Space Food Development
SFSL Internship Presentation
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What is the Space Food Systems Lab (SFSL)?

**Mission Statement:**

To provide high-quality flight food that meets the needs of the crew, mission and the unique logistics of space travel.
Space Food Systems Lab (SFSL)

Organization

**AFT: Advanced Food Technology Group**

* Develop technologies to support **future** missions
  * Improved packaging & shelf life extension
  * Product development for nutritional efficiency
    * Mass reduction
    * Expand processing capabilities

**ISS: International Space Station Support Group**

* Support **current** missions
  * Food Production and packaging
  * Product development & sensory evaluation
  * Menu planning & supply management
Internship Outline

• 10 Week Internship to support the SFSL

ISS:
• Develop a versatile dairy sauce as a base for dairy-based freeze dried food applications
  • The complex must rehydrate easily in warm water and result in a creamy mouth feel
  • Final demonstration of the complex should be performed in at least 2 freeze dried products

AFT:
• Conduct a literature review on the bioavailability of Vitamin A, K, B5, B6, B7, B9, B12, Potassium, Selenium, Zinc, Manganese, Copper, Iron
  • Review current scientific literature on bioavailability of nutrients and how they are affected by form, ingredient interactions and processing conditions
  • Characterize the conditions that reduce or improve bioavailability of nutrients for future food development
ISS Project Background

• A reformulation to reduce sodium has led to rehydration issues with cream of mushroom soup
• The cream base of the beef stroganoff had room for improvement
• Dairy based sauces are missing from the current menu
Unique Requirements for Space Food

• **Nutritional Demands**
  - Caloric density to support active astronauts
  - Low sodium to prevent ocular issues from zero gravity habitation
  - A balanced and varied diet to support performance and health

• **Shelf life**
  - Shelf stable
  - Must have extended shelf life
  - Meet microbial limits for launch

• **Ingredient Availability**
  - Be able to be sourced constantly
  - Production scale limitation

• **Flavor and Functionality**
  - Reduced flavor perception
  - Functionality in micro gravity
  - Provided in single servings
Development Strategy

• Approached dairy base as a Roux/ Béchamel
  • Starch + Dairy

• Focused initially on commercial ingredients then widened to industrial ingredients

• Ingredient interactions were also screened based on literature review learnings
  • Impact of protein
  • Impact of form: solid brick vs powdered
  • Impact of hydrocolloids and dispersants
25 starches were screened within 4 trials

- Addition of protein did not improve hydratability
- Pulverization did not improve hydratability enough to offset added complexity and risk
- Of store purchased starches, tapioca is the best for this application although industrial starches are more robust and provided better texture
- The recommended option is an industrial modified starch + maltodextrin
Formula Development

• Incorporated the dairy base into 3 freeze dried meals
  • Cream of Mushroom Soup
  • Beef Stroganoff
  • Angel Hair Alfredo
Formula Development

- Participated in Food Sessions, Bonus Sessions and Debriefs
  - Flavor and texture profile of current ISS menu
  - Hydration and serving constraints of zero gravity
  - Flavor profiles that the astronauts like
  - Opportunities to improve perceived flavor within low sodium items (spice/pepper/garlic)

https://twitter.com/Astro_Sabot
Cream of Mushroom Soup Development

**Goals**

- Increase flavor intensity without added sodium or replacers
  - Shift to a white pepper spice profile
  - Increase the mushroom intensity

- **Improve the texture**
  - Increase rehydratability of the base
  - Investigate modifications of both form and formulation
  - Look to increase the viscosity enough to allow it to be spoonable out of an EDO vs. sipped through a straw
Soup Viscosity
Increasing viscosity
Viscosity Data

- Spoonable Reform: 6.5
- Drinkable Reform: 16
- SFSL LS Reform: 24

Bostwick Data (cm in 30 sec)
Soup Summary

• Changed form from drinkable to spoonable
• Solved rehydration issues
• Created a more complex flavor profile
• Proof of process of developed dairy base in soup format
• Prepared formula for future sensory testing and scale up
Beef Stroganoff Development Goals

• Increase flavor intensity without added sodium
  • Shift to a more complex spice profile
  • Increase the dairy profile

• Improve the texture and satiety
  • Improve the creamy texture of the sauce
  • Proof of process of dairy base for multiple formulations
Sensory Results

• 35 gram sample hydrated w/ 75ml 150°F +/- 5 °F

  • Sensory score 6.03
  • SD 1.86
  • n=29
Panelist Feed Back

• **Cream Sauce**
  - Sauce texture and ratio was well received
  - Sour Cream Intensity seemed just about right – 66%
  - Creaminess seemed just about right – 79%

• **Seasoning**
  - Seasoning was well received
  - If changes are made increase intensity keeping similar profile
In Conclusion

• All project objectives were met for both ISS and AFT

• Cream of Mushroom Soup is currently scheduled for panel later this year
• Beef Stroganoff formula met requirements for flight
In Summary....

Thank you !!!
Questions?