Thermostabilized Shelf Life Study

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Abstract

The objective of this project is to determine the shelf life and point of various food items by means of actual measurement or mathematical projection. The primary goal of the Advanced Food Technology Project in these long duration exploratory missions is to provide the crew with a palatable, nutritious and safe food system while minimizing volume, mass and waste. The Mars missions could be as long as 2.5 years with the potential of the food being preserved prior to the crew arrival. Therefore, it is anticipated that foods that are used during the Mars missions will require a 5 year shelf life. Shelf life criteria are safety, nutrition, and acceptability. Any of these criteria can be the limiting factor in determining the shelf life endpoint has occurred. Shelf life can be defined when the food item is no longer acceptable. Acceptability can be defined in terms of appearance, taste, texture, or aroma. The current shelf life process will not provide acceptable products using the current thermostabilization process. Pluit products tend to brown over time. The Maillard Browning reaction affects color and flavor. The current thermostabilization process will not provide a 5 year shelf life for all formulations. External studies on emerging technologies, such as high pressure processing and microwave sterilization, are resulting in higher quality products and should be investigated further.

Results and Discussion

Entrées (Grilled Pork Chops, Tuna Noodle Casserole)

- Grilled Pork Chops: Vitamin B1 levels showed losses at higher storage temperatures. Drenches of the product were cited as a reason for product failure. Shelf life projected to be 37 months at 72°F.

- Tuna Noodle Casserole: Product failure was attributed to declining scores for hardness of noodles and darkening of color during the 36 month study. Shelf life projected to be 48 months at 72°F.

Sweets (Bread Pudding)

- High sugar items tend to have longer shelf lives. Shelf life projected to be 48 months at 72°F.

Vegetables (Carrot Coins, Sugar Snap Peas)

- Gradual decreases in all related color values for all temperatures over the storage period, yellow in particular, texture declined over time. About 33% of the folate acid was lost over the shelf life. Overall acceptability scores for carrot coins declined gradually over the storage period with the comments as “too mushy.” The 40°F and 72°F samples were still acceptable after three years. The sugar snap peas were unacceptable at all temperatures at 20 months due to bitter aftertaste and darker color. Sugar snap shelf life was projected to be 24 months at 72°F.

Cheese and Vegetable (Palak Paneer)

- Overall acceptability and specifically aroma scores decreased over time likely due to oxidation of the spices and lipids (cheese). Color changes indicated a loss of green color in the spinach and a masking of the off-flavor over time. Shelf life for both products projected to be 26 months at 72°F.

Shelf Life Calculations

Shelf life will be determined by various quality attributes, such as color, flavor, or texture, that will determine the shelf life. The shelf life will be determined by the shelf life at different temperatures. The shelf life at 40°F, 72°F and 95°F for an acceptable shelf life for: Grilled Pork Chops, Tuna Noodle Casserole, Sweets (Bread Pudding), Vegetables (Carrot Coins, Sugar Snap Peas), Cheese and Vegetable (Palak Paneer). The shelf life projections are based on the shelf life projections for these three shelf life qualities, namely shelf life of all NASA’s thermostabilized food products will be predicted.

Conclusions

Shelf life is determined by safety, acceptability, and nutritional content. Safety is not an issue due to the processing. Acceptability is dependent on formulation and processing conditions. Nutrition is lost over time. Sugar can protect the food from degradation. Formulations that contain whole eggs at a significant level did not provide acceptable products using the current thermostabilization process. Pluit products tend to brown over time. The Maillard Browning reaction affects color and flavor. The current thermostabilization process will not provide a 5 year shelf life for all formulations. External studies on emerging technologies, such as high pressure processing and microwave sterilization, are resulting in higher quality products and should be investigated further.

Next Steps

Complete analysis of 36 month data for the last two products – Roasted Vegetables and Tuna Noodle Casserole. Based on the projected shelf life of these two shelf life shelf life of all NASA’s thermostabilized food products will be predicted. Report will be completed in April 2009.

References