

General Disclaimer

One or more of the Following Statements may affect this Document

- This document has been reproduced from the best copy furnished by the organizational source. It is being released in the interest of making available as much information as possible.
- This document may contain data, which exceeds the sheet parameters. It was furnished in this condition by the organizational source and is the best copy available.
- This document may contain tone-on-tone or color graphs, charts and/or pictures, which have been reproduced in black and white.
- This document is paginated as submitted by the original source.
- Portions of this document are not fully legible due to the historical nature of some of the material. However, it is the best reproduction available from the original submission.

FINAL REPORT

January 5, 1970 to April 30, 1971

DEVELOPMENT OF COMPRESSED NON-SWEET, FLAVORED
SNACK FOODS TO BE USED IN THE
APOLLO FOOD SYSTEM

TASK No. 10

Contract NAS 9-9032

FACILITY FORM 602

N71-25001	
(ACCESSION NUMBER)	(THRU)
17	Q3
(PAGES)	(CODE)
CR-114996	C5
(NASA CR OR TMX OR AD NUMBER)	(CATEGORY)

Submitted to: NASA Manned Spacecraft Center
2101 NASA Boulevard
Houston, Texas 77058

Submitted by: Whirlpool Corporation
Life Support Systems Group
300 Broad Street
St. Joseph, Michigan 49085



Prepared by:

For Robert W. Larson (2125)

Robert W. Larson, Ph.D.
Senior Research Food Scientist

Approved by:

Norman G. Roth

Norman G. Roth, Ph.D., Director
Life Support Systems Group

FINAL REPORT
DEVELOPMENT OF COMPRESSED NON-SWEET, FLAVORED
SNACK FOODS TO BE USED IN THE
APOLLO FOOD SYSTEM

Contract NAS 9-9032

Task No. 10

January 5, 1970 to April 30, 1971

ABSTRACT

The purpose of this task was to develop at least two new non-sweet, flavored snack food items for use in the Apollo Food System. Formulation for the new cube items were initially based on the cheese cracker formulation. Four flavored cube formulations were developed that passed taste tests after storage for 3 hours at $135 \pm 5^{\circ}\text{F.}$ and four weeks storage at $100^{\circ} \pm 5^{\circ}\text{F.}$ A Production Guide for these cubes has been prepared. Thirty servings of each of the new flavor snack items have been submitted to NASA for evaluation.

OBJECTIVE

The objective of this task was to develop at least two (2) new non-sweet, flavored snack food items for use in the Apollo Food System. Suggested flavors were parmesan, blue cheese, bacon, chicken, ham and swiss, and barbecue. The products developed were to be stable for three hours at $135^{\circ} \pm 5^{\circ}\text{F.}$ and for four weeks at $100^{\circ} \pm 5^{\circ}\text{F.}$ The products shall comply with Apollo Food, Quality Assurance Provisions and Microbiological Requirements. Thirty packages each containing four cubes of each of the developed food items were to be shipped to NASA for its evaluation.

APPROACH

The first step in the development of the new food items were to select

CR-114996

APPROACH (Continued)

the flavor types for formulation development. The cheese cracker cube formulation was used as the basis for the development of the new flavor snack cubes. Small batches of each trial formulation were prepared and compressed on the laboratory single cavity cube press. The cubes were coated, then freeze dried. After drying, the various cube formulations were evaluated for flavor, texture and appearance. Improvements and adjustments were made, if needed, in the formulations in order to achieve acceptable products. After acceptable formulations were developed, larger batches of each type of cube were made and part of each type of cube was vacuum packed in aluminum foil laminated plastic pouches. A part of each packaged batch was stored for three hours at $135^{\circ} \pm 5^{\circ}\text{F.}$ and a part was stored for four weeks at $100^{\circ} \pm 5^{\circ}\text{F.}$ After storage, each candidate flavored cube was tasted by four judges to determine if the product had undergone any appreciable change during storage. The unatored product (control) was tasted at the same time as the stored samples and was used for comparison. Tasters rated the quality of the product and noted if there were any differences between the two.

Samples of each type of flavored cube item were also evaluated to determine if they complied with the requirements of Addendum No. 1, Microbiological Requirements for Space Food Prototypes and Addendum No. 2, The Quality Assurance Provision of Space Food Prototypes.

RESULTS

Eight flavors of cubes were selected for formulation development: Pizza, chicken, barbecue, bacon, ham and swiss, parmesan and blue cheese. Initial formulations for each flavor of cube were patterned after the cheese cracker formulation. Small batches of each flavor

RESULTS (Continued)

of cubes were prepared using a laboratory cube press. The cubes were coated with a gelatin-water coating, then freeze-dried. After drying, the various cubes were evaluated for flavor, texture and appearance. Most of the initial formulations were modified to improve their acceptance and then remade and re-evaluated. For a few of the flavors of cubes only one modification of the formulation was needed; however, for others several modifications were needed. For two of the flavors, Rye and Pizza, it was found that a great deal of effort would be needed to develop these flavors; therefore, no further developments were conducted on these items. Next, larger batches of each of the five remaining cube flavors were produced. Part of each of the batches were packaged in aluminum foil laminated plastic pouches. One package of each of the cube flavors was stored at $135^{\circ} \pm 5^{\circ}\text{F}$. for three (3) hours. After storage, these samples were informally taste tested by four judges. The judges compared the stored and the unstored samples and found that only the chicken flavored cubes had undergone some major changes during storage.

Samples of each new cube flavor were stored for four (4) weeks at $100^{\circ} \pm 5^{\circ}\text{F}$., and then taste tested. The four judges found only a major flavor difference in the chicken flavored cubes. The other cubes did not change significantly. The task order requested that taste test samples be removed from storage once a week during the one month storage period. In the storage test plan used, the flavored cube samples were to be first stored for one month to determine if changes took place and what type of changes took place. In the plan, if changes in the cubes were noted, additional samples would

RESULTS (Continued)

be packaged, stored, and taste tested weekly over the four-week storage period. It was believed that by using the two storage period methods the taste judges would become familiar with the characteristics of the change and therefore could more readily identify them when changes were occurring. If changes did not occur during the first storage period of one month, it was felt that the second storage study was not necessary. Changes only occurred in the chicken flavored cubes and since these changes were also noted at 135°F storage, this flavor of cube was dropped from further testing.

The cube items were tested to determine if they complied with the microbiological requirements. Some deviation from the requirements of Addendum No. 1 were noted in some of the flavored cubes. This was not considered a major problem because it was believed that all the ingredients considered to have possible microbiological problems could either be purchased to meet the microbiological requirements or they could be treated to reduce microbiological count if large lots of these cubes were required.

The flavored cubes complied with the requirements of the Space Food Quality Assurance Provisions.

Thirty servings of each of the following flavored cubes were submitted to NASA for evaluation:

Ham and Swiss
Blue Cheese
Parmesan
Barbecue

A Space Food Prototype Production Guide for the above products has been written and is included in this report as Attachment 1.

CONCLUSION

The results of the development work showed that several flavored snack cube items could be developed rather easily. It also indicated that a number of flavor types could not be so readily developed and that if a wider range in flavors is desired, more extensive development effort would be needed. The problem appears to involve flavor stability and flavor loss during freeze drying. Also, several types of cubes expanded and cracked after compression, coating and dehydration; this would indicate that either a better cracker base is needed or that other, perhaps stronger, binders need to be found.

Space Food Prototype
Production Guide S F-1-11
Whirlpool Corporation
St. Joseph, Michigan
May, 1971

BITE-SIZE CUBES, DEHYDRATED

1. SCOPE

1.1 Scope. This Production Guide covers the manufacturing of compressed, freeze-dehydrated cubes for use in aerospace feeding.

1.2 Classification. The product shall be of the following types as specified (See 6.1):

Type I - Ham and Swiss

Type II - Blue Cheese

Type III - Parmesan

Type IV - Barbecue

2. APPLICABLE DOCUMENTS

2.1 The following documents of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

STANDARDS

Federal

Federal Test Method Standard No. 101-Preservation, Packaging and Packing Materials: Test Procedures.

MILITARY

MIL-STD-668 Sanitary Standards for Food Plants.

NASA

ADDENDA TO SPACE FOOD PROTOTYPE PRODUCTION GUIDES

Addendum No. 1 - Microbiological Requirements for Space Food Prototypes.

Addendum No. 2 - Quality Assurance Provisions

(Copies of specifications and standards required by suppliers in connection with specific procurement functions should be obtained from

the procuring activity or as directed by the contracting officer.)

2.2 OTHER PUBLICATIONS. The following documents form a part of this specification to the extent specified herein: Unless otherwise indicated, the issue in effect on the date of invitation for bids or request for proposal shall apply:

U.S. Department of Health, Education, and Welfare

Federal, Food, Drug, and Cosmetic Act and Regulations Promulgated Thereunder.

(Application for copies should be addressed to the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.)

Association of Official Analytical Chemists

Official Methods of Analysis

(Application for copies should be addressed to the Association of Official Analytical Chemists, Box 540, Benjamin Franklin Station, Washington, D.C. 20044.)

3. REQUIREMENTS

3.1 Preaward Sample. When specified (See 7.1) a sample of the product the supplier proposes to furnish shall be submitted for use in evaluating bids or proposals. The sample shall be packaged, labeled, packed, and marked in accordance with Section 5, and submitted as instructed by the contracting officer. Sample evaluation will be based on compliance with the applicable requirements of 4.4. When a sample is required, the quantity will also be specified.

3.2 First Article. When specified (See 7.1), a sample of the product shall be submitted to the contracting officer for approval before production commences. This sample shall be representative of the product the supplier proposes to furnish under the contract. Sample approval will

3.2 (continued) be based on compliance with the applicable requirements of 4.4. When a sample is required, the quantity will also be specified.

3.3 Material (All Types). All ingredients and materials shall be clean and free from foreign material, foreign odor, foreign color, and foreign flavor.

3.3.1 Crackers, White. The white crackers shall have unsalted tops and shall be crisp, commercially available saltine type cracker that are in excellent condition at the time of use.

3.3.2 Hydrogenated Shortening. The shortening shall be high quality, general purpose shortening. It shall be made from hydrogenated vegetable oil. Proctor and Gamble's Primex or its equivalent shall be used.

3.3.3 Sorbitol. Aqueous 70% sorbitol solution of edible grade or better was used in development.

3.3.4 Egg Albumen (Dehydrated). The egg albumen shall be of the spray-dried type, free flowing and in excellent condition at time of use.

3.3.5 Blue Cheese Flavoring. The pure powdered blue cheese flavoring shall be in excellent condition at time of use. Blue Cheese flavoring manufactured by Florasynth Incorporated, or its equivalent shall be used.

3.3.6 Liquid Dextrin. The liquid dextrin shall be food grade and shall have by typical analysis only a trace of mono and disaccharides. It shall have a commercial Baume of 40.2 and a dextrose equivalent of 15.

3.3.7 Gelatin. The product shall be a high quality edible gelatin with a gel strength of 275 bloom.

3.3.8 Ham Crackers. The crackers shall be fresh and crisp Ham

3.3.8 (continued) Appetesser Crackers, commercially available, manufactured by Nabisco Company or its equivalent.

3.3.9 Ham and Swiss Cheese, Flavoring. The flavoring shall have fresh ham and swiss cheese flavor and shall be in excellent condition at time of use. The ham and swiss cheese shall be flavoring No. 1200, a product of Edlong Chemical Company or its equivalent.

3.3.10 Smoke Flavor (Char Oil). The smoke flavor shall be an oil base natural smoke flavor. It shall be prepared by liquid-liquid extraction of entrapped hardwood smoke flavor.

3.3.11 Parmesan Flavoring. The parmesan flavoring shall be Good Season brand manufactured by General Food or its equivalent.

3.3.12 Powdered Parmesan. The powder parmesan shall be free flowing and in excellent condition at time of use. Powdered parmesan No. 1322 manufactured by Beatrice Foods Company or its equivalent shall be used.

3.3.13 Malto Dextrin. The product shall be high quality, free flowing, and in excellent condition at time of use. Pro Dex 15 manufactured by American Maize Products Company or its equivalent shall be used.

3.3.14 Barbecue Flavor. All purpose Bar B-Q flavoring manufactured by Foote and Jenks or its equivalent shall be used.

3.3.15 Italian Spaghetti Sauce Mix. R. T. French's Italian Spaghetti Sauce Mix or its equivalent shall be used.

3.3.16 Starch. The product shall be a pregelatinized modified waxy maize starch that is in excellent condition at the time of use. Amoigum 39 manufactured by American Maize Company or its equivalent shall be used.

3.3.17 Sloppy Joe Mix. R. T. French's Sloppy Joe Mix or its equivalent shall be used.

3.3.18 Barbecue Sauce. Open Pit Barbecue Sauce (Hickory Smoke Flavor) manufactured by General Foods or its equivalent shall be used.

3.3.19 Nitrogen. The nitrogen shall be labeled USP grade and be water or liquid nitrogen pumped.

3.4 Processing. Components complying with 3.3 shall be processed in accordance with 3.4.1 and 3.4.2.

3.4.1 Formula. The product formulation shall be in accordance with Table I.

TABLE I - PRODUCT FORMULA

Ingredients	Quantity (Percent by Weight)			
	Type I <u>Ham and Swiss</u>	Type II <u>Blue Cheese</u>	Type III <u>Parmesan</u>	Type IV <u>Bar B-Q</u>
Crackers, Unsalted		51.59	52.10	52.53
Shortening	6.26	11.91	12.02	12.12
Sorbitol	5.51	4.37	4.41	4.44
Egg Albumen	5.51	4.37	4.41	4.44
Liquid Dextrin	12.53	7.93	8.02	8.08
Blue Cheese Flavoring		17.85		
Ham Appetizer Crackers	65.13			
Ham and Swiss Cheese Flavoring	5.01			
Smoke Flavor	0.05			0.20
Parmesan Flavoring			3.01	
Powdered Parmesan			10.02	
Malto-Dextrin			4.01	2.02
Barbecue Flavor				0.01
Italian Spaghetti Sauce Mix				7.07
Sloppy Joe Mix				3.03
Starch				2.02
Barbecue Sauce				4.04
Water		1.98	2.0	
	100.00%	100.00%	100.00%	100.00%

3.4.2 Gelatin Coating. The product coating formulation shall be in accordance with Table II.

TABLE II - COATING FORMULA

Ingredients	Quantity (Percent by Weight)
Water	91.4
Gelatin	8.6
	100.0%

4.0 PREPARATION

4.1 Granulation. The unsalted top crackers and the ham appetizer crackers shall first be granulated through 12 mesh screen before processing.

4.1.2 Mixing

4.1.2.1 Type I. The shortening, sorbitol, egg albumen, liquid dextrin, Ham and Swiss Cheese flavoring and the smoke flavor shall be mixed together until a uniform paste is obtained. The above mixture shall be mixed with the cracker crumbs until a uniform blend is obtained.

4.1.2.2 Type II. The shortening, sorbitol, egg albumen and liquid dextrin shall be mixed together until a uniform paste is obtained. The above mixture shall be mixed with the cracker crumbs and blue cheese flavor until a uniform blend is obtained. Next, the water shall be added drop by drop and mixed until all lumps are removed.

4.1.2.3 Type III. The shortening, sorbitol, egg albumen and liquid dextrin shall be mixed together until a uniform paste is obtained. The above mixture shall be mixed with the cracker crumbs until a uniform blend is obtained. Next, the malto-dextrin, parmesan flavor and powdered parmesan shall be blended into the above mixture. Finally the water shall be added drop by drop and the mixture blended until all the lumps are removed.

4.1.2.4 Type IV. The shortening, sorbitol, egg albumen, liquid dextrin, smoke flavor and barbecue flavor shall be mixed together until a uniform paste is obtained. The above mixture shall be mixed with the cracker crumbs until a uniform blend is obtained. Next, the malto-dextrin, starch, Sloppy Joe Mix and Italian Spaghetti Sauce Mix shall be blended into the above mixture. Finally, the barbecue sauce shall be mixed in until all lumps are removed.

4.1.3 Compression. The mixture shall be compressed into 11/16 inch cubes so that the finished product conforms to the requirements in Table III.

4.2 Coating.

a. The cubes shall be coated by dipping into gelatin coating solution maintained at 140 - 150°F. The gelatin solution shall be prepared by swelling the gelatin in cold water for approximately 5 minutes, then heating solution to 140 - 150°F.

b. The cubes shall be dipped in the gelatin solution making sure that they are completely coated.

c. The cubes shall be tumbled on release material to move excess coating.

d. The coated cubes shall be refrigerated for one hour minimum to allow coating to set.

e. Cover cubes and place in freezer.

4.3 Freeze-Drying. Freeze dehydration shall be at a maximum pressure of 1.0 mm and a maximum temperature of the dry product of 100°F. The dehydrator vacuum shall be broken with nitrogen (See 3.3.19).

4.4 Finished Product. The finished product shall comply with the requirements of 4.4.1 and 4.4.2 and Table III.

4.4.1 Moisture. The finished product shall have a moisture content of not greater than 3.0 percent (See 5.2.1).

4.4.2 Microbiological. The finished product shall comply with the requirements specified in Addendum No. 1, Microbiological Requirements for Space Food Prototypes.

TABLE III - FINISHED PRODUCT REQUIREMENTS

Item No.	Requirements
<u>Dehydrated Product</u>	
1	There shall be no foreign odor, such as, but not limited to, burnt, scorched, stale, sour, oxidized, rancid, fermented, musty or moldy odor.
2	There shall be no foreign material such as, but not limited to, dirt, insect, insect parts, wood, paper, paint, glass or metal.
3	There shall be no evidence of incomplete dehydration such as damp or soggy areas.
4	The product shall have an acceptable appearance.
5	The finished product shall have rounded corners and conform to the following dimensions and weight (grams) and be no larger than the following dimensions (inches):
<u>Dimensions (in.)</u>	<u>Weight (gms.)</u>
11/16 inch cube $\pm$ 1/16	6.0 $\pm$ 0.5 Type I
11/16 inch cube $\pm$ 1/16	6.0 $\pm$ 0.5 Type II
11/16 inch cube $\pm$ 1/16	6.0 $\pm$ 0.5 Type III
11/16 inch cube $\pm$ 1/16	6.0 $\pm$ 0.5 Type IV

4.4.3 The product shall be processed in establishments meeting the sanitary requirements of MIL-STD-668.

4.4.4 All deliveries shall conform in every respect to the provisions of the Federal Food, Drug, and Cosmetic Act and Regulation Promulgated Thereunder.

5. QUALITY ASSURANCE PROVISIONS

5.1 Quality Assurance Provisions shall be in accordance with Addendum No. 2 Quality Assurance Provisions.

5.2 Tests

5.2.1 Moisture. The analysis for moisture content shall be as follows:

- a. Weigh two (2) samples of approximately 2 grams each of finished product into tared, dry aluminum dishes (approximately 2 to 2 1/2 inches in diameter and 3/4 inch in depth) with tight fitting covers.
- b. Place the dishes, with cocked lids in a vacuum oven for 30 hours at 60°C. under a pressure of not more than 100 mm of Mercury. During drying, admit to the oven a slow current of air (approximately 2 bubbles per second) dried by passing through concentrated sulfuric acid.
- c. Remove the dishes, close the lids and allow to cool to room temperature in a desiccator, then weigh.
- d. Calculate the percent moisture by dividing the weight loss by the original sample weight and multiplying by 100. The average of the duplicate samples shall be reported to the nearest 0.1 percent.

5.2.2 Headspace Oxygen. The oxygen content shall be determined in accordance with method 237 of Fed. Std. No. 101, Preservation, Packaging, and Packing Materials: Test Procedures. The oxygen content shall be reported to the nearest 0.1 percent.

5.2.3 Microbiological. The finished product shall be tested in accordance with Addendum No. 1 Microbiological Requirements for Space Food Prototypes.

6. PREPARATION FOR DELIVERY

6.1 Packaging. After dehydration, the product shall be immediately packaged in accordance with 6.1.1 or 6.1.2

6.1.1 Interim Packaging. The finished product shall be filled into

6.1.1 (continued) cans of any convenient size. The cans shall be evacuated and flushed with nitrogen enough times so that the headspace gas contains not more than 2.0 percent oxygen (See 5.2.2). Cans shall be held at not more than 50°F. until packaged in accordance with 6.1.2.

6.1.2 Flexible Packages. Four cubes of the dry product shall be placed in the package; unless otherwise specified. (See 7.1)

6.2 Labeling, Packaging and Marking. Assembly and subassembly documents will contain the detailed instructions for labeling, intermediate packaging, packing and marking. However, when the product is to be shipped other than as part of a subassembly or assembly (See 7.1), labeling, packaging and marking shall be in accordance with 6.2.1 through 6.2.3.

6.2.1 Labeling. The following information shall appear on a label glued to the package:

- a. Name of the Product
- b. Net Weight
- c. Date of Manufacture
- d. Name of Manufacturer
- e. Lot Number

6.2.2 Packing. The cans or flexible packages shall be packed and sealed (glue or tape) in a fluted fiberboard box. The contents shall be prevented from shifting by a tight fit or by padding.

6.2.3 Marking. The following information shall appear on a label or be marked on the box:

- a. Name and address of addressee
- b. Name and address of addressor
- c. An attention line

7. NOTES

7.1 Ordering Data. Purchasers should exercise any desired options offered herein and procurement documents should specify the following:

- a. Title, number and date of this production guide.
- b. The packaging materials required (6.1.1).
- c. Number of pieces.
- d. When preaward sample is to be furnished and the quantity (See 3.1).
- e. When first article sample is to be furnished and the quantity (See 3.2).
- f. When product is to be shipped as other than assembly or subassembly (See 6.2).