gummies become quite stiff at sub-ambient temperatures, only a high-force DMA can successfully carry out this "test job".

The moisture-dependency of the samples is investigated in tensile mode at a constant temperature of 35°C.

Measurement Results

In the first step of the experiment, the vegan and gelatin-based samples were exposed to a chamber humidity of 20% RH (relative humidity) for approx. one hour. This step corresponds to a drying process to get from ambient humidity to a "quasi" dried condition at 20% RH. At the end of this step, the fruit gummies were in an identical state of dehydration, enabling comparison of the curves obtained during the next steps. The change in their Young's modulus was recorded (figure 1, first step).



1 Young's modulus during drying and humidification phases for a vegan (red curve) and a gelatin-based fruit gummy (blue curve) along with the corresponding temporal course of the chamber humidity (RH, green curve) with steps at 20%, 50% and 90%.

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The samples dried this way were then subjected to a chamber humidity of 50% for about one hour and then to a chamber humidity of 90% for another hour. The resulting time-dependent changes in the Young's modulus and the chamber humidity are shown in figure 1 (second and third steps).

All tests were performed at a test frequency of 1 Hz, mimicking human biting that is not faster than 1 or 2 Hz.

The vegan gummy-bear exhibits higher |E*|-moduli and more or less the same moisture sensitivity as the gelatin-based gummy bear. Common to both is an increase in |E*|-modulus upon drying (here at 20% RH) and a decrease upon exposure to moisture (here at 50% RH and 90% RH).

Conclusion

Both the vegan and gelatin-based gummies showed changes in stiffness (E modulus) during drying and moisture absorption. Vegan as well as gelatin-based gummies are very sensitive to humidity. The stiffness of both samples drops down from the stiffness maximum of 7 MPa (vegan) and 6 MPa (gelatin-based) after one hour at 20% rH to 1.5 MPa (vegan) and 0.2 MPa (gelatin-based) after 1 hour at 90% rH. There is no remarkable difference in their humidity behavior. However, the vegan system is definitively much "harder in biting performance" than its gelatin-based counterpart.

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