NASA TECH BRIEF

Lyndon B. Johnson Space Center

Control of Nonenzymatic Browning in Intermediate-Moisture Foods

The problem:

When stored for long periods of time, many dehydrated and intermediate-moisture foods show a tendency to lose nutritional value and flavor. Many of these deteriorative conditions are brought about by a series of chemical reactions classified as "nonenzymatic browning". Nonenzymatic browning occurs because of a reaction between an amine group and a reducing compound; an example of particular interest is the reaction between dextrose (a reducing sugar) and lysine (an amino acid). Lysine is an essential amino acid (meaning it cannot be manufactured by the body but must be obtained in the diet) and is found as a part of protein molecules. When the lysine reacts with the sugar, the digestibility of the entire protein may be lowered, and the nutrient value of the lysine is lost. The only allowable food additives known to inhibit this reaction were sulfite compounds, but these destroy the B-complex vitamins in protein-based foods.

The solution:

A series of compounds, called humectants, are known to have an affinity for water and are able to control the water content of materials with which they are mixed. Several of these humectants have been tested and found to control nonenzymatic browning in intermediate-moisture foods.

How it's done:

Several glycols that are humectants (propylene glycol, glycerol, butylene glycol, and sorbitols) were found to decrease the rate of browning when added to intermediate-moisture foods. A 20-percent level of humectant can increase the shelf life of foods by a factor of 5 or 6, and even a 5-percent level can significantly decrease the rate of nonenzymatic browning.

The effect of the humectants was found to depend upon the relative volume of the liquid phase developed in the food, its viscosity, and the interactions with the food surface. The rate of browning had been previously considered to depend only on the water activity (a_w) which is related to the amount and availability of water in the food. However, these studies have shown that the browning rate increases with a_w to a maximum and then declines as more water is added. (The addition of more water is not an acceptable method of protecting against browning as it increases the food susceptibility to bacteriological growth.)

It was found that the browning rate is also related to the viscosity of the aqueous phase in the food. Apparently, up to a certain point, increased water content decreases viscosity and increases browning. After this point, the addition of further water acts as a dilutant to decrease the liquid-phase concentration of the reacting compounds, and the browning rate decreases.

Note:

Requests for further information may be directed to:

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Patent status:

Inquiries concerning rights for the commercial use of this invention should be addressed to:

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Categories: 04 (Materials)
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