Space Food Development

SFSL Internship Presentation
Johnson Space Center
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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

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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

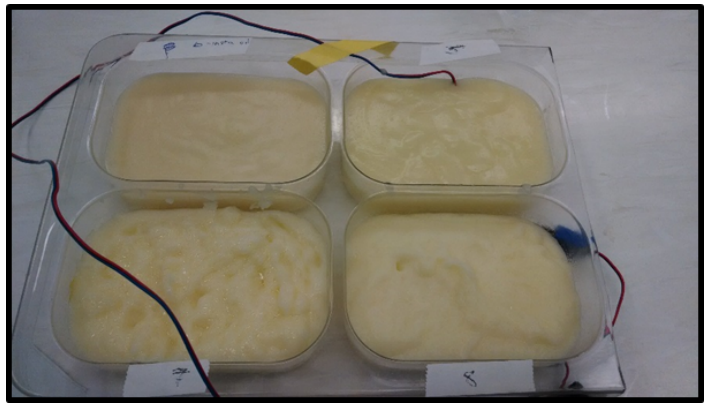
- A reformulation to reduce sodium has led to rehydration issues with cream of mushroom soup
- The cream base of the beef stroganoff had room for improvement
- Dairy based sauces are missing from the current menu

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

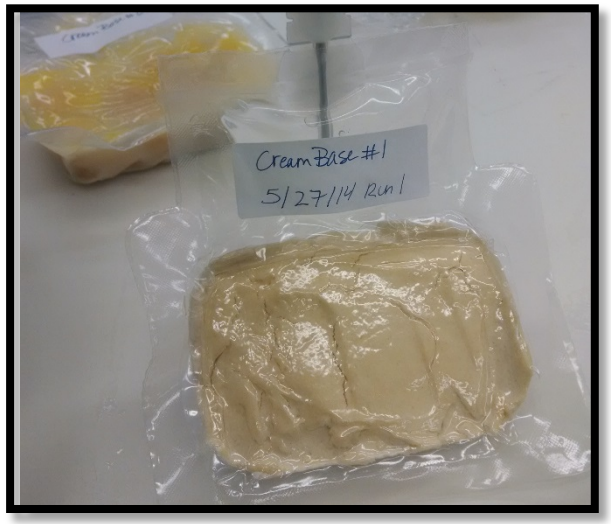
- **Approached dairy base as a Roux/ Béchamel**
  - Starch + Dairy
- **Focused initially on commercial ingredients then widened to industrial ingredients**
- **Ingredient interactions were also screened based on literature review learnings**
  - Impact of protein
  - Impact of form: solid brick vs powdered
  - Impact of hydrocolloids and dispersants



Starch Functionality: Overall Findings

➢ **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

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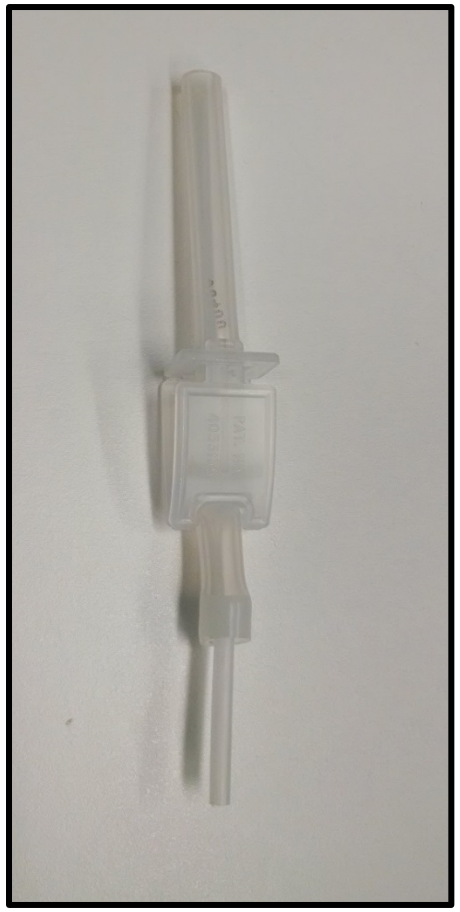

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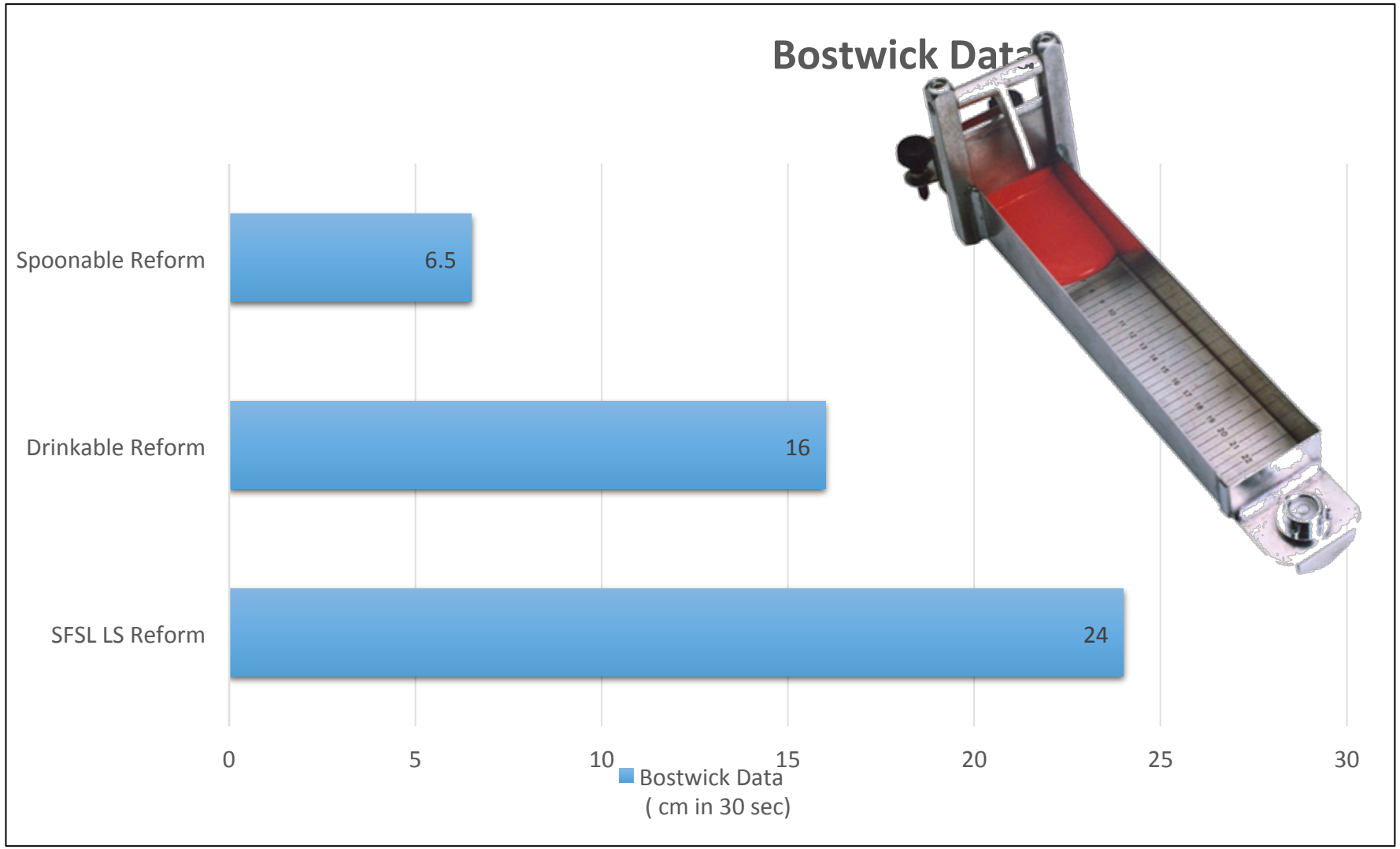
Increasing viscosity

Viscosity Data



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

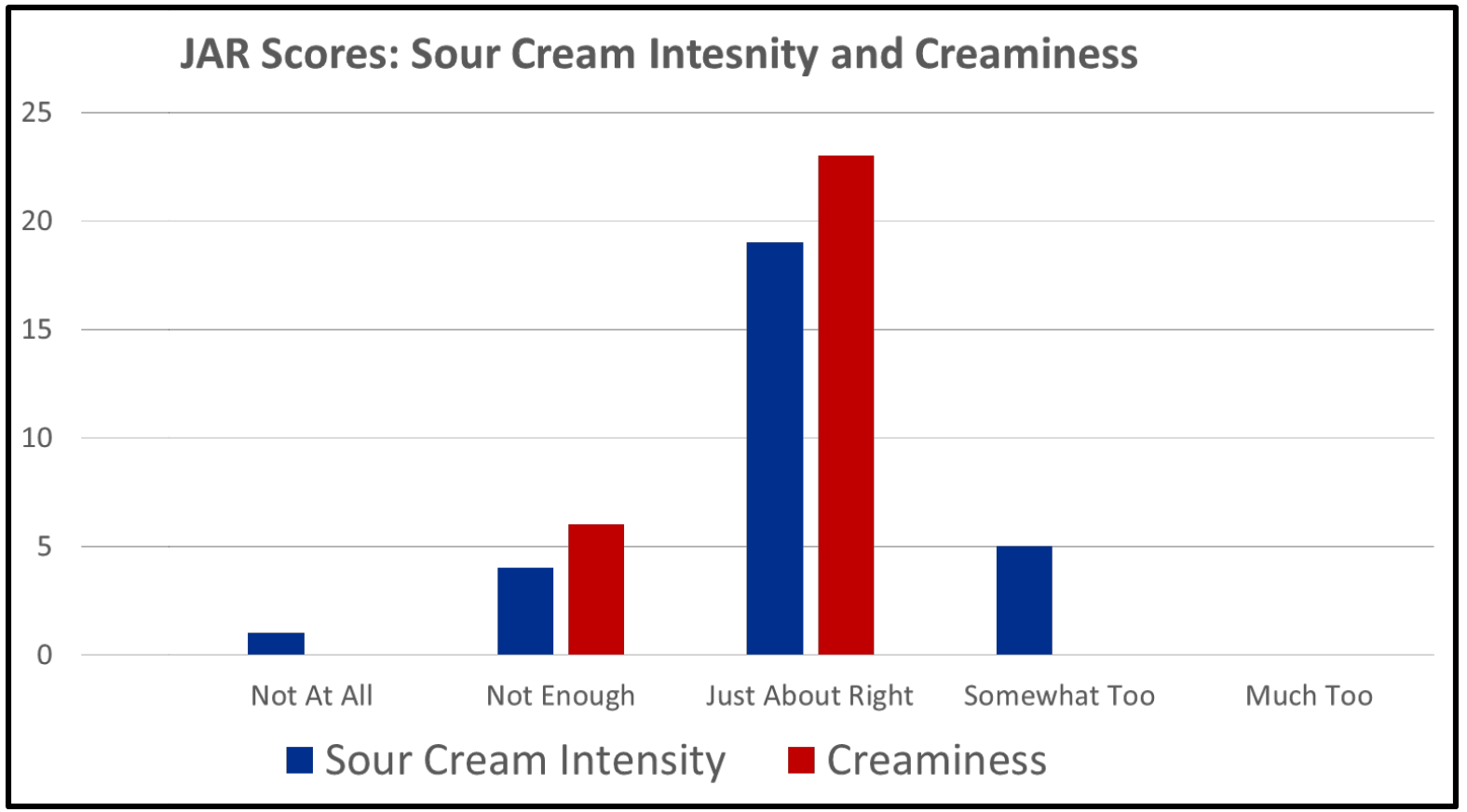
- **Improve the texture and satiety**
  - Improve the creamy texture of the sauce
  - Proof of process of dairy base for multiple formulations

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

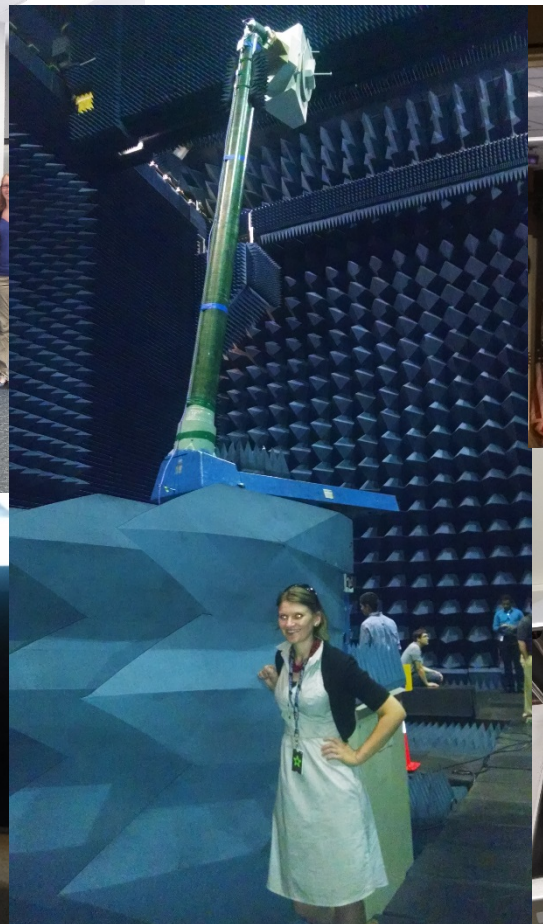


In Conclusion

- 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?