

# **Space Food Systems Laboratory Shelf Life Analysis Operations Guideline**

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Human and Environmental Factors Office  
Habitability and Human Factors Office  
Food Development Projects Group

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Johnson Space Center

Verify that this is the correct version before use.



National Aeronautics and  
Space Administration  
**Lyndon B. Johnson Space Center**  
Houston, Texas

Space Food Systems Laboratory Shelf-Life Analysis Operations Guideline

**Prepared by**

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**Approved by**

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**Change Record**

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|-------|--------|------------|-----------------|
| Basic | 9-2003 | S. French  | Initial Release |
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## 1 PURPOSE

The purpose of this document is to provide an operation guideline for National Aeronautics and Space Administration (NASA) Johnson Space Center (JSC) Space Food Systems Laboratory (SFSL) personnel and external researchers conducting shelf life testing for existing and potential future flight ready food items. In particular, this document provides methodology for conducting analytical and sensory evaluation of thermally processed, intermediate form and freeze dried food items.

## 2 REFERENCE AND/OR APPLICABLE DOCUMENTS

| Document # | Title  |
|------------|--|
| SC-T-0253B | General Specification Procedure for Moisture Determination in Food                               |
| SD-T-0251T | Microbiological Specification and Testing Procedure for Foods Which Are Not Commercially Sterile |
| SD-T-0252M | Microbiological Specification and Testing Procedure for Commercially Sterile Foods               |
| JSC 28038  | Nutritional Requirements for International Space Station Missions up to 360 Days                 |
| JSC 26725  | Space Food Systems Laboratory Standard Operating Procedures                                      |

## 3 ACRONYMS

|      |   |
|------|---|
| JSC  | Johnson Space Center                          |
| NASA | National Aeronautics and Space Administration |
| SFSL | Space Food Systems Laboratory                 |

## 4 INTRODUCTION

The National Aeronautics and Space Administration's (NASA) Space Food Systems Laboratory (SFSL) at Johnson Space Center (JSC) currently conducts shelf life testing on its current and future flight ready menu items. This testing includes both analytical and sensory evaluation of the item. To ensure that comparative results are generated within the SFSL and through external research efforts, it is recommended that a standard methodology should be followed.

There are currently three categories of available food items:

- Thermally Processed/Irradiated
- Bakery/Natural/Intermediate Moisture
- Freeze Dried

Each of these food item categories contains a variety of products. Thermally processed/irradiated products include menu items such as entrees, soups and desserts. Bakery/Natural Form/Intermediate Moisture products include menu items such as breads, dried fruit, cereals, cookies, crackers, nuts and candy. Freeze-dried products include menu items similar in nature to thermally processed/irradiated menu items, but are subjected to lyophilization.

Shelf life can be defined in terms of safety, nutrition or acceptability. Clearly safety is the most important attribute to consider when measuring shelf life. However, safety is not the only quality attribute that will be considered. If a certain level of nutrition is required in the product, then a loss in nutrition may determine when the shelf life endpoint has occurred. Finally, shelf life can be determined by the change in quality factors of the product, whether it is appearance, texture, or odor (Perchonok 2002).

The measurements made during the shelf life test will be those that will help determine when the product is no longer safe, acceptable, and/or provides the expected nutrition. These tests will be a combination of analytical and sensory tests. And, the analytical tests will complement the sensory tests. In other words, if color is expected to change significantly throughout the shelf life, then the color will be measured analytically with a spectrophotometer and subjectively in a sensory test. Both types of testing are necessary to determine when the consumer in a sensory test can see the analytical differences and if those changes are unacceptable (Kuntz 1991).

## 5 TESTING PROTOCOL

A flow diagram illustrating the protocol used in the SFSL for determining appropriate testing is seen in Figure 1. A menu item is stored according to the predetermined conditions (section 6). Upon removal, the item is internally screened. If determined safe, sensory analysis (section 8) is performed. If a

statistical difference is found in a Difference-from-Control test, Acceptance testing is performed at the failing temperature(s). If Acceptance testing results in an overall acceptability score of 6.0 or below, the overall drop in overall acceptability is determined. If the drop in overall acceptability is greater than 20%, the shelf life study is ends at that temperature. If, however, the drop is less than 20% or the acceptance testing results are greater than 6.0, the shelf life study continues. The shelf life test is completed when the samples at all storage temperatures have “failed acceptance testing. Expiration dates are then assigned.

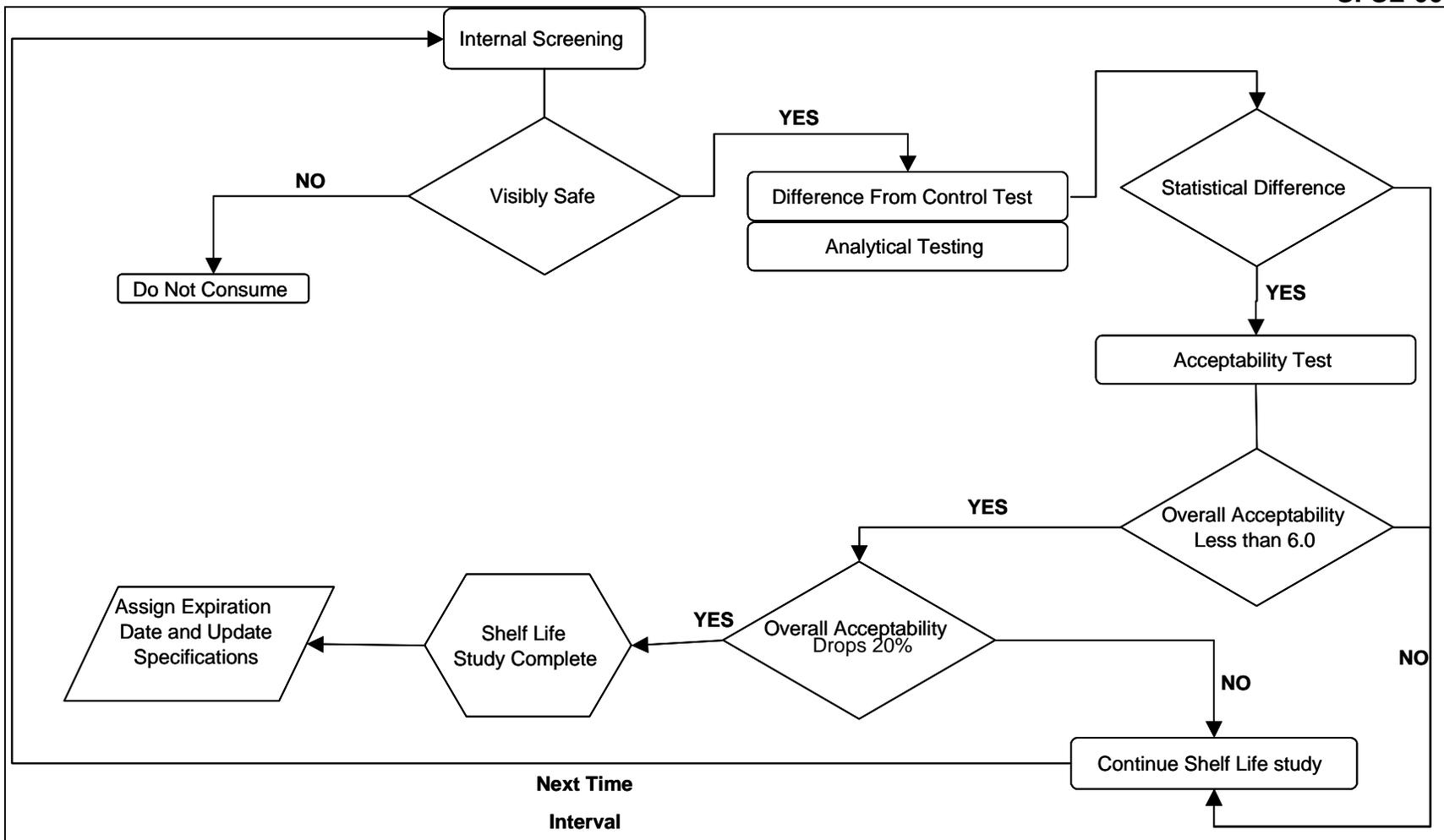


Figure 1 Flow diagram illustrating testing protocol for determining shelf life

## 6 STORAGE TIMES/TEMPERATURES

Performance of shelf life testing will follow protocols for time and temperature combinations. With the exception of breads, food items will be subjected to storage temperatures of 40°F, 72°F and 95°F. Testing of products will occur immediately following production and at intervals to provide at least 4 data points in addition to the zero time. For example, foods with an anticipated shelf life of greater than 3 years will be tested every 4 months for 2 years and 6 months thereafter. Foods with shorter shelf lives will have more frequent testing intervals but the duration of the entire test will be shorter.

### 6.1 THERMOSTABILIZED/IRRADIATED PRODUCTS

Storage treatment of thermostabilized items does not differ within the category and consists of the following temperatures:

- Control: 40°F
- 72°F
- 95°F

### 6.2 BAKERY/NATURAL/INTERMEDIATE FORM PRODUCTS

Storage conditions change only for bread products:

- Control: 40°F (except for breads)
- 72°F (control for breads)
- 95°F

### 6.3 FREEZE DRIED PRODUCTS

Storage conditions:

- Control: 40°F for 4 weeks without metallized overwrap then overwrap and store at 40°F
- 72°F
- 95°F

Following storage, samples are rehydrated. Time and temperature combinations for rehydration are followed and free liquid is measured.

## 7 ANALYTICAL METHODS

Analytical methods may include analyses performed on both a macro- and microscopic level. While this section includes a comprehensive list of possible

analyses, it may be that only certain analyses are required for a particular food item or that particular information is desired by the researcher. In this, it is important for researchers to replicate the specific tests and test protocols to gain comparative data. Analytical data collected will be used to complement sensory data.

### 7.1 pH

The hydrogen ion concentration,  $-\text{Log} [\text{H}^+]$ , of a product is measured using a probe and meter apparatus. Electrode configuration will be either a separate indicator and reference or a combined probe. Choice of probe physical dimensions will take sample type into account. For example, a flat surface probe should be used for surface sampling of meats while a bulb-type probe should be used for liquid and particulate samples. Harsh testing conditions such as elevated temperatures should be avoided in pH testing. Samples should be equilibrated to room temperature (approximately 25°C) before measurements are taken. Samples should not be stirred as this may affect pH. Within the SFSL, an Orion model 607 is used.

### 7.2 MOISTURE OR TOTAL SOLIDS

The moisture content of a food or ingredient is defined through the following equation:

$$\% \text{ Moisture} = (m_w/m_{\text{sample}}) \times 100$$

where  $m_w$  is the mass of the water and  $m_{\text{sample}}$  is the mass of the sample. There are a number of analytical techniques used to obtain this value. The technique to be used will depend, to a large extent, on the physicochemical properties of the water (bulk, capillary, physically bound or chemically bound) and the level of precision desired for the product.

The method of choice within the SFSL is evaporative. A general specification procedure for moisture determination to be used at JSC is found in document SC-T-0253B. However, other evaporation devices: convection, vacuum and microwave ovens as well as infrared lamps can be used for this method, if determined applicable or more appropriate for said food item.

### 7.3 WATER ACTIVITY

Water activity is defined as the partial pressure of water above a given sample divided by the partial pressure of pure water at the same temperature. Control of water activity is important to food items as it can affect both safety and quality. Within the SFSL, a Decagon model CX-1/CX-2 is used for water activity measurement.

#### 7.4 COLOR

The color of a food item may be expressed using the L\*, a\*, b\* scale. Color values are determined in the SFSL using a HunterLab LabScan XE colorimeter. Before measurement, the colorimeter is standardized using procedures from the manufacturer's user guide.

#### 7.5 TEXTURE

Texture characteristics and values within the SFSL are measured using a Texture Technologies TA-XT2i analyzer. As individual food items will differ greatly in composition, testing methods will be defined accordingly. Methods of assessing different food items are being developed both internally and externally. Methods being developed take into consideration the specific characteristics for which information is desired. As methods are determined, they will be added to a reference source (Appendix A) for others to access. This reference will be reviewed and edited periodically. For further information regarding appropriate testing methods, reference methods developed by the texture analyzer manufacturer at: [http://www.texturetechnologies.com/foods\\_applications.html](http://www.texturetechnologies.com/foods_applications.html)

#### 7.6 MICROBIOLOGICAL

Microbiological testing will directly impact the safety of a food item. Testing of the microbiological quality of food items at JSC will follow documents SD-T-0251 and SD-T-0252.

#### 7.7 NUTRIENT

Nutritional analysis of food items, using approved AOAC methods, will take into consideration the nutritional requirements for International Space Station missions up to 360 days (JSC 28038). Measurements will be taken immediately after production, at the end of the shelf life test and possibly periodically during the test.

### 8 SENSORY METHODS

Sensory analysis on food items within the SFSL will implement two types of testing methods for differentiating samples. Both Difference-from-Control and Acceptance tests will be used. A flow diagram illustrating the protocol used in the SFSL for determining appropriate testing is seen in Figure 1 (section 5). Along with this protocol, certain guidelines will be used in conjunction. The following are guidelines for conducting sensory analyses of different food items:

- When multiple samples are tested, only samples of similar type (ex. spicy vs. non-spicy, dessert item vs. dessert item) will be tested

- Samples will be coded randomly
- Samples will be provided to panelists in random order
- A worksheet (Appendix B-1 to B-3) will be used by the sensory administrator to ensure proper testing protocols are followed for a particular food item taking such issues as tempering and blending into consideration.
- Water and crackers will be provided with each sample
- Approximately 30 panelists will be used in each sensory test
- Subjects should be familiar with the testing format prior to the test.

### 8.1 DIFFERENCE TESTING

A Difference-from-Control test is used to determine whether a difference exists between one or more samples with an added assessment of the size of the difference (Meilgaard et al., 1999).

In each test, one set of samples will be blind controls. At the SFSL, two 40°F samples are used for the blind control test. The blind controls provide for a measure of production variability and/or the sensitivity of the subjects. Scales are provided to the subject to rate the difference between samples. An example of a Difference-from-Control ballot is seen in Appendix B-4.

Results of a Difference-from-Control are analyzed by calculating the mean difference-from-control for each sample and for the blind controls followed by an analysis of variance (or paired t-test if only one sample is compared with the control).

### 8.2 ACCEPTABILITY TESTING

A product concept rather than the specific product name will be used to set the expectation for the type of food that will be tested. A product concept refers to the product in general terms such as “spicy tofu” rather than “hot mustard tofu”. Use of this terminology will remove potential bias and clearly define the food expectation. Since the panelists are not prescreened, the preannouncement of the product concepts provides each panelist the opportunity to decide to participate or not participate, according to their likes and dislikes. An example of an Acceptability testing ballot is seen in Appendix B-5.

### 8.3 STATISTICAL ANALYSIS

An Analysis of Variance (ANOVA) will be conducted on all sensory tests using a significance level of 0.1. Results of a Difference-from-Control are analyzed by calculating the mean Difference-from-Control for each sample and for the blind controls followed by the ANOVA (or paired t-test if only one sample is compared with the control). A logistic regression analysis may also be performed on Difference-from-Control tests.

## 9 REFERENCES

Perchonok, M.H. 2002. "Shelf Life Considerations and Techniques", Food Product Development Based on Experience; Catherine Side, editor. Iowa State University Press, pp. 59-74.

Kuntz, Lynn A. 1991. Accelerated Shelf Life Testing: Is Faster Better? *Food Product Design*. December.

Meilgaard, M., Civille, G.V. and Carr, B.T. 1999. Sensory Evaluation Techniques. CRC Press, pp.

## **APPENDIX A**

Texture analysis shelf life testing methods for food items within the SFSL

| Food Item             | Characteristic  | Probe  | TA Settings  | Sample Preparation  |
|-----------------------|-----------------|--|--|---|
| Tuna Noodle Casserole | Noodle Hardness | TA-91<br>Kramer<br>Shear<br>Cell                           | Pre-test speed:1.5mm/s<br>Test speed:2.0mm/s<br>Post-test speed:10mm/s<br>Measure force in<br>compression      | Empty product contents into strainer> Wash sauce away<br>and remove noodles from other contents> Wash again><br>Weigh 120 grams of noodles and place into TA-91><br>Begin analysis  |
| Grilled Pork Chop     | Toughness       | TA-7<br>USDA Warner<br>Bratzler knife with<br>triangle cut | Pre-test speed:6cm/min<br>Test speed:<br>Post-test speed:  | Cut pork chop sample to dimensions of 10 X 10 X 15<br>mm>Place sample so shearing occurs perpendicular to<br>the longitudinal axis of muscle fibers>Begin analysis  |
| Carrot Coins          | Softening       | TA-91<br>Kramer Shear<br>Cell                              | Pre-test speed:1.5mm/s<br>Test speed:3.0mm/s<br>Post-test<br>speed:10.0mm/s<br>Measure force in<br>compression | Drain liquid from carrots>Weigh 100 grams of carrots and<br>place into TA-91>Begin analysis   |
| Apricot<br>Cobbler    | Dough softening | TA-47<br>Pasta blade                                       | Pre-test speed:2.0mm/s<br>Test speed:1.0mm/s<br>Post-test<br>speed:10.0mm/s<br>Measure force in<br>compression | Remove contents and choose piece of crust that<br>measures at least ¼ inch X ½ inch in length and width for<br>testing> Remove excess apricot filling from crust without<br>damaging> Place sample on base so blade will intersect><br>Begin analysis |
| Bread Pudding         | Bread hardness  | TA-7<br>Warner-Bratzler<br>knife                           | Pre-test speed:2.0mm/s<br>Test Speed:1.7mm/s<br>Post-test speed:10mm/s<br>Measure force in<br>compression      | Empty product onto plate and cut into slices<br>approximately 1 inch in diameter> Place under knife><br>Begin analysis  |

**APPENDIX B**

Sensory worksheets and ballots for shelf life determination of food items within  
the SFSL

**Appendix B-1: Sample worksheet for thermostabilized products**

Difference-from-Control Panel

Product: \_\_\_\_\_

Date Tested: \_\_\_\_\_

**Presentation Order:****Test:**

Pair A = Sample 435(40°F, 1 month) and Sample 216 (40°F, 1 month)

Pair B = Sample 264 (40°F, 1 month) and Sample 358 (72°F, 1 month)

Pair C = Sample 863 (40°F, 1 month) and Sample 592 (95°F, 1 month)

| Session                           | First Pair  | Second Pair                                       | Third Pair  |
|-----------------------------------|---|---|---|
| 1<br>Time<br>_____-_____<br>_____ | A<br>40 ( <b>435</b> )<br>vs<br>40 ( <b>216</b> ) | B<br>40 ( <b>264</b> )<br>vs<br>72 ( <b>358</b> ) | C<br>40 ( <b>863</b> )<br>vs<br>95 ( <b>592</b> ) |
| 2<br>Time<br>_____-_____<br>_____ | B<br>40 ( <b>264</b> )<br>vs<br>72 ( <b>358</b> ) | A<br>40 ( <b>435</b> )<br>vs<br>40 ( <b>216</b> ) | C<br>40 ( <b>863</b> )<br>vs<br>95 ( <b>592</b> ) |
| 3<br>Time<br>_____-_____<br>_____ | B<br>40 ( <b>264</b> )<br>vs<br>72 ( <b>358</b> ) | C<br>40 ( <b>863</b> )<br>vs<br>95 ( <b>592</b> ) | A<br>40 ( <b>435</b> )<br>vs<br>40 ( <b>216</b> ) |
| 4<br>Time<br>_____-_____<br>_____ | C<br>40 ( <b>863</b> )<br>vs<br>95 ( <b>592</b> ) | A<br>40 ( <b>435</b> )<br>vs<br>40 ( <b>216</b> ) | B<br>40 ( <b>264</b> )<br>vs<br>72 ( <b>358</b> ) |

**Preparation Instructions:** Warm in convection oven at 150° for 10-15 minutes (hold maximum of 30 minutes in oven).

**Sample Holding:** If the sample needs to be warmed, leave in oven until opened and serve immediately. Discard after 5 minutes of opening if unused. Discard after 30 minutes of total warming if unused. The temperature of samples should be similar to avoid temperature bias.

**Serving Size:** This will be at the sensory analysis discretion.

**Special Instructions:** This will be determined per product.

**Total Quantities Needed for Test:** Dependent on the serving sizes and how many sessions.

**Total Panelists Scheduled for Testing:** A minimum of 30 panelists is recommended.

Samples Prepared By: \_\_\_\_\_

Samples Served By: \_\_\_\_\_

Administrator Comments:

\*\*\*Instructions will vary between products.

## Appendix B-2: Sample worksheet for natural form and intermediate moisture products

Difference-from-Control Panel

Product: \_\_\_\_\_

Date Tested: \_\_\_\_\_

### Presentation Order:

### Test:

Pair A = Sample 435(40°F, 1 month) and Sample 216 (40°F, 1 month)

Pair B = Sample 264 (40°F, 1 month) and Sample 358 (72°F, 1 month)

Pair C = Sample 863 (40°F, 1 month) and Sample 592 (95°F, 1 month)

| Session                           | First Pair  | Second Pair                                       | Third Pair  |
|-----------------------------------|---|---|---|
| 1<br>Time<br>_____-_____<br>_____ | A<br>40 ( <b>435</b> )<br>vs<br>40 ( <b>216</b> ) | B<br>40 ( <b>264</b> )<br>vs<br>72 ( <b>358</b> ) | C<br>40 ( <b>863</b> )<br>vs<br>95 ( <b>592</b> ) |
| 2<br>Time<br>_____-_____<br>_____ | B<br>40 ( <b>264</b> )<br>vs<br>72 ( <b>358</b> ) | A<br>40 ( <b>435</b> )<br>vs<br>40 ( <b>216</b> ) | C<br>40 ( <b>863</b> )<br>vs<br>95 ( <b>592</b> ) |
| 3<br>Time<br>_____-_____<br>_____ | B<br>40 ( <b>264</b> )<br>vs<br>72 ( <b>358</b> ) | C<br>40 ( <b>863</b> )<br>vs<br>95 ( <b>592</b> ) | A<br>40 ( <b>435</b> )<br>vs<br>40 ( <b>216</b> ) |
| 4<br>Time<br>_____-_____<br>_____ | C<br>40 ( <b>863</b> )<br>vs<br>95 ( <b>592</b> ) | A<br>40 ( <b>435</b> )<br>vs<br>40 ( <b>216</b> ) | B<br>40 ( <b>264</b> )<br>vs<br>72 ( <b>358</b> ) |

**Preparation Instructions:** There is no preparation needed for these items.

**Sample Holding:** Discard after 5 minutes of opening if unused. The temperature of samples should be similar to avoid temperature bias.

**Serving Size:** This will be at the sensory analysis discretion.

**Special Instructions:** This will be determined per item.

**Total Quantities Needed for Test:** Dependent on the serving sizes and how many sessions.

**Total Panelists Scheduled for Testing:** A minimum of 30 panelists is recommended.

Samples Prepared By: \_\_\_\_\_

Samples Served By: \_\_\_\_\_

Administrator comments:

\*\*\*Instructions will vary between products.

### Appendix B-3: Sample worksheet for freeze-dried products

Difference-from-Control Panel  
 Product: \_\_\_\_\_  
 Date Tested: \_\_\_\_\_

#### Presentation Order:

#### Test:

Pair A = Sample 435(40°F, 1 month) and Sample 216 (40°F, 1 month)

Pair B = Sample 264 (40°F, 1 month) and Sample 358 (72°F, 1 month)

Pair C = Sample 863 (40°F, 1 month) and Sample 592 (95°F, 1 month)

| Session                           | First Pair  | Second Pair                                       | Third Pair  |
|-----------------------------------|---|---|---|
| 1<br>Time<br>_____-_____<br>_____ | A<br>40 ( <b>435</b> )<br>vs<br>40 ( <b>216</b> ) | B<br>40 ( <b>264</b> )<br>vs<br>72 ( <b>358</b> ) | C<br>40 ( <b>863</b> )<br>vs<br>95 ( <b>592</b> ) |
| 2<br>Time<br>_____-_____<br>_____ | B<br>40 ( <b>264</b> )<br>vs<br>72 ( <b>358</b> ) | A<br>40 ( <b>435</b> )<br>vs<br>40 ( <b>216</b> ) | C<br>40 ( <b>863</b> )<br>vs<br>95 ( <b>592</b> ) |
| 3<br>Time<br>_____-_____<br>_____ | B<br>40 ( <b>264</b> )<br>vs<br>72 ( <b>358</b> ) | C<br>40 ( <b>863</b> )<br>vs<br>95 ( <b>592</b> ) | A<br>40 ( <b>435</b> )<br>vs<br>40 ( <b>216</b> ) |
| 4<br>Time<br>_____-_____<br>_____ | C<br>40 ( <b>863</b> )<br>vs<br>95 ( <b>592</b> ) | A<br>40 ( <b>435</b> )<br>vs<br>40 ( <b>216</b> ) | B<br>40 ( <b>264</b> )<br>vs<br>72 ( <b>358</b> ) |

**Preparation Instructions:** Re-hydrate product per the instructions on the package. Re-hydrate with standardized amount of water. Warm, if needed, in convection oven at 150°F for 10-15 minutes (hold maximum of 30 minutes in oven).

**Sample Holding:** If the sample needs to be warmed, leave in oven until opened and serve immediately. Discard after 5 minutes of opening if unused. Discard after 30 minutes of total warming if unused. The temperature of samples should be similar to avoid temperature bias.

**Serving Size:** This will be at the sensory analysis discretion.

**Special Instructions:** Be sure that the pouch is fully hydrated before serving.

**Total Quantities Needed for Test:** Dependent on the serving sizes and how many sessions.

**Total Panelists Scheduled for Testing:** A minimum of 30 panelists is recommended.

Samples Prepared By: \_\_\_\_\_

Samples Served By: \_\_\_\_\_

Administrator comments:

\*\*\*Instructions will vary between products.

**Appendix B-4: Sample difference-from-control ballot**

**Date:**

**Panelist #** \_\_\_\_\_

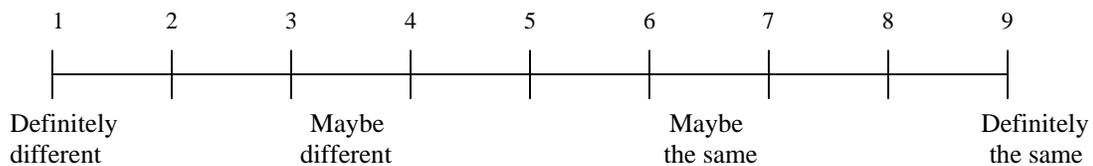
**Sample 435 vs. Sample 216**

1. Please cleanse your palate by **eating cracker and drinking some water** before tasting **each** sample.
2. Taste **sample 435 first** and **then sample 216**. Rate how similar 435 is to 216 by circling the point the scale represents your response to the following attributes. Re-taste the samples if necessary while evaluating the attributes.
3. Evaluate attributes in the **order** that they appear on the ballot.
4. Indicate **additional comments** at the end of the ballot.

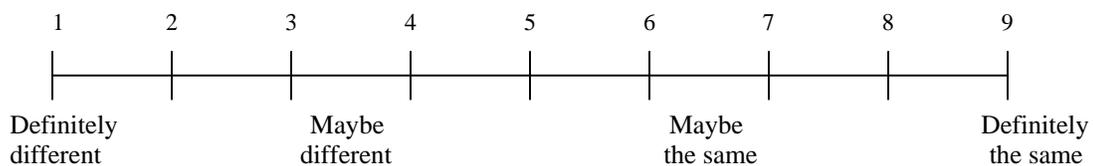
**PRODUCT CONCEPT: GRILLED PORK CHOPS**

**Questions:**

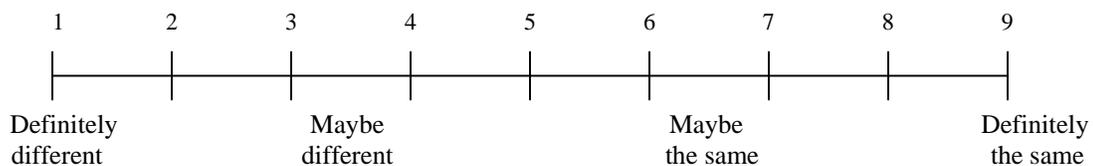
1. Is the **overall acceptability** of sample 435 a match to sample 216?



2. Is the **appearance** of sample 435 a match to sample 216?



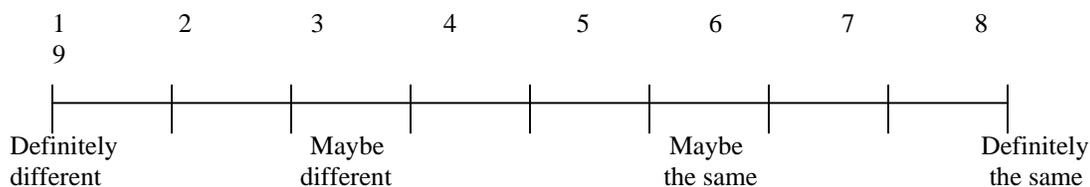
3. Is the **color** of sample 435 a match to sample 216?



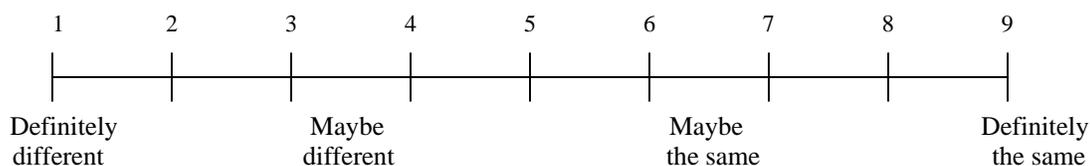
**Please continue to the next page.**

### Sample 435 vs. Sample 216

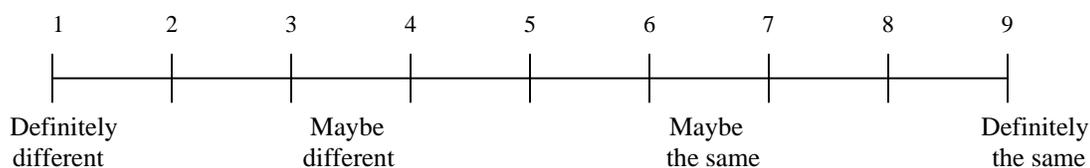
4. Is the **aroma** of sample 435 a match to sample 216?



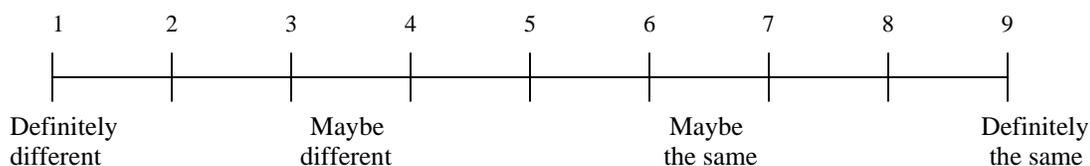
5. Is the **flavor** of sample 435 a match to sample 216?



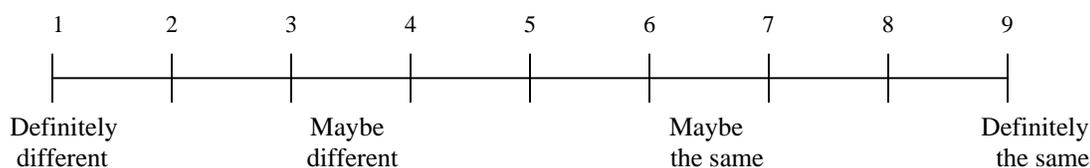
6. Is the **level of saltiness** for sample 435 a match to sample 216?



7. Is the **texture** of sample 435 a match to sample 216?



8. Is the **aftertaste** of sample 435 a match to sample 216?



**Comments:**

**Appendix B-5: Sample acceptability sensory ballot**

**Date:**

**Panelist # :** \_\_\_\_\_

**Sample 169**

**Please rinse with water and crackers before tasting this product.**

**Product Concept: Bread Pudding**

**Questions:**

**How often have you consumed bread pudding in the past year?**

- 1x or more/ week
- 1x/ 2 weeks
- 1x/ month
- 1x/ 3 months
- 1x/ 6 months
- > 6 months
- Not at all

**Please taste the product.**

**Considering ALL characteristics (APPEARANCE, FLAVOR, and TEXTURE), circle the description that corresponds to your overall opinion of this product**

|                      |                         |                       |                     |                                |                  |                    |                      |                   |
|----------------------|-------------------------|-----------------------|---------------------|--------------------------------|------------------|--------------------|----------------------|-------------------|
| Dislike<br>Extremely | Dislike<br>Very<br>Much | Dislike<br>Moderately | Dislike<br>Slightly | Neither<br>Like nor<br>Dislike | Like<br>Slightly | Like<br>Moderately | Like<br>Very<br>Much | Like<br>Extremely |
|----------------------|-------------------------|-----------------------|---------------------|--------------------------------|------------------|--------------------|----------------------|-------------------|

**Overall Appearance**

|                      |                         |                       |                     |                                |                  |                    |                      |                   |
|----------------------|-------------------------|-----------------------|---------------------|--------------------------------|------------------|--------------------|----------------------|-------------------|
| Dislike<br>Extremely | Dislike<br>Very<br>Much | Dislike<br>Moderately | Dislike<br>Slightly | Neither<br>Like nor<br>Dislike | Like<br>Slightly | Like<br>Moderately | Like<br>Very<br>Much | Like<br>Extremely |
|----------------------|-------------------------|-----------------------|---------------------|--------------------------------|------------------|--------------------|----------------------|-------------------|

**Overall Color**

|                |                            |                                    |                             |                 |
|----------------|----------------------------|------------------------------------|-----------------------------|-----------------|
| Too Dark/Brown | Slightly<br>Too Dark/Brown | Just About Right<br>(Golden Brown) | Slightly<br>Too Pale/Yellow | Too Pale/Yellow |
|----------------|----------------------------|------------------------------------|-----------------------------|-----------------|

**Overall Aroma**

|                      |                         |                       |                     |                                |                  |                    |                      |                   |
|----------------------|-------------------------|-----------------------|---------------------|--------------------------------|------------------|--------------------|----------------------|-------------------|
| Dislike<br>Extremely | Dislike<br>Very<br>Much | Dislike<br>Moderately | Dislike<br>Slightly | Neither<br>Like nor<br>Dislike | Like<br>Slightly | Like<br>Moderately | Like<br>Very<br>Much | Like<br>Extremely |
|----------------------|-------------------------|-----------------------|---------------------|--------------------------------|------------------|--------------------|----------------------|-------------------|

### Sample 169

Please retaste the product and indicate how much you **LIKE** or **DISLIKE** the following:

#### Overall Flavor

|                      |                         |                       |                     |                                |                  |                    |                      |                   |
|----------------------|-------------------------|-----------------------|---------------------|--------------------------------|------------------|--------------------|----------------------|-------------------|
| Dislike<br>Extremely | Dislike<br>Very<br>Much | Dislike<br>Moderately | Dislike<br>Slightly | Neither<br>Like nor<br>Dislike | Like<br>Slightly | Like<br>Moderately | Like<br>Very<br>Much | Like<br>Extremely |
|----------------------|-------------------------|-----------------------|---------------------|--------------------------------|------------------|--------------------|----------------------|-------------------|

How would you describe the sweetness level?

Not Sweet Enough    Slightly Sweet    Just About Right    Slightly Too Sweet    Too Sweet

How would you describe the level of vanilla flavor?

Too Little    Slightly Too Little    Just About Right    Slightly Too Strong    Too Strong

#### Overall Texture

|                      |                         |                       |                     |                                |                  |                    |                      |                   |
|----------------------|-------------------------|-----------------------|---------------------|--------------------------------|------------------|--------------------|----------------------|-------------------|
| Dislike<br>Extremely | Dislike<br>Very<br>Much | Dislike<br>Moderately | Dislike<br>Slightly | Neither<br>Like nor<br>Dislike | Like<br>Slightly | Like<br>Moderately | Like<br>Very<br>Much | Like<br>Extremely |
|----------------------|-------------------------|-----------------------|---------------------|--------------------------------|------------------|--------------------|----------------------|-------------------|

#### Texture of Bread

Too Dry/Firm    Slightly  
Too Dry/Firm    Just About Right    Slightly  
Too Wet/Soggy    Too Wet/Soggy

#### Overall Aftertaste

|                      |                         |                       |                     |                                |                  |                    |                      |                   |
|----------------------|-------------------------|-----------------------|---------------------|--------------------------------|------------------|--------------------|----------------------|-------------------|
| Dislike<br>Extremely | Dislike<br>Very<br>Much | Dislike<br>Moderately | Dislike<br>Slightly | Neither<br>Like nor<br>Dislike | Like<br>Slightly | Like<br>Moderately | Like<br>Very<br>Much | Like<br>Extremely |
|----------------------|-------------------------|-----------------------|---------------------|--------------------------------|------------------|--------------------|----------------------|-------------------|

How well does this product meet your expectations for **Bread Pudding?** (*circle only one*)

Not at all    Slightly    Moderately    Very Much    Extremely

**Comments:**