Storage stability of ultrasonic compression nutrition bars: Predicting temperature effect

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Nutrition bar texture change during storage is widely observed. It is essential to determine the change in mechanical properties of bars for shelf stable products within the expected shelf-life of one year. The stability of long shelf-life products typically are studied under accelerated conditions of higher temperature. Nutrition bars have glass transition temperature close to storage temperature. Therefore, the accelerated studies at higher temperatures may not provide an accurate shelf life prediction.
The objective of the study is to evaluate the effect of storage temperature for prediction of shelf-life of nutrition bars produced by ultrasonic compression.
Wheat flour was used for ultrasonic compression (UC). Bars were fabricated with an ultrasonic welding equipment. Flour with 22 % moisture was placed in a mold and horn was lowered until a force of 222N was reached which triggers welding. Weld time and percent amplitude were selected as processing parameters. Bars were sealed in pouches and stored at temperatures of 23, 40 and 50 C for 9 months. Periodically, samples were pulled out and mechanical properties were determined using a texture analyzer. Fracture stress change was calculated as a function of time at each temperature. Kinetic models were developed to determine the shelf life of products. Thermal analysis were conducted to determine the effect of storage on glass transition temperature of products.
UC nutrition bars have 16-17 percent moisture. The glass transition of bars occurs over a temperature range of 40 and 70 C with a mid-temperature of 60 C. After 8month of storage, glass transition appears to expand over a larger temperature range of 40 to 110 C with a mid-temperature of 75 C. While the storage temperature of 23 C assures the bar to stay in the glassy state where the molecular level movements and moisture diffusion is restricted, accelerated storage temperatures causes the bar to be transitioning from glassy to rubbery state allowing the moisture redistribution which lead to firming of product.
Development of predictive capability of the shelf-life for bars accurately will lead to optimization of storage conditions for food processors and to serve the consumer needs.