Thermostabilized Shelf Life Study
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ABSTRACT

The objective of this project is to determine the shelf life and point-of-service 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 positioned 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 food’s shelf life.

Due to the heat sterilization process used for the thermostabilized food items, shelf life will be preserved as long as the integrity of the package is maintained.

Nutrition and acceptability will change over time. Since the food can be the sole source of nutrition to the crew, a significant loss in volume will determine when the shelf life expires when used.

Shelf life can be defined when the food item is no longer acceptable. Acceptability can be defined in terms of appearance, flavor, texture, or aroma.

Results from shelf life studies of the thermostabilized food items suggest that the shelf life of the foods range from 6 months to 5 years, depending on formulation.

MATERIALS AND METHODS

Products stored at three temperatures, 40°F, 72°F, and 95°F for an acceptable shelf life.

Evaluation is every four months for the first 2 years and every 6 months for the 3rd year.

Sensory testing includes difference from control testing and overall acceptability testing.

Sensory evaluation includes texture, color, moisture, and water activity determination.

RESULTS AND DISCUSSION

Entrées (Pork Chops, Tuna Noodle Casserole)

Grilled Pork Chops

- Vitamin B1 levels showed losses at higher storage temperatures.
- Dryness of the product was cited as a reason for product failure.
- Shelf life projected to be 87 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 49 months at 72°F

Sweets (Bread Pudding)

High sugar items tend to have longer shelf lives.

Vitamin A, B1, and B2 demonstrated a linear decline with temperature.

The overall flavor, level of sweetness, and vanilla, and overall appearance showed a decline likely due to the Maillard Browning reactions. The three most prevalent ingredients; milk, sugar and egg, would provide sufficient amounts of free amino groups and reducing sugar to allow for condensation reactions to occur.

Shelf life projected to be 12 months at 72°F

Vegetables (Carrot Coins, Sugar Snap Peas)

Grilled Pork Chops

Vitamin C significantly declined over time. Apricot cobbler declined from 179 mg/100g to 4.87 mg/100g. The level in thiamin and riboflavin loss in pasta as a function of constant and varied storage periods.

Overall acceptability levels for carrot coins declined gradually over the storage period with comments as “too mushy”.

The 40°F and 72°F samples were still acceptable after three years.

Carrot coins shelf life projected to be 48 months at 72°F

Sugar snap peas shelf life projected to be 20 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 as a function of constant and varied storage temperatures.

Shelf life at temperature ToC changes for the three temperatures.

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 folic 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 129°F samples were still acceptable after three years.

The color snap peas were unacceptable at all temperatures at 20 months due to bitter aftertaste and darker color.

Carrot coin shelf life projected to be 48 months at 72°F

Sugar snap peas shelf life projected to be 20 months at 72°F

Starch (Homestyle Potatoes)

Flavor decreased over time due to acidic aftertaste, off aroma, and overall decrease in flavor.

There was a significant decline in folic acid and pantothentic acid.

Shelf life projected to be 48 months at 72°F

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.

Fruit 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.

EXPERIENCE

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 Thyme Bean Salad
- Based on the projected shelf lives of these 13 items, shelf lives of all of NASA’s thermostabilized food products will be predicted. Report will be completed in April 2009.

REFERENCES


