From Mercury to the ISS: A History of Food Safety at NASA

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ISS Food System Manager
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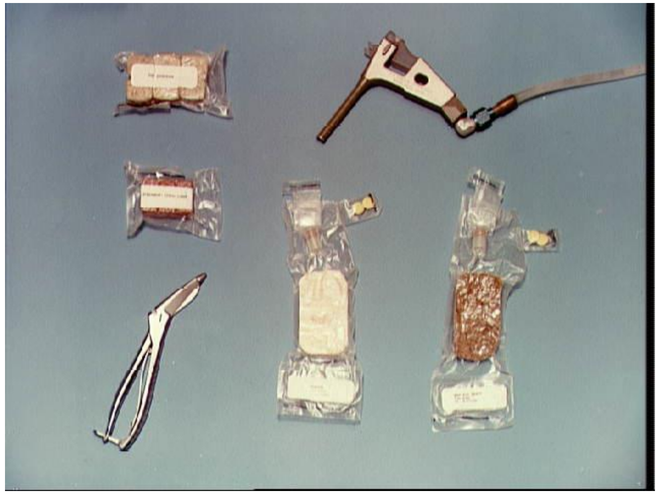
About Me

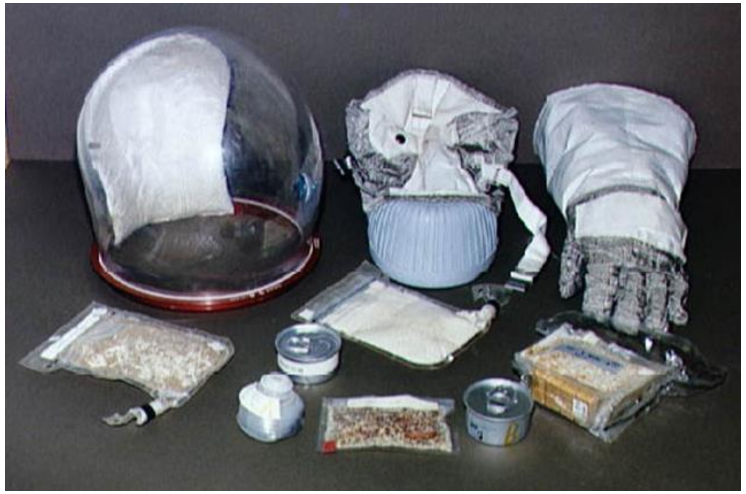
- Born in Auburn, Alabama
- BA, English from UNC Chapel Hill 2010
- Post-baccalaureate, Food Science from NC State 2014
- NASA Space Food Systems Laboratory Intern 2014 and 2016
- Ph.D., Food Science from University of California Davis 2018
- ISS Food System Manager since October 1, 2018

HAZARD ANALYSIS CRITICAL CONTROL POINT (HACCP) HISTORY HIGHLIGHTS

- Joint effort of NASA (Dr. Paul A. Lachance), Pillsbury (Howard E. Baumann) and U.S. Army Laboratories (Mary Klicka)
- Critical control point concept → engineering world
- HACCP implemented at Pillsbury in response to a food safety issue
- 1969: "Food Safety through the Hazard Analysis and Critical Control Point System"
- First applied in the canning industry
- Widely used in national and state regulations

Food Systems: Mercury to Apollo





MERCURY GEMINI APOLLO

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Early Space Food Design Parameters

- Availability of water
- Limited storage facilities
- Low volume
- Low residue
- Nutrition requirements
- Acceptability
- Cabin pressure
- Flammability concerns
- Spacecraft specifications
- Bathroom facilities

Cube Forming

- Dr. Malcolm Smith with cube press
- Whirlpool Corp. produced the majority of cubed foods

Micro Standards, old and new

Microbiological Requirements for Space Food Prototypes, 1971

- Total Aerobic Plate Count < 10,000/g
- Total Coliform Count < 10/g
- Fecal Coliform Count = negative in 1 gram
- Fecal Streptococci < 20/g
- Coagulase + Staphylococci = negative in 5 grams
- Salmonellae = negative in 10 grams

Current Microbiological Requirements for the ISS

- Total Aerobic Plate Count < 20,000 CFUs/g
- Enterobacteriaceae < 100 CFUs/g
- Salmonella = rejection if positive
- Yeast and Mold < 1000/g

Food Systems: Skylab to early International Space Station

SKYLAB

SHUTTLE

INTERNATIONAL SPACE STATION

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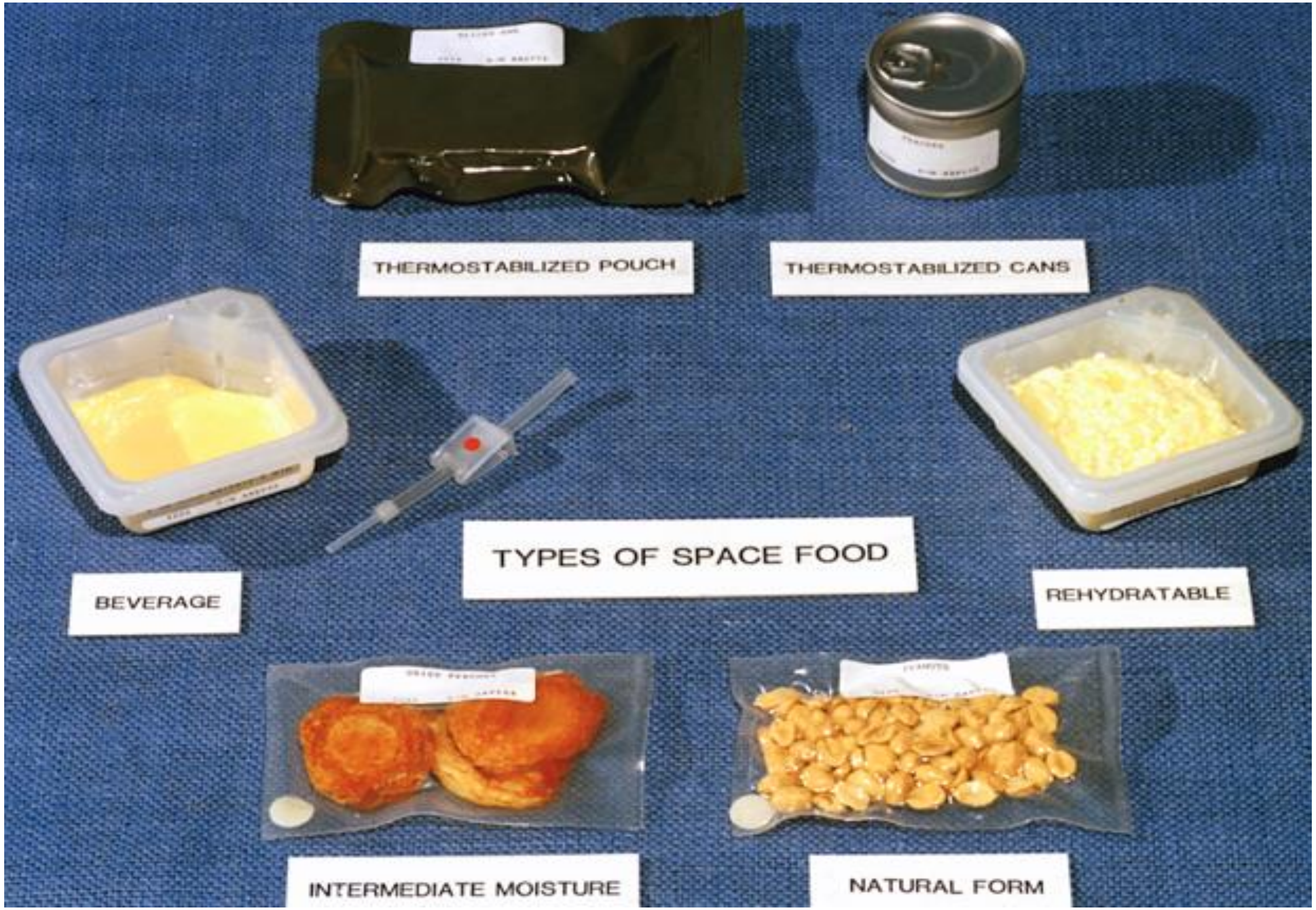
Shuttle Food 1981 - 1990



Shuttle Food 1990 - 2011

International Space Station 2000-2008

- 130 options, 6 month missions
- 10 day repeating menu, USOS and Russian crewmembers shared food by design
- Resupply delays = preference menus did not coincide with crewmembers on-orbit

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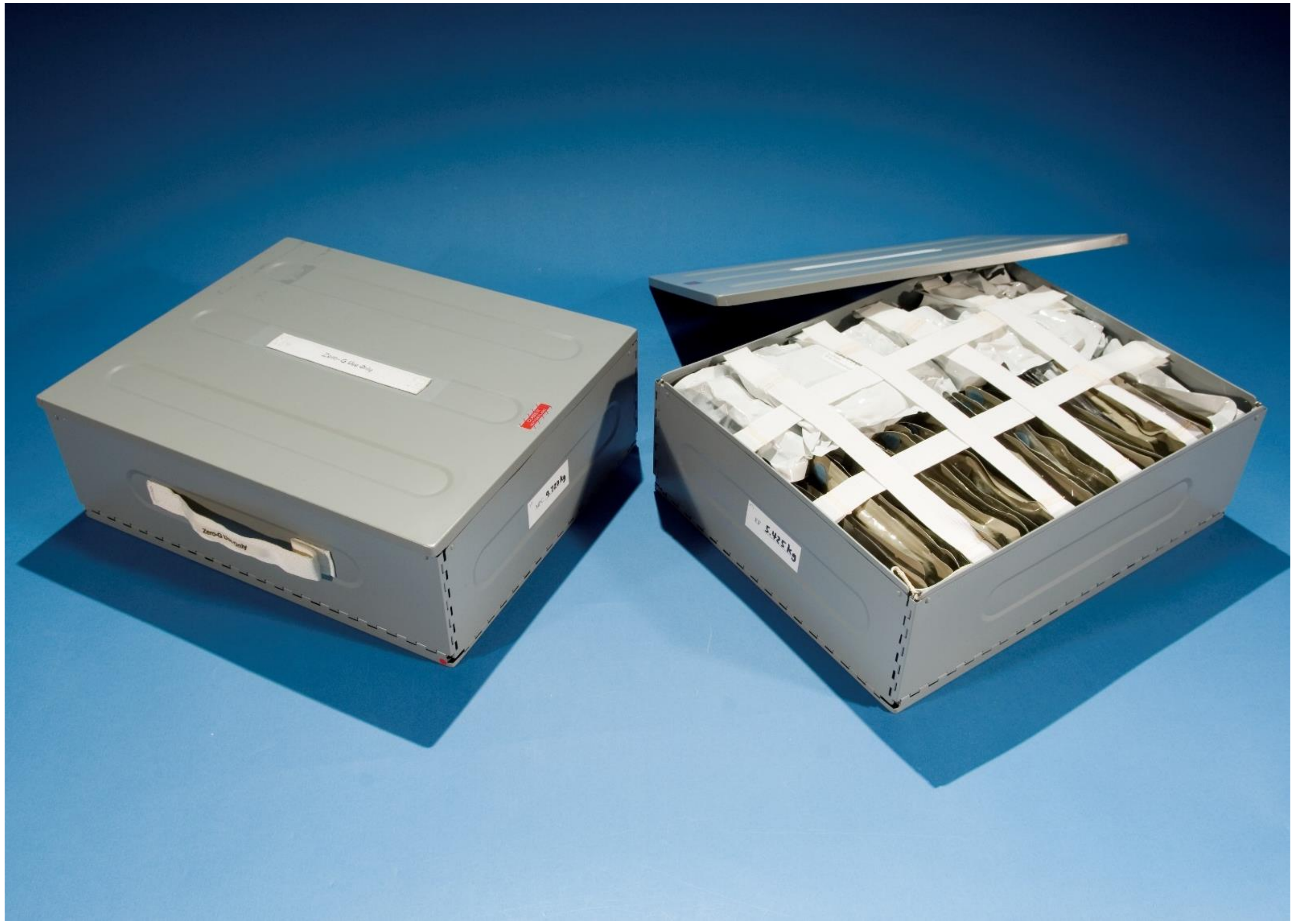
Flight Food Containers



International Space Station 2008-Current

<u>200 options in 8 Standard Menu Categories</u>

1. Breakfast
2. Rehydratable Meats
3. Meat and Fish
4. Side Dishes
5. Vegetables and Soups
6. Fruits and Nuts
7. Desserts and Snacks
8. Beverages

Bulk Overwrap Bag (BOB)

A set of 8 BOBS (one per menu category) will feed a crew of 3 for 7-9 days

Limited crew specific food, fresh food, condiments

No food refrigeration available on ISS

Shelf life of 1-3 years under room temperature storage

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To A/L
EXIT
EMERGENCY USE
FIRE PORT
STATE HISTORY MUSEUM
Empty Food
Container
Pantry


MA16J
Columbia
STS-58

Our Facilities

- Space Food Systems Laboratory
- Space Food Research Facility

What We Do

- Produce and package flight food products which are stowed in Bulk Overwrap Bags (BOBs) for delivery to the International Space Station (ISS)
- Maintain an inventory of flight food items for on-ground experiments, training activities, and education/outreach
- Conduct research activities supporting the development of food systems for the next generation of deep space exploration vehicles and planetary habitations → Lunar base/Mars base

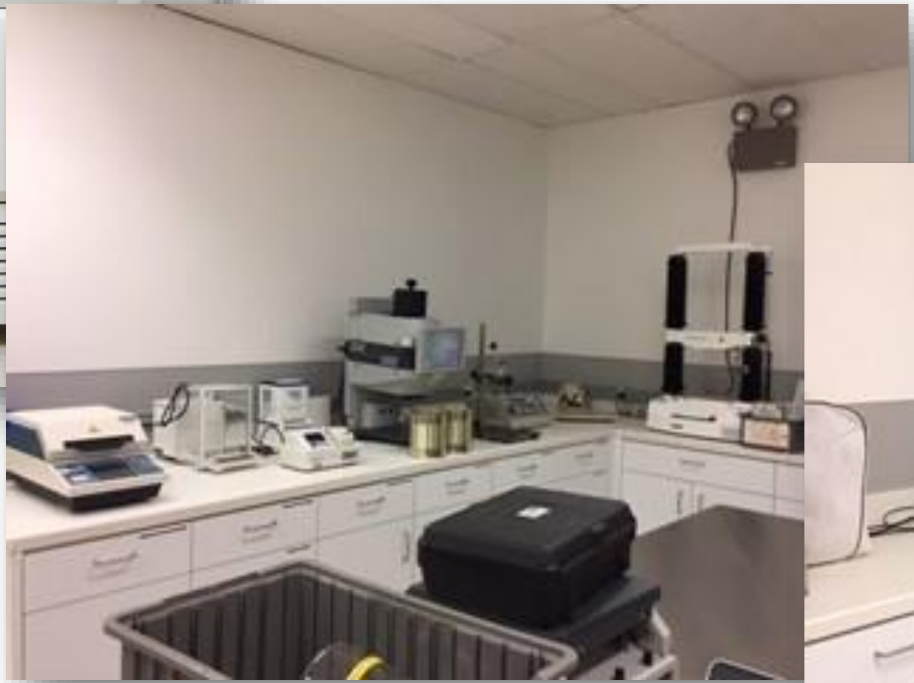
Processing at Space Food Systems Lab

Processing at Space Food Research Facility

Packaging

Controlled Storage

Testing



Flight Food Inventory

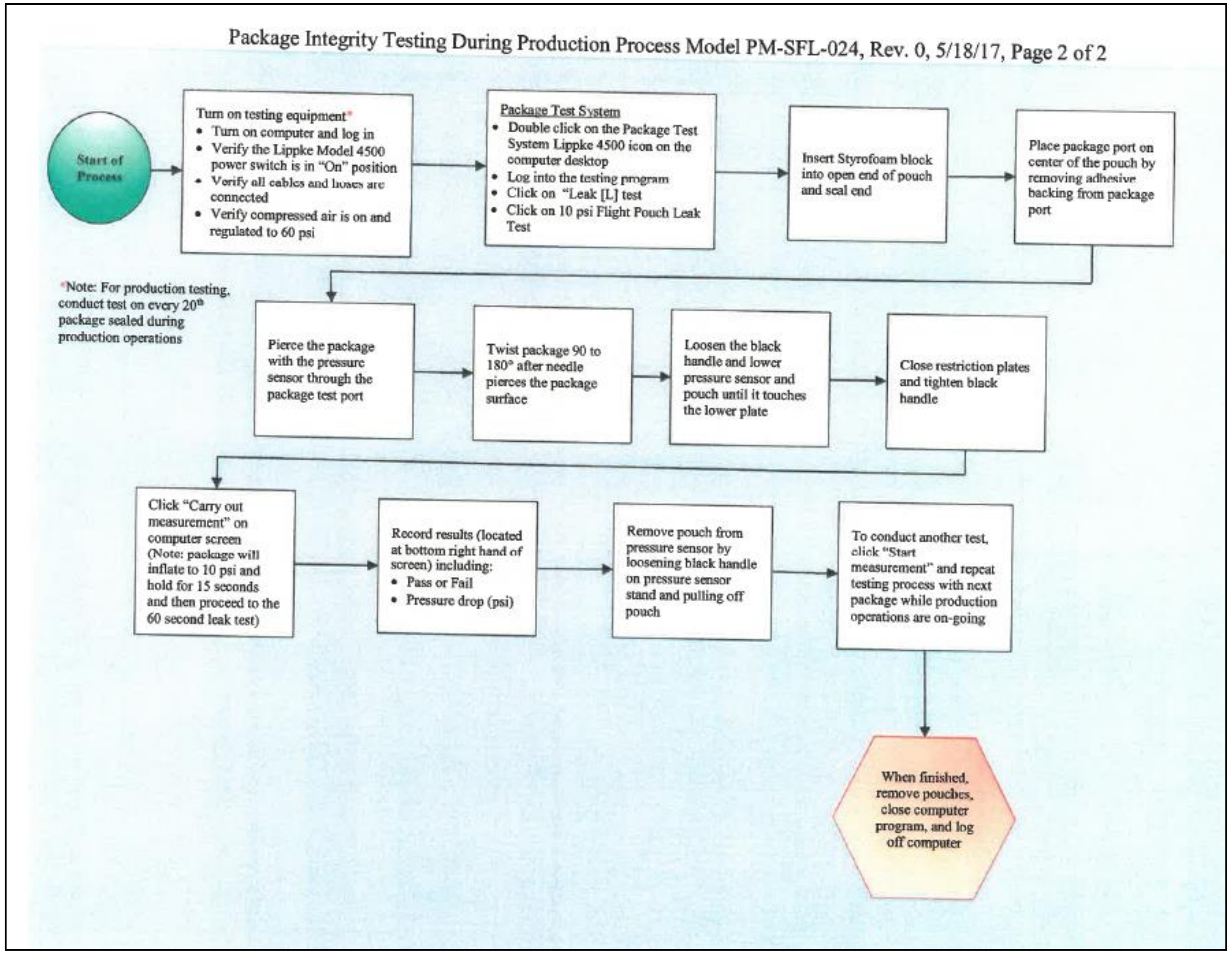
Fresh Food Containers

Sensory Booths

Quality Assurance

- Document Management
  - Standard Operating Procedures Manual
  - Work Instructions
  - Process Models
  - Specifications
- Physical Analysis
  - Micro testing – environmental and product
  - Sensory testing
  - Physical properties – pH, moisture, ^{o}Brix, Aw, viscosity
- HACCP
  - TPS
  - 911 tags
  - Independent Quality Auditor

Document Management



SS-F-0292

Food Manufacturing Specification Butternut Squash

Revision: B

December 2017

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

Hazard Analysis Critical Control Point (HACCP)

TASK PERFORMANCE SHEET

PROJECT	JPIC	SUB JPIC	RESP ORG	PERF ORG	PREFIX	DOCUMENT NUMBER
SA-FD	N/A	N/A	SF		93	18-TPS-00031997

SHORT TITLE
Process MEXICAN SCRAMBLED EGGS for use in the ISS Flight Food Inventory.

ITEM	OPERATION	BUY OFF
44.00	At clean bench, remove 5 RANDOM samples for microbiological testing from 5 RANDOM trays. (Note: 1 piece =~ 28.6 grams): MICROBIOLOGICAL= 5 SERVINGS	TECH WD 3-7-18
	The oxygen scavengers shall be exposed to air for as brief a period of time as possible (not more than 2 hours) to help maintain their efficacy.	
45.00	Place two (2) oxygen scavengers inside each can on top of the product.	TECH DC 3-7-18
	INTERIM 10 BLOCKS OF PRODUCT IN EACH CAN. This is to assure QTY for packaging is met. Last can may have less.	
46.00	THIS STEP HAS MIPS WHICH MAY BE ON NEXT PAGE Immediately interim package (can) the remaining product per FPS-153 REV F, Standard for Interim Packaging of Aerospace Food (Raw Material Foods).	TECH WD 3-7-18
MIP	QA to verify 10 each are in each can is correct. One can will have less	QAR MIP-V SAIC 155 3/15/18
	Seq. Nos. 47.00-51.00 can be worked out of order to allow samples to be transferred to the Microbiological Laboratory for testing.	
47.00	Hold packages (cans) for a minimum of 48 hours on the wire rack in Building 17, Room 1025AB prior to testing:	TECH WD 3-7-18

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TPS

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JSC PROJECT PARTS TAG

1. PART NUMBER	2. S/N / LOT NUMBER
SEG48102124-975	FR75-02A

3. PART NAME	4. S/L EXP.	5. U/I
Butternut Squash	3/19/19	EA

6. UNIT PRICE	7. QTY. REC.
	78

8. ACQ. DOCUMENT #	9. PROJECT CODE
18-TPS-00037762	SA-FD

10. QUALITY CLASS	11 ADP	12. INSPECT	13. DATE
I	Y N		9/25/18

14. MANUFACTURER	15. SUPPLIER
	SFSL

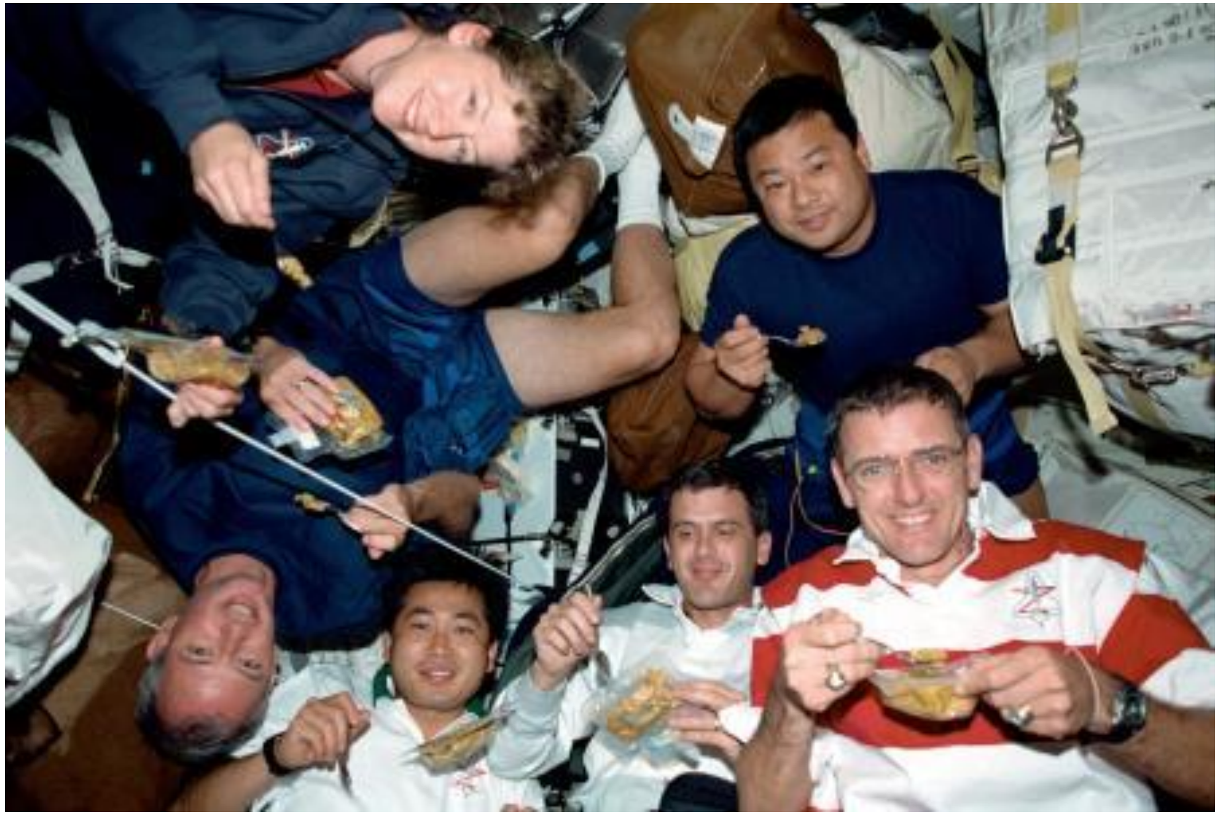
16. TRANSACTION DOCUMENT#	QTY. / BAL.	DATE	STAMP
Issue 18-TPS-00037762	24 / 54	9/25/18	RB
SORT 18-TPS-00038488	6 / 48	9/27/18	KA
Return to inv 18-TPS-00038488	2 / 50	10/2/18	KA

JSC Form 911 (Rev July 9, 2007)
(Informed September 2000)

INFO TRANS YES NO
PAGE 1

ISS Food System Key Points

- Establish Safety
- Stabilize Nutrition and Acceptability
- Ensure Variety
- Reduce Resource Use
- **Promote Human Health and Performance**



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SPACE FOOD

SYSTEMS LABORATORY

NASA-JSC