AD 637847

TECHNICAL REPORT
66-1-FD

# ALL PURPOSE MATRICES for COMPRESSED FOOD BARS

by

JACK R. DURST

The Pillsbury Co.
Minneapolis, Minn.

Contract No. DA19-129-AMC-2103



January 1966

UNITED STATES ARMY
NATICK LABORATORIES
Natick Massachusetts 01760

Food Division
FD-37

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## FOREWORD

In the design and development of military feeding systems increased emphasis is being given to the reduction of food bulk. Such a reduction becomes a virtual necessity in the development of food packets for the soldier who must carry on his person his entire food supply for indefinite periods when resupply is not feasible. In addition to prescribed nutritional characteristics, the food contained in such packets must combine general acceptability with economy of both weight and bulk. Weight economy can be achieved by use of dehydrated foods, which, fortunately, are microbiologically stable. Compression has long been recognized as a method for reducing the bulk of dry foods. In addition a geometrically regular module resulting from compression provides obvious advantages for packaging and packing.

This project is concerned with the development of food bars which are acceptable for consumption from the compressed state and which can also be rehydrated to yield familiar meal items of even greater acceptability. Conceptually, a variety of casserole items, creamed soups, puddings, and beverages can be supplied as dry bars for direct consumption or for consumption after rehydration. Recognition is given to the fact that many dry foods will require a binder to insure cohesiveness and other desirable physical characteristics after compression. This project is directed to the development and performance of several binders which will insure that a wide variety of dry foods can be compressed into bars suitable for consumption both directly and after rehydration.

The investigation described herein was performed in the Research and Development Laboratories of the Pillsbury Company, 311 Second Street S.E., Minneapolis 14, Minnesota. Dr Jack Durst served as the Official Investigator. His collaborators were Merlin J. Slettin, John J. Slavics, J. Ringstrom, R. Sundeen, G. Detlefsen, Jr., J. Blodgett, R. Gauthier, L. Brandberg, and Robert Brunson.

Project Officer for the U.S. Army Natick Laboratories was Dr. Maxwell C. Brockmann of the Animal Products Branch, Food Division. The Alternate Project Officer was Dr. Karl Johnson, Plant Products Branch, Food Division.

FERDINAND P. MEHRLICH, Ph.D.
Director
Food Division

APPROVED:

DALE H. SIELING, Ph.D.
Scientific Director

W. W. VAUGHAN
Brigadier General, USA
Commanding

TABLE OF CONTENTS

TABLE OF CONTENTS - Cont'd.

TABLE OF CONTENTS - Cont'd.

TABLE OF CONTENTS - Cont'd.

TABLE OF CONTENTS - Cont'd.

TABLE OF CONTENTS - Cont'd.

TABLE OF CONTENTS - Cont'd.

TABLE OF CONTENTS - Cont'd.

## ABSTRACT

Edible binders have been developed which impart favorable physical properties including cohesiveness to compressed dry foods representing a broad range of chemical compositions. Further experimental effort yielded binders for compressed foods which are acceptable for consumption from the compressed state and which can also be rehydrated to yield a familiar meal item, such as casseroles, creamed soups, puddings, thin soups and beverages. These binders do not significantly alter the storage stability of the basic food components.

SCOPE OF THE CONTRACT

PHASE I:

1. The objective of this project shall be the development, testing, and demonstration of edible compositions which permit the incorporation of any food having adequate physical, chemical, and microbiological stability into compressed bars which conform to requirements herein specified and which are adaptable to commercial production with existing equipment.

2. Effort shall be confined to two compositions conforming to Compositions A and B below.

| | Composition A | Composition B |
|---|---|---|
| Kg-Cal per gram, minimum | 4.0 | 6.0 |
| Percent fat, dry basis, maximum | 20 | 50 |
| Percent high quality protein, dry basis | 20 to 50 | 0 to 25 |
| Percent ash, dry basis, maximum | 1.5 | 1.0 |

Each composition shall conform to current Food and Drug Administration requirements, shall not be the source of objectionable flavors or odors, and shall not adversely alter the flavor or odor of the primary ingredients of the compressed bars.

3. Each composition when used in amounts not to exceed 25 percent by weight with foods such as those listed below and subjected to compression at pressures below 500 p.s.i. shall result in a food bar conforming to special requirements listed in Paragraph 5 herein.

a. Precooked tapioca

b. Graham crackers

c. Dry non-fat milk

d. Cookies at 5-10% moisture

e. Pie crust at 10% moisture

f. Dried peaches at 18% moisture

g. Peanuts

h. Freeze dried cooked chicken

i. Sweet chocolate

j. Prefried bacon

k. Dried raisins or dates at 18-20% moisture

l. Fruit preserves at 20% moisture

m. Dry fish (cooked)

n. Precooked freeze dried scrambled eggs

o. Gouda cheese or equivalent

4. The preparation and components of Composition A and B shall be fully described by the Contractor and submitted in writing. Likewise, all operations in the preparation of each type bar, including pre-compression treatments, shall be adequately described and critical operations shall be supported by data. All process operations shall be recognized as commercially feasible.

5. Compressed bars shall have the following properties:

a. Rectangular cross section, 1/2 inch thick, weight 2 ounces minimum.

b. Acceptable odor and taste normal to major ingredients.

c. Easily sheared by incisors at temperatures between 30 and 100°F. and subsequently chewable without becoming crumbly or difficult to swallow.

d. Shall not shatter when dropped on a smooth concrete floor from a height of 6 feet and shall remain dimensionally stable within 10 percent when held at 120°F. for 24 hours under a load of 5 pounds per square inch.

e. Shall not become sticky when held 24 hours at room temperature in the presence of 40% relative humidity.

f. When packaged in metalized polyethylene polyester pouches, will remain organoleptically acceptable and without significant manifestations of chemical, physical or microbiological deterioration throughout three months storage at 30, 70 and 100°F.

6. The Contractor shall recommend and describe as an engineering design an efficient production process to be submitted in writing, based on currently available equipment and the matrix compositions here demonstrated, for the commercial fabrication of 6000 compressed food bars per hour.

PHASE II:

Commencing with the effective date of modification of the contract, the Contractor shall continue for a period of twelve (12) months thereafter, to perform the additional work to Phase I as follows:

7. Objectives stated in Paragraph 2, Scope, Phase I, and the requirements of Paragraphs 5, 6, and 7 shall be extended to include an additional compression matrix, designated Composition H (See Paragraph 8) and the development of compressed food bars which are acceptable for direct consumption and which disperse and rehydrate in water to yield acceptable casserole-type items (See Paragraph 9), acceptable creamed foods and soups (See Paragraph 10), and acceptable thin soups and beverages (See Paragraph 11). All bars, Composition H, and all components thereof shall meet Food and Drug Administration requirements for food use.

8. In the event Compositions A and B are found unsuitable for bars alternatively used for any of the thin soups or beverages listed in Paragraph 11, Composition H shall be developed as a compression matrix to provide cohesion and other essential properties. Composition H shall contain not less than 3.8 kg-cal per gram (based on human metabolism) at the time of compression. No restriction is placed on the fat, protein, carbohydrate, and ash contents. Composition H shall not be the source of objectionable flavor, odor, or physical properties in either the compressed bar or the rehydrated products therefrom

9. Compressed bars which rehydrate in hot water to produce the casserole-type items listed below shall be developed from suitable ingredients and may include up to 25 percent by weight of Composition A or B.

a. Beef stew

b. Barbecued ground beef

c. Chili con carne

d. Ground beef and rice (as for stuffed green peppers)

e. Shrimp creole

10. Compressed bars which rehydrate in hot water to produce the creamed items listed below shall be developed from suitable ingredients and may contain up to 50 percent by weight of Composition A or B.

a. Creamed ground beef

b. Chicken a la king

c. Cream of mushroom soup

d. Cream of tomato soup

e. Creamed lemon or banana pie filling

11. Compressed bars which rehydrate in hot water to produce the soups listed below or in hot or cool water to yield the beverages listed below shall be developed from suitable ingredients which may include up to 50 percent composition A or B or an unlimited amount of Composition H (See Paragraph 8 above).

a. Beef-barley soup

b. Shrimp chowder

c. Coffee with cream and sugar

d. Tomato juice

e. Orange juice

INTRODUCTION

While doing research work on food bars in the Pillsbury Research Laboratory, it was found that by use of a Stable Dispersion Process patented by the Pillsbury Company, food bars could be fabricated using the dispersion as a binder matrix. Rather low over-all pressures were required to make the bars. The Pillsbury Company has agreed to the Government's use of this process on the food bars covered in this contract on a royalty free basis.

The stable dispersion or encapsulation process is simply two immiscible systems, a film former in the continuous phase surrounding a liquid or once liquid discontinuous phase. The following are needed to form the stable dispersion: (1) film former, something that is capable of forming a film around something. (2) A liquid which is immiscible in this film former. (3) A plasticizer which actually makes the film former able to form a film. (4) Proper mixing.

For our use in food bars as a universal matrix a stable dispersion is made with known amounts of protein, fat, carbohydrates, minerals, and water. The stable

disperion is then spray dried and the dry powder is then mixed with the other ingredients of the food bar and placed in a mold and shaped under low pressure into bars 2" x 4" x 1/2" that weigh approximately 2 ounces.

Specifically, for making a stable dispersion binder matrix we take a protein such as sodium caseinate that is hydrated or can be hydrated and limit the amount of the plasticizer to form a film of protein around an oil or a liquid melted normally solid shortening which is immiscible in the protein film. This can be accomplished by simple mixing such as with a Waring Blendor or Hamilton Beach rotary mixer. Once the stable dispersion is formed, it can be diluted with additional water to give whatever viscosity is desired. Other materials such as sugars, vitamins, flaverings, minerals, colors, other proteins, preservatives, etc. may be added to the stable dispersion either before or after the formation of the dispersion depending on the desired results. For example, if one wishes to add a fat soluble flavoring or coloring, they should be added to the liquid fat before the dispersion is formed since the fat will be encapsulated with a film of protein.

An important point in this process is that we add no emulsifiers. Emulsifiers can actually hinder or prevent the formation of a stable dispersion because they can make the water (the plasticizer) more compatible with the oil or melted normally solid fat and thus prevent the stretching of a film around the liquid fat globule. A film around a sphere is a thermodynamically stable structure.

EXPERIMENTAL

I. Preparation of "A" Series of All Purpose Matrices

The "A" Series of matrices was developed to meet the requirements outlined in the Scope of the Contract in a typically evolutionary way. The first matrix, simply designated "A", was formulated to meet the nutritional requirements for this matrix. It compared as follows:

| | Contract Requirement | Experimental |
|---|---|---|
| Percent fat, dry basis, maximum | 20 | 20 |
| Percent high quality protein | 20-50 | 23.4 |
| Percent ash, dry basis, maximum | 1.5 | 1.1 |
| Kg-Cal per gram, minimum | 4.0 | 4.9 |

The complete formula for Matrix A was:

| | |
|---|---|
| Lard flakes | 20% |
| Sodium caseinate | 27% |
| Sucrose | 53% |
| Composition A | 100% |

This matrix was made by the stable dispersion process and then spray dried as outlined in the Introduction. The result was a white, free-flowing powder whose detailed manufacturing process follows in paragraph A. The food bars were fabricated by procedures outlined in section V.

In taste tests where Composition A was the matrix with graham crackers, vanilla wafers and peanut food bars, the bars were consistently too sweet. This led to the formulation of matrix $A_1$, which was formulated as follows:

| | |
|---|---|
| Kex oil (Durkee) | 20% |
| Sodium Caseinate | 27% |
| Lactose | 53% |
| | 100% |

This matrix was made by the stable dispersion process and then spray dried as outlined in the Introduction. The result was a white, free-flowing powder whose detailed manufacturing process follows in paragraph A. The food bars were fabricated by procedures outlined in section V.

(The change to Kex oil from lard flakes was made with an eye to organoleptic stability during the coming three-month storage study, especially since a 73°F. and 100° F. temperature variable would thus be experienced, and to eliminate the lard flavor and mouth feel.

Since one of the primary considerations in the development of suitable matrices was microbiological stability, it was necessary to spray dry the matrix so that the moisture level was low enough to retard microbiological activity. This was done with the above formula, and with all succeeding formulas described here. The result was always a white, free-flowing powder, whose formula follows:

| | |
|---|---|
| Corn Starch (Col-Flo 67) | 15% |
| Sucrose | 10% |
| Lactose | 28% |
| Kex Oil | 20% |
| Sodium Caseinate | 27% |
| | 100% |

This matrix was made by the stable dispersion process and then spray dried as outlined in the Introduction. The result was a white, free-flowing powder whose detailed manufacturing process follows in paragraph A. The food bars were fabricated by procedures outlined in section V.

This formula was somewhat starchy in flavor as the free powder. When used as a matrix in graham crackers, vanilla wafer and peanut food bars, it also contributed a starchy flavor to the complete bar. Therefore, we developed the A3 matrix whose formula follows:

| | |
|---|---|
| Corn Starch (Col-Flo 67) | 10% |
| Sucrose | 10% |
| Lactose | 18% |
| Dextrose | 15% |
| Kex Oil (Durkee) | 20% |
| Sodium Caseinate | 27% |
| | 100% |

The reduced starch level in this matrix solved the flavor problem. Initially, food bars were fabricated from graham crackers, vanilla wafers, peanuts, and bacon together with the $A_3$ matrix, and in all cases the flavor of the major ingredient was very apparent and unchanged by the presence of the matrix. It was felt then that this matrix would suffice for the general "A" type matrix required in the Scope of the Contract. The complete manufacturing process, together with typical batch size and typical weights is outlined below. It should be noted in this final formula that the fat was changed from Kex oil, which had an A.O.M. stability of 100 hours, to Durkex 500, which has an A.O.M. stability of 500 hours.

A. Matrix $A_3$

1. Formula

| | % Dry | Typical Quantities (lb) |
|---|---|---|
| Sodium Caseinate, Edible, Land-O-Lakes | 27.00 | 54.0 |
| Water | ----- | 216.0 |
| Sucrose, Granulated | 10.00 | 20.0 |
| Dextrose | 15.00 | 30.0 |
| Durkex 500 oil, Durkee | 20.00 | 40.0 |
| Starch | 10.00 | 20.00 |
| Lactose, Foremost Dairies | 18.00 | 36.0 |
| Water (for lactose make-up) | ----- | 36.0 |
| | | 452.0 total |
| | | 200.0 dry |

2. Procedure

a. Make up 20% Sodium Caseinate solution using Schnellkutter or similar high speed mixer.

b. Pass to make up tank and raise temperature to 130°F.

c. Add sucrose and dextrose to Sodium Caseinate solution and mix until dissolved.

d. Suspend starch in Durkex oil and pass to make up tank, and mix with the Sodium Caseinate solution by passing through an Oakes mixer. Check stability at this

point by floating out a small amount of dispersion in a quantity of 130°F. water. If no "oiling-out" is seen, continue as below. If "oiling-out" does occur, mix for a longer period.

e. Make up lactose in an equal weight of water, add to make up tank and mix.

f. Recirculate this completed solution through an Oakes mixer.

g. Pass to surge tank and spray dry at 2400 psi with an outlet temperature of 170-175°F. and an inlet temperature of 265°F., using a #67 orifice and #17 core

3. Results

A free flowing white powder of the following composition results.

| | |
|---|---|
| Protein | 23.4% |
| Fat | 20.0% |
| Moisture | 3.6% |
| Ash | 1.1% |
| Carbohydrate | 51.1% (by diff.) |

Calories - 4.9 per gram

II. Preparation of "B" Series of All Purpose Matrices

The development of the "B" Series of Matrices also closely followed the requirements outlined in the Scope of the Contract. The first formula, designated "B", compared as follows:

| | Contract Requirement | Experimental |
|---|---|---|
| Kgm-Cal per gram, minimum | 6.0 | 6.3 |
| Percent fat, dry basis, maximum | 50 | 47.7 |
| Percent high quality protein | 0 to 25 | 16.8 |
| Percent ash, dry basis, maximum | 1.0 | 0.8 |

The complete formula for matrix B was:

| | |
|---|---|
| Lard Flakes | 47.1% |
| Sodium Caseinate | 19.2% |
| Sucrose | 33.7% |
| | 100.0% |

This matrix was made by the stable dispersion process and then spray dried as

outlined in the Introduction. The result was a white, free flowing process following that given in Paragraph A. The food bars were fabricated by procedures outlined in Section V.

When used as a matrix for graham crackers, and vanilla wafer food bars, a "lardy" flavor was detectable. In peanut food bars, the B Matrix contributed a sweet flavor. In order to overcome this, a new formulation, originally called D Matrix, but later changed to $B_1$ Matrix, was made as follows:

| | |
|---|---|
| Lard Flakes | 47.1% |
| Sodium Caseinate | 19.2% |
| Dextrin | 33.7% |
| | 100.0% |

This matrix was made by the stable dispersion process and then spray dried as outlined in the Introduction. The result was a white, free flowing powder whose detailed manufacturing process follows that given in Paragraph A. The food bars were fabricated by procedures outlined in Section V. When this formula was used as a matrix for peanut and graham cracker food bars, the resulting flavor was too "chalky".

Another reformulation of the matrix to overcome the above mentioned complaint resulted in the following $B_2$ matrix.

| | |
|---|---|
| Corn Starch (Cal-Flo 67) | 10.0% |
| Lactose | 16.7% |
| Sucrose | 7.0% |
| Kex Oil | 47.1% |
| Sodium Caseinate | 19.2% |
| | 100.0% |

In graham cracker, vanilla wafer and peanut food bars, this matrix gave good results initially, and it was decided that this formula would be the B type matrix of choice. Again, the Kex oil was changed to Durkex 500 and the complete formula and detailed manufacturing procedure follows:

A. Matrix $B_2$

1. Formula

| | % Dry | Typical Quantities (lb) |
|---|---|---|
| Sodium Caseinate, Edible, Land-O-Lakes | 19.2 | 38.4 |
| Water | ---- | 153.6 |
| Sucrose, granulated | 7.0 | 14.0 |
| Durkex 500 Oil, Durkee | 47.1 | 94.2 |
| Starch | 10.0 | 20.0 |
| Lactose, Foremost Dairies | 16.7 | 33.4 |
| Water (for lactose make-up) | ---- | 33.4 |
| | | 387.0 total |
| | | 200.0 dry wt |

2. Procedure

a. Make up 20% Sodium Caseinate solution using Schnellkutter or similar high speed mixer.

b. Pass to make up tank and raise temperature to 130°F.

c. Add sucrose to the Sodium Caseinate solution and mix until dissolved.

d. Suspend starch in the Durkex (temperature 145°F.) oil and pass to make up tank, and mix with the Sodium Caseinate solution by passing through an Oakes mixer. Check stability as noted previously.

e. Dissolve lactose in an equal weight of water, add to make up tank and mix.

f. Recirculate the completed solution through an Oakes mixer.

g. Pass to surge tank and spray dry at 2000 psi with an outlet temperature of 263-270°F. using a #67 orifice and a #17 core.

3. Results

The product was a white, free-flowing powder of the following composition:

| | |
|---|---|
| Fat | 47.7% |
| Protein | 16.8% |
| Carbohydrate | 32.5% (by diff.) |
| Ash | 0.8% |

| | |
|---|---|
| Moisture | 2.2% |
| Calories per gram | 6.3 |

III. Discovery of Matrix "H"

A note on the discovery of a material suitable for use as H matrix as defined in Phase II of the Scope of the Contract is in order here, since it is also used in the formulation of certain food bars. Originally it was intended to manufacture a series of enzyme degraded gelatin preparations in order to test these for cohesion and water dispersability as an indication of their suitability as Matrix H. Our proposed method included the following steps:

1. To samples of gelatin solutions of known concentrations and viscosity, add aliquots of a bromalin solution of known concentration.

2. Incubate samples at 37°C. and withdraw samples at intervals.

3. Heat inactivate the enzymes (90°C. for 10').

4. Centrifuge all samples and determine the viscosity of the supernatant by Brookfield viscometer.

5. Vacuum dry the supernatant and screen samples so obtained for suitability of use as Matrix H.

It was then discovered that Wilson and Co. had a collagen fraction on the market suitable for cosmetic use, and an inquiry by us elicited the information that a similar fraction suitable for food use was also available. This material, "Solu-Pro", can probably be supplied by Wilson at rather lower prices than our proposed enzymatically degraded gelatin. It has proved acceptable, even though a slightly mucilagenous flavor is apparent at high concentrations. The caloric value of this matrix is 3.85 calories per gram, dry basis.

IV. Special Ingredients

In addition to the development of the matrices outlined previously, it became apparent that it was necessary to master certain freeze drying techniques in order to ensure that the requirements of the contract of rapid rehydration be met. In most cases, the commercially available freeze-dried products, particularly the grains (rice,

barley) were not suitable because of grittiness, slow or impossible rehydration without cooking, or poor flavor. The following describes in detail the processing necessary for suitable ingredients as used in the food bars and the compounding of a suitable dry barbecue sauce.

A. Kidney Beans

1. Procedure

a. Blanch 2 minutes in steam at atmospheric pressure.

b. Soak in 1% Sodium Bicarbonate solution at room temperature for 1½ hours.

c. Drain, then soak in 1% Sodium Acid Pyrophosphate at room temperature for 1½ hours.

d. Drain, then cook in excess of tap water at a slow boil for 25-30 minutes.

e. Drain and freeze-dry.

B. Rice

1. Procedure

a. To 8½ lb water add 1/2 oz salt and bring to a boil.

b. Add 1 lb long grain par boiled rice and cook at a rolling boil for 25 minutes.

c. Drain, then rinse in cold water.

d. Add rice back to 10 lb water per original lb of rice and cook at a rolling boil for 25 minutes.

e. Drain. Rinse with hot water, then with cold water.

f. Stir the rice gently to prevent lumping when piling onto freeze drying trays.

g. Freeze-dry.

C. Barley

1. Procedure

a. To 8 lb water, add 1/2 oz salt.

b. Add 1 lb barley and boil for 1 hour, adding more water if too thick.

c. Drain and rinse in warm water.

d. Add back 8 lb water per lb of original barley and cook 30 minutes.

e. Drain and rinse in warm water.

f. Add back 8 lb water per pound of original barley and cook 30 minutes longer.

g. Drain and rinse in warm water, then in cold water.

h. Stir the barley gently while piling onto freezer trays to avoid lumping.

i. Freeze-dry.

D. Barbecue Sauce

1. Formula

| | |
|---|---|
| Onion Powder, soluble | 0.29 |
| Celery Seed, ground or whole | 0.11 |
| Paprika, ground | 0.32 |
| Cayenne Pepper, ground | 0.11 |
| Cinnamon, Korintji, ground | 0.05 |
| Allspice, ground | 0.08 |
| Salt, Flour | 5.63 |
| Sugar, granulated | 46.30 |
| Tomato Powder, I.D.I.T. S.P.A.* | 18.11 |
| Sodium Diacetate | 14.50 |
| Smoked Yeast, Florasynth | 14.50 |
| | 100.00 |

2. Procedure

a. Weigh all ingredients into a 1 cubic food twin cone Patterson-Kelly mixer and mix, using intensifier bar, until homogenous.

E. Pimientos

1. Procedure

Canned whole pimientos were freeze dried without further treatment.

* Available from Tower Instant Foods, Chicago

V. Manufacture of Phase I Food Bars

A. Pregelatinized Tapioca Starch Bars

1. Formula

| | |
|---|---|
| Pregelatinized Tapioca Starch | 75% |
| $A_3$ or $B_2$ Matrix | 25% |
| Water/100 g. dry materials | 15 ml. |

2. Procedure

The starch and the respective matrices were mixed together in a one cubic foot Patterson-Kelly mixer using the blade type intensifier bar. When the mixture was homogenous, the water was added through the intensifier bar. Depth of fill on the Denison hydraulic press was adjusted so that the resulting bars were 1/2" in thickness. About 120 bars were fabricated at 4000 #g.p. (500 psi.) with normal press action and zero dwell time. About 100 bars were packed in aluminized PVC pouches (pouch stock: 0.5 mil mylar, 0.00035" aluminum foil, 3 mil polyvinyl chloride) and 21 were packed under nitrogen in glass jars after being dried 20' at 120°F. Storage of the pouched bars began on August 30, 1963 at 0° F, 35°F, 73°F, and 100°F. The nitrogen packed bars began storage at 0°F, 73°F and 100°F on August 30, 1963 also.

3. Results: The following test results were obtained:

| Test | $A_3$ Matrix | $B_2$ Matrix |
|---|---|---|
| Odor and Flavor | Typical of Tapioca Starch | Typical of Tapioca Starch |
| Mastication | | |
| a. Shear by Incisors | | |
| (1) 35°F | Fair | Fair |
| (2) 70°F | Good | Fair |
| (3) 100°F | Fair | Fair |

| Test | $A_3$ Matrix | $B_2$ Matrix |
|---|---|---|
| b. Chew | | |
| (1) 35° F | Fair | Fair |
| (2) 70°F | Good | Fair |
| (3) 100°F | Fair | Fair |
| c. Swallow | | |
| (1) 35°F | Fair | Fair |
| (2) 70°F | Good | Fair |
| (3)100°F | Fair | Fair |
| Six ft. drop test | One corner broke off on 16th drop | Broke in half on 35th drop |
| Stickiness (24 hrs) at 40% humidity and room temperature | None | None |
| Dimensional Stability (24 hrs. at 120°F and 5 psi.) | | |
| a. Before | 1/2" x 1 31/32"x 3 15/16" | 1/2" x 1 15/16"x 3 7/8" |
| b. After | 15/32"x1 15/16"x 3 7/8" | 15/32"x 1 15/16"x 3 25/32" |
| c. Net Change | -1/32" -1/32" 1/16" | -1/32" 0 -3/32" |
| d. Percent change | -6.25 -1.58 -1.58 | -6.25 0.00 -2.42 |
| Moisture (16 hr vacuum over) | | |
| a. Nitrogen pack | 11.44 | 12.15 |
| b. Pouch pack | 12.54 | 13.90 |

| Bacteriology | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
|---|---|---|---|---|
| a. SPC | 2700 | 1200 | 2750 | 1220 |
| b. Coliforms | $<10$ | $>5$ | $>10$ | $>5$ |
| c. Yeasts and Molds | 20 | $<10$ | $<10$ | 10 |
| d. Staphylococcus | neg. | neg. | neg. | neg. |

| Storage Study | $A_3$ Matrix | | $B_2$ Matrix | |
|---|---|---|---|---|
| 2 Week - 35° F. | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| Organoleptic | | | | |
| shear | - | very difficult | - | very difficult |
| Odor | - | typical | - | ypical |
| flavor | - | typical | - | typical |
| 73° F. | | | | |
| Bacteriology | | | | |
| SPC | - | 550 | - | 220 |
| Coliforms | - | < 10 | - | < 10 |
| Yeast & Molds | - | < 10 | - | < 10 |
| Staphlococcus | - | neg. | - | neg. |
| Moisture | - | 11.32 | - | 14.20 |
| Organoleptic | | | | |
| shear | difficult | difficult | difficult | difficult |
| Odor | typical | typical | typical | typical |
| Flavor | typical | typical | typical | typical |
| 100° F. | | | | |
| Bacteriology | | | | |
| SPC | 2000 | 300 | 300 | 330 |
| Coliforms | < 10 | < 10 | < 10 | < 10 |
| Yeasts & Molds | 15 | 20 | 15 | 15 |
| Moisture | - | 10.37 | - | 13.49 |
| Organoleptic | | | | |
| Shear | very difficult | very difficult | very difficult | very difficul |
| Odor | typical | typical | typical | typical |
| Flavor | typical | rubber like | typical | rubber like |

| Storage Study cont. | A3 Matrix Nitrogen Pack | A3 Matrix Pouch Pack | B2 Matrix Nitrogen Pack | B2 Matrix Pouch Pack |
|---|---|---|---|---|
| 4 Week - 35° F. | | | | |
| Organoleptic | | | | |
| Shear | - | difficult | - | difficult |
| Odor | - | typical | - | typical |
| Flavor | - | typical | - | typical |
| 73° F. | | | | |
| Organoleptic | | | | |
| Shear | difficult | very difficult | difficult | impossible |
| Odor | typical | typical | typical | typical |
| Flavor | typical | typical | typical | typical |
| 100° F. | | | | |
| Organoleptic | | | | |
| Shear | difficult | difficult | impossible | impossible |
| Odor | typical | typical | typical | typical |
| Flavor | typical | typical | typical | typical |
| 8 Week - 35° F. | | | | |
| Organoleptic | | | | |
| Shear | - | very difficult | - | very difficult |
| Odor | - | typical | - | typical |
| Flavor | - | typical | - | typical |
| 73° F. | | | | |
| Organoleptic | | | | |
| Shear | impossible | very difficult | impossible | impossible |
| Odor | typical | typical | typical | typical |
| Flavor | typical | typical | typical | typical |
| 100° F. | | | | |
| Organoleptic | | | | |
| Shear | difficult | very difficult | impossible | impossible |
| Odor | typical | typical | typical | typical |
| Flavor | typical | typical | typical | typical |

| Storage Study Cont. | $A_3$ Matrix | | $B_2$ Matrix | |
|---|---|---|---|---|
| | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| 13 Week 35° F. | | | | |
| Organoleptic | | | | |
| Shear | - | difficult | - | difficult |
| Odor | - | typical | - | typical |
| Flavor | - | typical | - | typical |
| 73° F. | | | | |
| Organoleptic | | | | |
| Shear | difficult | very difficult | difficult | impossible |
| Odor | typical | typical | typical | typical |
| Flavor | typical | typical | typical | typical |
| 100° F. | | | | |
| Organoleptic | | | | |
| Shear | very difficult | very difficult | very difficult | impossible |
| Odor | typical | typical | typical | typical |
| Flavor | typical | typical | typical | typical |
| 26 Week 35° F. | | | | |
| Organoleptic | | | | |
| Shear | - | very difficult | - | very difficult |
| Odor | - | typical | - | typical |
| Flavor | - | typical | - | typical |
| 73° F. | | | | |
| Organoleptic | | | | |
| Shear | difficult | impossible | difficult | impossible |
| Odor | typical | typical | typical | typical |
| Flavor | typical | typical | typical | typical |
| 100° F. | | | | |
| Organoleptic | | | | |
| Shear | impossible | impossible | impossible | impossible |
| Odor | typical | typical | typical | typical |
| Flavor | typical | typical | typical | typical |

| 52 Week 72°F | $A_3$ Matrix Nitrogen Pack | $A_3$ Matrix Pouch Pack | $B_2$ Matrix Nitrogen Pack | $B_2$ Matrix Pouch Pack |
|---|---|---|---|---|
| Moisture | | 11.98 | | 13.29 |
| Bacteriology | | | | |
| SPC | 1650 | 150 | 170 | 190 |
| Coliforms | <10 | <10 | <10 | <10 |
| Yeasts & Molds | <10 | <10 | <10 | <10 |
| Staphlococcus | neg | neg | neg | neg |
| Salmonella | neg | neg | neg | neg |
| 100°F. | | | | |
| Moisture | | 12.11 | | 13.29 |
| Bacteriology | | | | |
| SPC | 160 | 190 | 180 | 140 |
| Coliforms | <10 | <10 | <10 | <10 |
| Yeasts & Molds | <10 | <10 | <10 | <10 |
| Staphlococcus | neg | neg | neg | neg |
| Salmonella | neg | neg | neg | neg |

B. Graham Cracker Bars

1. Formula

| | |
|---|---|
| Graham crackers | 75% |
| $A_3$ and $B_2$ Matrix | 25% |
| Water/100 gm. dry material | 5 ml. |

2. Procedure

The graham crackers were placed in a 12 qt. bowl and broken up on speed #2 of the A-200 Hobart mixer until the largest fragment remaining was 1/2" in its largest dimension. The respective matrices were added and mixing was continued until homogenous. Water was then added by separatory funnel while mixing continued. Depth of fill was adjusted on the Denison hydraulic press so that resulting bars were 1/2" thick. About 120 bars were fabricated at 6000 #g.p. (750 psi.) and zero dwell time with normal action of the press (both upper and lower rams activated). The bars were finished by drying for 20' at 120°F. About 100 were sealed into aluminized mylar pouches (pouch stock was

0.5 mil mylar, 0.00035" aluminum foil and 3 mil polyvinyl chloride.) Twenty-one bars were sealed under nitrogen in glass jars. Storage at 100°F, 73°F, and 0°F was begun on August 30, 1963 for the pouched bars. The nitrogen packed bars began storage on August 23, 1963 at 100°F, 73°F, and 0°F.

3. Results

The following test results were obtained initially.

| Test | $A_3$ Matrix | $B_2$ Matrix |
|---|---|---|
| Odor and Flavor | typical of graham crackers | typical of graham crackers |
| Mastication | | |
| a. Shear by Incisors | | |
| (1) 35°F | good | good |
| (2) 70°F | good | good |
| (3) 100°F | good | good |
| b. Chew | | |
| (1) 35°F | good | good |
| (2) 70°F | good | good |
| (3) 100°F | good | good |
| c. Swallow | | |
| (1) 35°F | good | good |
| (2) 70°F | good | good |
| (3) 100°F | good | good |
| Six foot Drop Test | Broke into 2 pcs. on 4th drop | Broke into 2 pcs. on 6th drop |
| Stickiness (24 hrs. at 40% humidity and room temp.) | none | none |
| Dimensional Stability (24 hrs at 120°F and 5 psi) | | |
| a. Before | 17/32"x2 1/32"x4 1/32" | 15/32:x2 1/32"x4 1/32" |
| b. After | 1/2"x2 1/32"x4 1/32" | 7/16"x2 1/32"x4 1/32" |
| c. Net Change | -1/32 0 0 | -1/32" 0 0 |
| d. Percent change | -5.88 0.00 0.00 | -6.66 0.00 0.00 |
| Moisture % (16 hr. vacuum oven) | | |
| a. Nitrogen pack | 7.66 | 6.49 |
| b. pouch pack | 8.38 | 6.99 |

| | $A_3$ Matrix | | $B_2$ Matrix | |
|---|---|---|---|---|
| | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| Bacteriology | | | | |
| SPC | 1040 | 180 | 290 | 200 |
| Coliforms | < 10 | < 10 | < 10 | < 10 |
| Yeasts and Molds | < 10 | < 10 | < 10 | < 10 |
| Staphylococcus | neg. | neg. | neg. | neg. |
| Storage Study | | | | |
| 2 Weeks | | | | |
| 35° F. | | | | |
| Organoleptic | | | | |
| Shear | - | good | - | good |
| Odor | - | typical | - | typical |
| Flavor | - | typical | - | typical |
| 73° F. | | | | |
| Bacteriology | | | | |
| SPC | - | 730 | - | 550 |
| Coliforms | - | < 10 | - | < 5 |
| Yeasts & Molds | - | < 10 | - | < 10 |
| Staphlococcus | - | neg. | - | neg. |
| Moisture % | - | 7.96 | - | 8.48 |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | typical | typical | typical | typical |
| Flavor | typical | typical | typical | typical |
| 100° F | | | | |
| Bacteriology | | | | |
| SPC | 700 | 240 | 400 | 200 |
| Coliforms | < 10 | < 10 | < 10 | < 10 |
| Yeasts & Molds | < 10 | < 10 | 5 | 10 |

| | $A_3$ Matrix | | $B_2$ Matrix | |
|---|---|---|---|---|
| 2 Weeks | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| 100°F | | | | |
| Moisture | - | 4.80 | - | 3.18 |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | typical | typical | typical | typical |
| Flavor | typical | typical | typical | typical |
| 4 Weeks | | | | |
| 35°F | | | | |
| Organoleptic | | | | |
| Shear | - | good | - | good |
| Odor | - | typical | - | typical |
| Flavor | - | typical | - | typical |
| 73°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | typical | typical | typical | typical |
| Flavor | typical | typical | typical | typical |
| 100°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | typical | typical | typical | typical |
| Flavor | typical | typical | typical | typical |
| 8 Weeks | | | | |
| 35°F | | | | |
| Organoleptic | | | | |
| Shear | - | good | - | good |
| Odor | - | typical | - | typical |
| Flavor | - | typical | - | typical |

| | $A_3$ Matrix | | $B_4$ Matrix | |
|---|---|---|---|---|
| 73°F | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | typical | typical | typical | typical |
| Flavor | typical | typical | typical | typical |
| 100°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | typical | typical | typical | typical |
| Flavor | typical | typical | typical | stale |
| 13 Weeks | | | | |
| 35°F. | | | | |
| Organoleptic | | | | |
| Shear | - | good | - | good |
| Odor | - | typical | - | typical |
| Flavor | - | typical | - | typical |
| 73°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | typical | typical | typical | typical |
| Flavor | typical | typical | typical | typical |
| 100°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | typical | typical | typical | typical |
| Flavor | typical | typical | typical | typical |
| 26 Weeks | | | | |
| 35°F | | | | |
| Organoleptic | | | | |
| Shear | - | good | - | good |
| Odor | - | typical | - | typical |
| Flavor | - | typical | - | typical |
| 73°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | typical | typical | typical | typical |
| Flavor | typical | typical | typical | typical |
| 100°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | typical | typical | typical | typical |
| Flavor | typical | typical | typical | typical |

| 52 weeks | $A_3$ Matrix | | $B_2$ Matrix | |
|---|---|---|---|---|
| | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| 73°F | | | | |
| Moisture % | | 6.98 | | 5.87 |
| Bacteriology | | | | |
| SPC | 640 | 500 | 200 | 10 |
| Coliforms | <10 | <10 | <10 | <10 |
| Yeasts & Molds | <10 | <10 | <10 | <10 |
| Staphylococcus | Negative | Negative | Negative | Negative |
| Salmonella | Negative | Negative | Negative | Negative |
| 100°F | | | | |
| Moisture % | | 8.24 | | 8.10 |
| Bacteriology | | | | |
| SPC | 10 | 50 | 20 | 60 |
| Coliforms | <10 | <10 | <10 | <10 |
| Yeasts & Molds | <10 | <10 | <10 | <10 |
| Staphylococcus | Negative | Negative | Negative | Negative |
| Salmonella | Negative | Negative | Negative | Negative |

C. Non-Fat Dry Milk (Maple Island-Instant) Bar

1. Formula

| | |
|---|---|
| Non-fat Dry Milk (Maple Island-Instant) | 75% |
| $A_3$ or $B_2$ Matrix | 25% |
| Water/100 gm Dry Material | 5 ml |

2. Procedure

The dry milk solids together with the respective matrices were mixed together in a 12 qt. bowl on the A-200 Hobart mixer at speed #2. The water was added dropwise while mixing by means of a separatory funnel. Depth of fill was adjusted on the Denison hydraulic press so that resulting bars were 1/2" in thickness. Bars were pressed at 6000# gauge pressure (750 psi) with zero dwell time and normal action of both rams (simultaneous pressing of both upper and lower rams). The resulting 120 bars were dried in a hot air oven for 20 minutes at 120°F. Twenty one were packed in a glass

jars under a nitrogen atmosphere and the remainder was sealed into aluminized mylar pouches. Pouch stock is 0.5 mil mylar 0.00035" aluminum foil, and 3 mil polyvinyl chloride. Storage of the pouched bars was begun August 30, 1963 at 100°F, 73°F, 35°F, and 0°F. The nitrogen packed bars were placed in storage at 100°F, 73°F, and 0°F on August 30, 1963 also.

3. Results:

Initially the following test results were obtained.

| Test | $A_3$ Matrix | $B_2$ Matrix |
|---|---|---|
| Odor and Flavor | Typical of non-fat dry milk | Typical of non-fat dry milk |
| Mastication | | |
| a. Shear by incisors | | |
| (1) 35°F | Good | Good |
| (2) 70°F | Good | Good |
| (3) 100°F | Good | Good |
| b. Chew | | |
| (1) 35°F | Good | Good |
| (2) 70°F | Good | Good |
| (3) 100°F | Good | Good |
| c. Swallow | | |
| (1) 35°F | Good | Good |
| (2) 70°F | Good | Good |
| (3) 100°F | Good | Good |
| 6-Foot Drop Test | Broke into 3 pcs. each approx. 1/3 of bar | Broke into 3 pcs each approx. 1/3 of bar |
| Stickiness (24 hrs. at 40% humidity and room temperature) | None | None |
| Dimensional Stability (24 hrs. @120°F. and 5 psi.) | | |
| Before | 1/2" x 2-1/32" x 4-1/32" | 17/32" x 2-1/32" x 4-1/32" |
| After | 1/2" x 2" x 4" | 17/32" x 2-1/32" x 4" |

| | | $A_3$ Matrix | | | $B_2$ Matrix | |
|---|---|---|---|---|---|---|
| Net Change | 0 | -1/32" | -1/32" | 0 | 0 | -1.32" |
| Percent Change | 0.00 | -1.53 | -0.77 | 0.00 | 0.00 | =0.77 |

Moisture (16 hr. vacuum oven)

| | | |
|---|---|---|
| Nitrogen pack | 7.77 | 6.49 |
| Pouch pack | 7.38 | 7.00 |

Test

| Bacteriology | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
|---|---|---|---|---|
| SPC | 1590 | 1200 | 2660 | 1260 |
| Coliforms | 10 | 5 | 10 | 5 |
| Mold & Yeast | 40 | 30 | 80 | 30 |
| Staphylococci | Neg. | Neg. | Neg. | Neg. |

Storage Study

2 Weeks

35°F

| Organoleptic | | | | |
|---|---|---|---|---|
| Shear | - | Difficult | - | Difficult |
| Odor | - | Typical | - | Typical |
| Flavor | - | Typical | - | Typical |

73°F

| Bacteriology | | |
|---|---|---|
| SPC | 2330 | 2020 |
| Coliforms | 10 | 10 |
| Yeasts & Molds | 10 | 10 |
| Staphylococcus | Neg. | Neg. |
| Moisture | 6.74 | 6.96 |

| Organoleptic | | |
|---|---|---|
| Shear | Very difficult | Very difficult |
| Odor | Typical | Typical |
| Flavor | Typical | Typical |

| | $A_3$ Matrix | | $B_2$ Matrix | |
|---|---|---|---|---|
| 100°F | | | | |
| Bacteriology | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| SPC | 2420 | 740 | 2000 | 770 |
| Coliforms | 10 | 10 | 10 | 10 |
| Yeasts & Molds | 120 | 20 | 110 | 20 |
| Moisture | 6.34 | | 6.50 | |
| Organoleptic | | | | |
| Shear | Very difficult | Very difficult | Very difficult | Very difficult |
| Odor | Typical | Typical | Typical | Typical |
| Flavor | Typical | Typical | Typical | Typical |
| 4 Weeks | | | | |
| 35°F | | | | |
| Organoleptic | | | | |
| Shear | - | Difficult | - | Difficult |
| Odor | - | Typical | - | Typical |
| Flavor | - | Typical | - | Typical |
| 73°F | | | | |
| Organoleptic | | | | |
| Shear | Difficult | Difficult | Difficult | Good |
| Odor | Typical | Typical | Typical | Typical |
| Flavor | Typical | Typical | Typical | Typical |
| 100°F | | | | |
| Organoleptic | | | | |
| Shear | Difficult | Difficult | Difficult | Difficult |
| Odor | Typical | Typical | Typical | Typical |
| Flavor | Typical | Typical | Typical | Typical |
| 8 Weeks | | | | |
| 35°F | | | | |

| | $A_3$ Matrix | | $B_2$ Matrix | |
|---|---|---|---|---|
| Organoleptic | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| Shear | - | Difficult | - | Difficult |
| Odor | - | Typical | - | Typical |
| Flavor | - | Typical | - | Typical |
| 73°F | | | | |
| Organoleptic | | | | |
| Shear | Difficult | Difficult | Difficult | Difficult |
| Odor | Sl. burned | Typical | Typical | Typical |
| Flavor | Sl. burned | Typical | Typical | Typical |
| 100°F | | | | |
| Organoleptic | | | | |
| Shear | Difficult | Difficult | Difficult | Difficult |
| Odor | Typical | Typical | Typical | Typical |
| Flavor | Typical | Typical | Typical | Typical |
| 13 Week | | | | |
| 35°F | | | | |
| Organoleptic | | | | |
| Shear | - | Difficult | - | Difficult |
| Odor | - | Typical | - | Typical |
| Flavor | - | Typical | - | Typical |
| 73°F | | | | |
| Organoleptic | | | | |
| Shear | Difficult | Difficult | Difficult | Difficult |
| Odor | Typical | Typical | Typical | Typical |
| Flavor | Typical | Typical | Typical | Typical |
| 100°F | | | | |
| Organoleptic | | | | |
| Shear | Difficult | Difficult | Difficult | Difficult |
| Odor | Typical | Typical | Typical | Typical |
| Flavor | Typical | Typical | Typical | Typical |

| 26 Weeks | $A_3$ Matrix | | $B_2$ Matrix | |
|---|---|---|---|---|
| 35°F | | | | |
| Organoleptic | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| Shear | - | Difficult | - | Difficult |
| Odor | - | Typical | - | Typical |
| Flavor | - | Typical | - | Typical |
| 73°F | | | | |
| Organoleptic | | | | |
| Shear | Difficult | Difficult | Difficult | Difficult |
| Odor | Typical | Typical | Typical | Typical |
| Flavor | Typical | Typical | Typical | Typical |
| 100°F | | | | |
| Organoleptic | | | | |
| Shear | Difficult | Impossible | Difficult | Impossible |
| Odor | Sl. burned milk | Burned milk | Sl. burned milk | Burned milk |
| Flavor | Sl. burned milk | Burned milk | Sl. burned milk | Burned milk |
| 52 Weeks | | | | |
| 73°F | | | | |
| Moisture | 6.85 | | 7.70 | |
| Bacteriology | | | | |
| SPC | 1380 | | 2320 | |
| Coliforms | <10 | | 15 | |
| Yeast & Molds | 110 | | 40 | |
| Staphylococcus | Neg. | | Neg. | |
| Salmonella | Neg. | | Neg. | |
| 100°F | | | | |
| Bacteriology | | | | |
| SPC | 310 | 110 | 105 | 80 |
| Coliforms | <10 | <10 | <10 | <10 |
| Yeasts & Molds | <10 | <10 | <10 | <10 |

| 100°F (continued) | A3 Matrix | | B2 Matrix | |
|---|---|---|---|---|
| Bacteriology | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| Staphylococcus | Negative | Negative | Negative | Negative |
| Salmonella | Negative | Negative | Negative | Negative |

D. Sugar Cookie Bar

1. Formula

Sugar Cookie 75%

$A_3$ or $B_2$ Matrix 25%

Water/100 gm Dry Material 5 ml

2. Procedure

Sugar cookies were weighed into a 12 qt. Hobart mixing bowl and broken up on speed #1 on the Hobart A-200 mixer until the largest fragments remaining were approximately 3/4" in the longest dimension. The respective matrices were then added and the whole mixed until homogenous. Water was then added by separatory funnel while mixing continued. Depth of fill on the Denison press was adjusted so that resulting bars were 1/2" thick. Bars were pressed at 2000 #g.p. (250 psi) and a dwell time of "30%-10 sec." Stratification and cracking of the bar in its horizontal plane was avoided by inactivating the lower ram and attaining pressure by use of the upper ram only. About 120 bars were manufactured, and these were dried in a forced draught oven at 120°F. Twenty one were packed in glass jars under a nitrogen atmosphere, and the remainder was sealed into alumized mylar pouches. Pouch stock is 0.5 mil mylar, 0.00035" aluminum foil, and 3 mil polyvinyl chloride. Storage of the pouched bars was begun August 30, 1963 at 100°F, 73°F, 35°F, and 0°F. The nitrogen packed bars were placed in storage at 100°F, 73°F, and 0°F on August 30, 1963 also.

3. Results

Initially the following test results were obtained.

| Test | A3 Matrix | B2 Matrix |
|---|---|---|
| Odor & Flavor | Typical of Sugar Cookie | Typical of Sugar Cookie |

| | $A_3$ Matrix | $B_2$ Matrix |
|---|---|---|
| Mastication | | |
| a. Shear by Incisors | | |
| (1) 35°F | Good | Good |
| (2) 70°F | Good | Good |
| (3) 100°F | Good | Good |
| b. Chew | | |
| (1) 35°F | Good | Good |
| (2) 70°F | Good | Good |
| (3) 100°F | Good | Good |
| c. Swallow | | |
| (1) 35°F | Good | Good |
| (2) 70°F | Good | Good |
| (3) 100°F | Good | Good |
| 6 Foot Drop Test | Broke into 3 pcs on 2nd drop | Broke into quarters on 1st drop |
| Stickiness (24 hrs. @ 40% humidity and room temp.) | None | None |
| Dimensional Stability (24 hrs. @ 120°F and 5 psi) | | |
| Before | 1/2" x 2" x 4-1/32" | 1/2" x 2-1/32" x 4-1/32" |
| After | 1/2" x 2" x 4-1/32" | 1/2" x 2-1/32" x 4-1/32" |
| Net Change | 0 0 0 | 0 0 0 |
| Percent Change | 0.00 0.00 0.00 | 0.00 0.00 0.00 |
| Moisture % (16 hr. vacuum oven) | | |
| Nitrogen Pack | 6.66 | 7.61 |
| Pouch Pack | 7.34 | 8.11 |

| Bacteriology | $A_3$ Matrix | | $B_2$ Matrix | |
|---|---|---|---|---|
| | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| SPC | 770 | 1260 | 490 | 28 |
| Coliforms | <10 | >5 | <10 | <10 |

| | $A_3$ Matrix | | $B_2$ Matrix | |
|---|---|---|---|---|
| Bacteriology (cont'd) | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| Molds & Yeasts | <10 | 30 | <10 | ≤10 |
| Staphylococci | Neg. | Neg. | Neg. | Neg. |

Storage Study

2 week - 35°F

| Organoleptic | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
|---|---|---|---|---|
| Shear | - | Good | - | Good |
| Odor | - | Typical | - | Typical |
| Flavor | - | Typical | - | Typical |

73°F

| | | | | |
|---|---|---|---|---|
| Bacteriology | | | | |
| SPC | 990 | | 370 | |
| Coliforms | >10 | | <10 | |
| Yeasts & Molds | <10 | | <10 | |
| Staphylococcus | Neg. | | Neg. | |
| Moisture % | 7.85 | | 7.98 | |
| Organoleptic | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| Shear | Good | Good | Good | Good |
| Odor | Typical | Typical | Typical | Typical |
| Flavor | Typical | Typical | Typical | Typical |

100°F

| Bacteriology | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
|---|---|---|---|---|
| SPC | 770 | 280 | 260 | 200 |
| Coliforms | <10 | <10 | <10 | <10 |
| Yeasts & Molds | <10 | <10 | 5 | <10 |
| Moisture % | 6.72 | | 8.16 | |
| Organoleptic | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| Shear | Good | Good | Good | Good |
| Odor | Typical | Typical | Typical | Typical |

| | $A_3$ Matrix | | $B_2$ Matrix | |
|---|---|---|---|---|
| Organoleptic (cont'd) | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| Flavor | Typical | Typical, but bitter after-taste | Typical | Typical, but rancid fat after taste |
| 4 Week 35°F | | | | |
| Organoleptic | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| Shear | - | Good | - | Good |
| Odor | - | Typical | - | Typical |
| Flavor | - | Typical | - | Typical |
| 73°F | | | | |
| Organoleptic | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pou h Pack |
| Shear | Good | Good | Good | Good |
| Odor | Typical | Typical | Typical | Typical |
| Flavor | Typical | Typical | Typical | Typical |
| 100°F | | | | |
| Organoleptic | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| Shear | Good | Good | Good | Good |
| Odor | Typical | Typical | Typical | Typical |
| Flavor | Typical | Typical | Typical | Typical |
| 8 week - 35°F | | | | |
| Organoleptic | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| Shear | - | Good | - | Good |
| Odor | - | Typical | - | Typical |
| Flavor | - | Typical | - | Typical |
| 73°F | | | | |
| Organoleptic | | | | |
| Shear | Good | Good | Good | Good |
| Odor | Typical | Typical | Typical | Typical |
| Flavor | Typical | Typical | Typical | Typical |

| 100°F | $A_3$ Matrix | | $B_2$ Matrix | |
|---|---|---|---|---|
| Organoleptic | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| Shear | Good | Good | Good | Good |
| Odor | Typical | Typical | Typical | Typical |
| Flavor | Typical; bitter after taste | Typical | Typical; bitter after taste | Typical |
| 13 Weeks | | | | |
| 35°F | | | | |
| Organoleptic | | | | |
| Shear | - | Good | - | Good |
| Odor | - | Typical | - | Typical |
| Flavor | - | Typical | - | Typical |
| 73°F | | | | |
| Organoleptic | | | | |
| Shear | Good | Good | Good | Good |
| Odor | Typical | Typical | Typical | Typical |
| Flavor | Typical | Typical | Typical | Typical |
| 100°F | | | | |
| Organoleptic | | | | |
| Shear | Different | Good | Different | Good |
| Odor | Typical | Typical | Typical | Typical |
| Flavor | Typical | Typical | Typical | Typical |
| 26 Weeks | | | | |
| 35°F | | | | |
| Organoleptic | | | | |
| Shear | - | Good | - | Good |
| Odor | - | Typical | - | Typical |
| Flavor | - | Typical | - | Typical |
| 73°F | | | | |
| Organoleptic | | | | |
| Shear | Good | Good | Good | Good |

| | $A_3$ Matrix | | $B_2$ Matrix | |
|---|---|---|---|---|
| Organoleptic (cont'd) | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| Odor | Typical | Typical | Typical | Typical |
| Flavor | Typical | Typical | Typical | Typical |
| 100°F | | | | |
| Organoleptic | | | | |
| Shear | Good | Good | Good | Good |
| Odor | Typical | Typical | Typical | Typical |
| Flavor | Typical | Typical | Typical | Typical |
| 52 week | | | | |
| 72°F | | | | |
| Moisture % | 7.81 | | 7.01 | |
| Bacteriology | | | | |
| SPC | 510 | 210 | 320 | 365 |
| Coliforms | <10 | <10 | <10 | <10 |
| Yeasts & Molds | <10 | <10 | <10 | <10 |
| Staphylococcus | Neg. | Neg. | Neg. | Neg. |
| Salmonella | Neg. | Neg. | Neg. | Neg. |
| 100°F | | | | |
| Moisture % | 7.99 | | 7.41 | |
| Bacteriology | | | | |
| SPC | 530 | 70 | 630 | 50 |
| Coliforms | <10 | <10 | <10 | <10 |
| Yeasts & Molds | <10 | <10 | <10 | <10 |
| Staphylococcus | Neg. | Neg. | Neg. | Neg. |
| Salmonella | Neg. | Neg. | Neg. | Neg. |

E. Pie Crust Bars

1. Formula

| | |
|---|---|
| Pie Crust (baked) | 75% |
| $A_3$ or $B_2$ Matrix | 25% |
| Water/100 gm dry materials | 5 ml. |

2. Procedure

The pie crust was weighed into a 12 qt. bowl and broken up on the Hobart A-200 mixer on speed #2. The matrix was added and the whole mixed until homogenous. Water was added by separatory funnel while mixing continued. Depth of fill on the Denison hydraulic press was adjusted so that resulting bars were 1/2" thick. Bars were then pressed at 4000 # g.p. (500 psi.) and a dwell time of "15% -10 sec." and normal action of both upper and lower rams. The resulting bars were dried for 20' at 120°F. Of the 120 bars manufactured, about 100 were packed in aluminized mylar pouches. (Pouch stock: 0.5 mil mylar, 0.00035" aluminum foil and 3 mil polyvinyl chloride). Twenty-one were sealed under nitrogen in glass jars. Storage of the pouched bars was begun August 30, 1963 at 100°F, 73°F, and 0°F. Nitrogen packed jars were placed in storage on August 30, 1963 at 100°F, 73°F, and 0°F.

3. Results : The following test results were obtained initially:

| Test | $A_3$ Matrix | $B_2$ Matrix |
|---|---|---|
| Odor and Flavor | Typical of pie crust | Typical of pie crust |
| Mastication | | |
| a. Shear by Incisors | | |
| (1) 35°F | Good | Good |
| (2) 70°F | Good | Good |
| (3) 100°F | Good | Good |
| b. Chew | | |
| (1) 35°F | Good | Good |
| (2) 70°F | Good | Good |
| (3) 100°F | Good | Good |

| Test | $A_3$ Matrix | | $B_2$ Matrix | |
|---|---|---|---|---|
| c. Swallow | | | | |
| (1) 35°F | Good | | Good | |
| (2) 70°F | Good | | Good | |
| (3) 100°F | Good | | Good | |
| 6 Foot Drop Test | Broke into 3 pcs. on 4th drop | | Broke into 3 pcs. on 1st drop | |
| Bacteriology | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| SPC | <50 | 420 | 350 | 460 |
| Coliforms | <10 | <10 | >10 | <10 |
| Molds & Yeasts | 20 | <10 | 10 | >5 |
| Staphylococci | neg. | neg. | neg. | neg. |
| Stickiness (24 hrs at 40% humidity and room temp.) | none | | None | |
| Dimensional Stability (24 hrs. at 120°F and 5 psi) | | | | |
| Before | 1/2"x2 1/32"x4 1/16" | | 17/32"x2 1/32"x4 1/16" | |
| After | 15/32"x2 1/32"x4 1/16" | | 1/2"x2 1/32"x4 1/32" | |
| Net Change | -1/32" 0 | 0 | -1/32" 0 | -1/32" |
| Percent change | -5.00 0.00 | 0.00 | -5.88 0.00 | -0.77 |
| Moisture | | | | |
| Nitrogen pack | 10.56 | | 7.86 | |
| Pouch pack | 10.24 | | 7.88 | |
| Storage Study | | | | |
| 2 Weeks | | | | |
| 35°F | | | | |
| Organoleptic | | | | |
| Shear | good | | good | |
| Odor | Typical | | Typical | |
| Flavor | Typical | | Typical | |

| 2 Weeks | $A_3$ Matrix | | $B_2$ Matrix | |
|---|---|---|---|---|
| | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| 73°F | | | | |
| Bacteriology | | | | |
| SPC | | 520 | | 360 |
| Coliforms | | <10 | | <10 |
| Yeasts & Molds | | <10 | | <10 |
| Staphylococcus | | neg. | | neg. |
| Moisture | | 9.97 | | 8.07 |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | sl. rancid fat | typical | typical | typical |
| Flavor | typical/bitter after taste | typical/bitter after taste | typical/bitter after taste | typical/bitter after taste |
| 100°F | | | | |
| Bacteriology | | | | |
| SPC | 1120 | 420 | 400 | 380 |
| Coliforms | <10 | <10 | <10 | <10 |
| Yeasts & molds | 20 | <10 | 20 | <10 |
| Moisture | | 10.69 | | 7.93 |
| Organoleptic | | | | |
| Shear | Good | Good | Good | Good |
| Odor | Rancid Fat | Rancid Fat | Rancid Fat | Rancid Fat |
| Flavor | " " | " " | " " | " " |
| 4 Weeks | | | | |
| 35°F | | | | |
| Organoleptic | | | | |
| Shear | | Good | | Good |
| Odor | | typical | | typical |
| Flavor | | Typical | | typical |

Storage Study cont'd

| 4 Weeks / 73°F | $A_3$ Matrix | | $B_2$ Matrix | |
|---|---|---|---|---|
| | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | sl. rancid fat | sour rancid fat | typical | rancid, bitter |
| Flavor | sl. rancid fat | sour rancid fat | typical | rancid, bitter |
| 100°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | sl. rancid fat | rancid fat | typical | rancid fat |
| Flavor | sl. rancid fat | rancid/bitter | typical | bitter |
| 8 weeks | | | | |
| 35°F | | | | |
| Organoleptic | | | | |
| Shear | | Good | | Good |
| Odor | | sl. rancid fat | | sl. rancid fat |
| Flavor | | sl. rancid fat | | sl. rancid fat |
| 73°F | | | | |
| Organoleptic | | | | |
| Shear | Good | Good | Good | Good |
| Odor | rancid | rancid | typical | sl. rancid |
| Flavor | rancid/bitter after taste | rancid | sl. rancid | sl. rancid |
| 100°F | | | | |
| Organoleptic | | | | |
| Shear | Good | Good | Good | Good |
| Odor | rancid fat | rancid fat | rancid fat | rancid fat |
| Flavor | bitter | rancid fat | rancid fat | bitter |

| Storage Study cont'd | $A_3$ Matrix | | $B_2$ Matrix | |
|---|---|---|---|---|
| | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| 13 Week | | | | |
| 35°F | | | | |
| Organoleptic | | | | |
| Shear | | good | | good |
| Odor | | typical | | typical |
| Flavor | | typical | | typical |
| 75°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | typical | sl rancid fat | typical | sl. rancid fat |
| Flavor | typical | sl. bitter | typical | sl. bitter |
| 100°F. | | | | |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | typical | typical | typical | rancid |
| Flavor | bitter | sl. bitter | bitter | bitter |
| 26 Weeks | | | | |
| 35°F | | | | |
| Organoleptic | | | | |
| Shear | | good | | good |
| Odor | | typical | | typical |
| Flavor | | typical | | typical |
| 73°F | | | | |
| Organoleptic | | | | |
| Shear | moldy | good | good | good |
| Odor | Not tested | typical | typical | typical |
| Flavor | Not tested | typical | typical | typical |

Storage Study cont'd

| | $A_3$ Matrix | | $B_2$ Matrix | |
|---|---|---|---|---|
| 26 Weeks 100°F | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| Organoleptic | | | | |
| Shear | moldy | good | good | good |
| Odor | not tested | typical | typical | typical |
| Flavor | not tested | bitter | bitter | bitter |
| 52 Weeks | | | | |
| 72°F | | | | |
| Moisture | | 10.86 | | 7.55 |
| Bacteriology | | | | |
| SPC | 80 | 320 | 100 | 110 |
| Coliforms | <10 | <10 | <10 | <10 |
| Yeasts & Molds | 10 | <10 | 60 | <10 |
| Staphlococcus | neg | neg | neg | neg |
| Salmonella | neg | neg | neg | neg |
| 100°F | | | | |
| Moisture | | 11.03 | | 8.05 |
| Bacteriology | | | | |
| SPC | 90 | 50 | 40 | 40 |
| Coliforms | <10 | <10 | <10 | <10 |
| Yeasts & Molds | <10 | <10 | <10 | <10 |
| Staphlococcus | neg | neg | neg | neg |
| Salmonella | neg | neg | neg | neg |

F. Peach Bars

1. Formula

| | |
|---|---|
| Peaches, dried | 75% |
| $A_3$ or $B_2$ Matrix | 25% |
| Water/100 gm. dry materials | 4 ml. |

2. Procedure

Peach halves were chopped using a 1 gal. Waring blendor canister. Water was added by separatory funnel to the chopped peach halves in a 12 qt. Hobart mixer bowl with mixing on speed #2. The matrix was next added and mixing was continued until the peach pieces were uniformly coated with matrix. Depth of fill on the Denison hydraulic press was adjusted so that resulting bars were 1/2" thickness. About 120 bars were fabricated at "2500 #g.p." (312.5 psi) and a dwell time of "25%-10 sec." with the lower ram of the press stationary thus duplicating the action of the Carver laboratory press. Bars were dried for 30 minutes at 120°F and about 100 were sealed in aluminized PVC pouches (pouch stock: 0.5 mylar 0.00035" aluminum foil and 3 mil polyvinyl chloride). Twenty-one were sealed under nitrogen in glass jars. The storage of pouched bars was begun on August 30, 1963 at 0°F, 35°F, 73°F, and 100°F. Storage of nitrogen packed bars was begun on August 30, 1963 also, but at 0°F, 73°F and 100°F.

3. Results: Initially the following test results were obtained.

| Test | $A_3$ Matrix | $B_2$ Matrix |
|---|---|---|
| Odor and Flavor | Typical of dried peaches | Typical of dried peaches |
| Mastication | | |
| a. Shear by Incisors | | |
| (1) 35°F | good | good |
| (2) 70°F | good | good |
| (3) 100°F | good | good |
| b. Chew | | |
| (1) 35°F | good | good |
| (2) 70°F | good | good |
| (3) 100°F | good | good |
| c. Swallow | | |
| (1) 35°F | good | good |
| (2) 70°F | good | good |
| (3) 100°F | good | good |

| | $A_3$ Matrix | | | $B_2$ Matrix | |
|---|---|---|---|---|---|
| Dimensional Stability (24 hrs. at 120°F and 5 psi) | | | | | |
| Before | 9/16"x 1 15/16"x3 7/8" | | | 9/16"x 1 15/16" x3 7/8" | |
| After | 17/32"x 1 31/32"x3 7/8" | | | 1/2" x 2" x 3 29/32" | |
| Net Change | -1/32" | +1/32" | 0 | -1/16" | +1/16" + 1/32" |
| Percent change | -5.56 | +1.61 | 0.00 | -11.11 | + 3.23 +0.81 |
| 6 Foot Drop Test | Broke in half on 59th drop | | | Broke in half on 11th drop | |
| Stickiness (24 hrs. at 40% humidity and room temp.) | None | | | None | |
| Moisture (18 hr vacuum oven) | | | | | |
| Nitrogen pack | | 20.47 | | | 20.53 |
| Pouch pack | | 20.95 | | | 21.50 |
| Bacteriology | Nitrogen Pack | Pouch Pack | | Nitrogen Pack | Pouch Pack |
| SPC | 600 | 280 | | 470 | 290 |
| Coliforms | <10 | <10 | | <10 | <10 |
| Yeasts & Molds | <10 | <10 | | <10 | <10 |
| Staphylococcus | neg. | neg | | neg | neg |
| Storage Study | | | | | |
| 2 Weeks | | | | | |
| 35°F | | | | | |
| Organoleptic | | | | | |
| Shear | | good | | | good |
| Odor | | typical | | | typical |
| Flavor | | typical | | | typical |
| 73°F. | | | | | |
| Bacteriology | | | | | |
| SPC | | 600 | | | 910 |
| Coliforms | | <10 | | | >10 |
| Yeasts & Molds | | <10 | | | <10 |
| Staphlococcus | | neg. | | | neg. |
| Moisture | | 21.92 | | | 21.56 |
| Organoleptic | | | | | |
| Shear | good | good | | good | good |

| 2 Weeks Cont'd | $A_3$ Matrix | | $B_2$ Matrix | |
|---|---|---|---|---|
| Organoleptic | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| Odor | typical | typical | typical | typical |
| Flavor | typical | typical | typical | typical |
| 100°F | | | | |
| Bacteriology | | | | |
| SPC | 440 | 320 | 290 | 260 |
| Coliforms | <10 | <10 | <10 | <10 |
| Yeasts & Molds | <10 | <10 | <10 | <10 |
| Moisture % | | 21.16 | | 19.93 |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | typical | typical | typical | typical |
| Flavor | typical | typical | typical | typical |
| 4 Weeks 35°F | | | | |
| Organoleptic | | | | |
| Shear | | Good | | Good |
| Odor | | typical | | typical |
| Flavor | | typical | | typical |
| 73°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | typical | typical | typical | typical |
| Flavor | typical | typical | typical | typical |
| 100°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | typical | typical | typical | typical |
| Flavor | typical | typical | typical | typical |

| Storage Study | $A_3$ Matrix | | $B_2$ Matrix | |
|---|---|---|---|---|
| | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| 8 Weeks | | | | |
| 35°F | | | | |
| Organoleptic | | | | |
| Shear | | good | | good |
| odor | | typical | | typical |
| Flavor | | typical | | typical |
| 73°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | typical | typical | typical | cooked peaches |
| Flavor | typical | typical | typical | cooked peaches |
| 100°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | typical | typical | typical | typical |
| Flavor | bitter | typical | typical | typical |
| 13 Weeks | | | | |
| 35°F | | | | |
| Organoleptic | | | | |
| Shear | | good | | good |
| Odor | | typical | | typical |
| Flavor | | typical | | typical |
| 73°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | typical | typical | typical | typical |
| Flavor | typical | typical | typical | typical |
| 100°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | cooked peaches | cooked peaches | cooked peaches | cooked peaches |
| Flavor | bitter | bitter | bitter | bitter |

| Storage Study cont'd | $A_3$ Matrix | | $B_2$ Matrix | |
|---|---|---|---|---|
| 26 Weeks | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| 35°F | | | | |
| Organoleptic | | | | |
| Shear | | good | | good |
| Odor | | typical | | typical |
| Flavor | | typical | | typical |
| 73°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | typical | typical | typical | typical |
| Flavor | typical | typical | typical | typical |
| 100°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| odor | cooked peaches | cooked peaches | cooked peaches | cooked peaches |
| Flavor | cooked peaches | sl. bitter | cooked peaches | sl. bitter |
| 52 Weeks | | | | |
| 72°F | | | | |
| Moisture | | 22.90 | | 21.27 |
| Bacteriology | | | | |
| SPC | 230 | 70 | 180 | 40 |
| Coliforms | <10 | <10 | <10 | <10 |
| Yeasts & Molds | <10 | <10 | <10 | <10 |
| Staphlococcus | neg | neg | neg | neg |
| Salmonella | neg | neg | neg | neg |
| 100°F | | | | |
| Moisture | | 23.44 | | 23.57 |
| Bacteriology | | | | |
| SPC | 740 | 30 | 10 | 20 |
| Coliforms | <10 | <10 | <10 | <10 |
| Yeasts & Molds | <10 | <10 | <10 | <10 |
| Staphlococcus | neg | neg | neg | neg |
| Salmonella | neg | neg | neg | neg |

G. Peanut Bars

1. Formula

| | |
|---|---|
| Peanuts (Grind "A" medium dry roast, Sachs Nut Co.) | 75% |
| A or B matrix | 25% |
| Water/100 gm. dry material | 5 ml |
| Salt/100 gm dry material | 1.5 gm. |

2. Procedure:

Peanuts and salt were mixed together until homogenous in a 12 qt. bowl in the A-200 Hobart mixer on speed #2. Water was added by separatory funnel while mixing continued. The respective matrices were added and mixing was continued until homogenous. Depth of fill was adjusted on the Denison hydraulic press so that resulting bars were 1/2" thick. About 120 bars were fabricated at 5000 #g.p. (625 psi.) and zero dwell time. The lower ram was not activated, the total pressure being applied by the upper ram only. This procedure avoided stratification and cracking in the horizontal plane. The bars were finished by drying in a forced air oven for 30' at 120°F. About 100 bars were sealed in aluminized mylar pouches and 21 were packed under nitrogen in glass jars. Pouch stock is 0.5 mil mylar, 0.00035" aluminum foil, and 3 mil polyvinyl chloride. Storage of the pouched bars was begun August 30, 1963, at 100°F, 73°F, 35°F, and 0°F. The nitrogen packed bars were placed in storage at 100°F, 73°F, and 0°F on August 30, 1963.

3. Results: The following test results were obtained initially.

| Test | $A_3$ Matrix | $B_2$ Matrix |
|---|---|---|
| Odor and Flavor | Typical of dry roasted peanuts | Typical of dry roasted peanuts |
| Mastication | | |
| a. Shear by Incisors | | |
| (1) 35°F | good | good |
| (2) 70°F | good | good |
| (3) 100°F | good | good |
| b. Chew | | |
| (1) 35°F | good | good |
| (2) 70°F | good | good |
| (3) 100°F | good | good |

| Test | $A_3$ Matrix | $B_2$ Matrix |
|---|---|---|
| c. Swallow | | |
| (1) 35°F | good | good |
| (2) 70°F | good | good |
| (3) 100°F | good | good |
| 6 Foot Drop Test | Broke into 2 pcs. on 2nd drop | Broke into 2 pcs. on 2nd drop |
| Stickiness (24 hrs. @ 40% humidity and room temp.) | none | none |

| Dimensional Stability (24 hrs. at 120°F and 5 psi.) | | | | | | |
|---|---|---|---|---|---|---|
| Before | 1/2"x2 1/32"x 4 1/32" | | | 17/32" x 2 1/32" x 4 1/16" | | |
| After | 15/32 x 2 1/32"x4 1/32" | | | 1/2" x2 1/32" x 4 1/16" | | |
| Net change | -1/32" | 0 | 0 | -1/32" | 0 | 0 |
| Percent change | -6.25 | 0.00 | 0.00 | -5.88 | 0.00 | 0.00 |

Moisture (16 hr vacuum oven)

| | | |
|---|---|---|
| Nitrogen Pack | 5.47 | 5.10 |
| Pouch Pack | 5.26 | 4.86 |

| Bacteriology | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
|---|---|---|---|---|
| SPC | 500 | 240 | 600 | 260 |
| Coliforms | <10 | <10 | <10 | <10 |
| Molds & Yeasts | 20 | 10 | 10 | 10 |
| Staphylococci | neg. | neg. | neg. | neg. |

Storage Study

2 Weeks
35°F
Organoleptic

| | | | | |
|---|---|---|---|---|
| Shear | good | good | good | good |
| Odor | sl. rancid oil | typical | sl. rancid oil | typical |
| Flavor | sl. rancid oil | sl. rancid oil | sl. rancid oil | sl. rancid oil |

73°F.
Bacteriology

| | | |
|---|---|---|
| SPC | 700 | 310 |
| Coliforms | <10 | >10 |
| Yeasts & Molds | <10 | <10 |
| Staphlococcus | neg | neg |

| Storage Study cont'd | $A_3$ Matrix | | $B_2$ Matrix | |
|---|---|---|---|---|
| | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| Moisture | | 4.52 | | 5.42 |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | rancid oil | sl. rancid oil | rancid oil | sl. rancid oil |
| Flavor | bitter after taste | sl. rancid oil | bitter after taste | sl. rancid oil |
| 100°F | | | | |
| Bacteriology | | | | |
| SPC | 770 | 280 | 580 | 190 |
| Coliforms | <10 | <10 | <10 | <10 |
| Yeasts & Mold | 10 | 10 | 5 | 10 |
| Moisture | | 5.39 | | 5.32 |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | rancid oil | rancid oil | rancid oil | rancid oil |
| Flavor | rancid oil | rancid oil | rancid oil | rancid oil |
| 4 Weeks | | | | |
| 35°F | | | | |
| Organoleptic | | | | |
| Shear | | good | | good |
| Odor | | sl. rancid oil | | sl. rancid oil |
| Flavor | | sl. rancid oil | | sl. rancid oil |
| 73°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | rancid oil | rancid oil | rancid oil | rancid oil |
| Flavor | rancid oil | rancid oil | rancid oil | rancid oil |
| 100°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| odor | rancid oil | rancid oil | rancid oil | rancid oil |
| Flavor | rancid oil | rancid oil | rancid oil | rancid oil |

| rage Study cont'd | $A_3$ Matrix | | $B_2$ Matrix | |
|---|---|---|---|---|
| | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| Moisture | | 4.52 | | 5.42 |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | rancid oil | sl. rancid oil | rancid oil | sl. rancid oil |
| Flavor | bitter after taste | sl. rancid oil | bitter after taste | sl. rancid oil |
| 100°F | | | | |
| Bacteriology | | | | |
| SPC | 770 | 280 | 580 | 190 |
| Coliforms | <10 | <10 | <10 | <10 |
| Yeasts & Mold | 10 | 10 | 5 | 10 |
| Moisture | | 5.39 | | 5.32 |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | rancid oil | rancid oil | rancid oil | rancid oil |
| Flavor | rancid oil | rancid oil | rancid oil | rancid oil |
| 4 Weeks | | | | |
| 35°F | | | | |
| Organoleptic | | | | |
| Shear | | good | | good |
| Odor | | sl. rancid oil | | sl. rancid oil |
| Flavor | | sl. rancid oil | | sl. rancid oil |
| 73°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | rancid oil | rancid oil | rancid oil | rancid oil |
| Flavor | rancid oil | rancid oil | rancid oil | rancid oil |
| 100°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| odor | rancid oil | rancid oil | rancid oil | rancid oil |
| Flavor | rancid oil | rancid oil | rancid oil | rancid oil |

Storage Study cont'd

| | $A_3$ Matrix | | $B_2$ Matrix | |
|---|---|---|---|---|
| | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| 8 Weeks | | | | |
| 35°F | | | | |
| Organoleptic | | | | |
| Shear | | good | | good |
| Odor | | rancid oil | | rancid oil |
| Flavor | | rancid oil | | rancid oil |
| 73°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | sl. rancid oil | rancid oil | rancid oil | rancid oil |
| Flavor | sl. rancid oil | rancid oil | rancid oil | rancid oil |
| 100°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | rancid oil | rancid oil | rancid oil | rancid oil |
| Flavor | rancid oil | rancid oil | rancid oil | bitter |
| 13 Weeks | | | | |
| 35°F | | | | |
| Organoleptic | | | | |
| Shear | | good | | good |
| Odor | | rancid oil | | rancid oil |
| Flavor | | rancid oil | | rancid oil |
| 73°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | rancid oil | rancid oil | rancid oil | rancid oil |
| Flavor | rancid oil | sl bitter | rancid oil | sl. bitter |
| 100°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | rancid oil | rancid oil | rancid oil | rancid oil |
| Flavor | bitter | bitter | bitter | bitter |

| Storage Study cont'd | $A_3$ Matrix | | $B_2$ Matrix | |
|---|---|---|---|---|
| 26 weeks | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| 35°F | | | | |
| Organoleptic | | | | |
| Shear | | good | | good |
| Odor | | sl rancid oil | | sl rancid oil |
| Flavor | | sl rancid oil | | sl rancid oil |
| 73°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | rancid oil | rancid oil | rancid oil | rancid oil |
| Flavor | rancid oil | rancid oil | rancid oil | rancid oil |
| 100°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | rancid oil | rancid oil | acrid oil | rancid oil |
| Flavor | bitter | very bitter | v. bitter | v. bitter |
| 52 Weeks | | | | |
| 72°F | | | | |
| Moisture | | 4.74 | | 5.22 |
| Bacteriology | | | | |
| SPC | 160 | 750 | 70 | 160 |
| Coliforms | < 10 | <10 | <10 | <10 |
| Yeasts & Molds | <10 | 10 | 10 | 60 |
| Staphlococcus | neg | neg | neg | neg |
| Salmonella | neg | neg | neg | neg |
| 100°F | | | | |
| Moisture | | 4.93 | | 5.46 |
| Bacteriology | | | | |
| SPC | 1500 | 130 | 940 | 60 |
| Coliforms | <10 | <10 | <10 | <10 |
| yeasts & Molds | <10 | <10 | < 10 | <10 |
| Staphlococcus | neg | neg | neg | neg |
| Salmonella | neg | neg | neg | neg |

H. Chicken Bars

1. Formula

| | |
|---|---|
| Chicken, freeze dried | 75% |
| $A_3$ or $B_2$ Matrix | 25% |
| Water-glycerine solution (16%)/100 g. dry material | 20 ml. |

2. Procedure

The chicken was weighed into a 12 qt. bowl on the A-200 Hobart mixer, and the chicken was reduced in particle size on speed #2. The respective matrices were added and the whole mixed until homogenous. The glycerine solution was added by separatory funnel while mixing continued. Depth of fill on the Denison hydraulic press was adjusted so that the resulting bar was 1/2" in thickness. About 120 bars were fabricated with a 6000 #g.p. (750 psi) and a dwell time of "25%-10 sec." and normal action of both upper and lower rams of the press. Bars were dried for 3.5 hrs at 120°F and about 100 were sealed in aluminized PVC pouches (pouch stock: 0.5 mil mylar, 0.00035" aluminum foil, 3 mil mylar) and 21 were sealed under nitrogen in glass jars. Storage at 0°F, 35°F, 73°F, and 100°F was begun on August 30, 1963 for the pouch packed bars. The nitrogen packed bars were placed into storage on August 30, 1963 at 0°F, 73°F, and 100°F.

3. Results: Test results initially were as follows.

| Test | $A_3$ Matrix | $B_2$ Matrix |
|---|---|---|
| Odor and Flavor | Normal to freeze dried chicken | Normal to freeze dried chicken |
| Mastication | | |
| a. Shear by Incisors | | |
| (1) 35°F | good | good |
| (2) 70°F | good | good |
| (3) 100°F | good | good |
| b. Chew | | |
| (1) 35°F | good | good |
| (2) 70°F | good | good |
| (3) 100°F | good | good |
| c. Swallow | | |
| (1) 35°F | good | good |
| (2) 70°F | good | good |
| (3) 100°F | good | good |

| Table | $A_3$ Matrix | | | $B_2$ Matrix | | |
|---|---|---|---|---|---|---|
| Dimensional Stability (24 hrs. at 120°F and 5 psi) | | | | | | |
| Before | 17/32"xl 31/32"x3 7/8" | | | 1/2" x 2" x 3 29/32" | | |
| After | 1/2"x 1 15/32"x 3 27/32" | | | 15/32"x 1 31/32"x3 7/8" | | |
| Net Change | -1/32" | -1/32" | -1/32" | -1/32" | -1/32" | -1/32" |
| Percent change | -5.88 | -1.58 | -0.81 | -6.25 | -1.45 | -0,80 |
| 6 foot Drop Test | Broke into 3 pieces on 8th drop | | | Broke into 4 pieces on 4th drop | | |
| Stickiness (24 hrs. at 40% humidity and room temp.) | none | | | none | | |
| Moisture (18 hr. vacuum oven) | | | | | | |
| Nitrogen pack | 10.71 | | | 8.11 | | |
| Pouch pack | 9.41 | | | 7.76 | | |
| Bacteriology | Nitrogen Pack | Pouch Pack | | Nitrogen Pack | Pouch Pack | |
| SPC | 900 | 1080 | | 900 | 1110 | |
| Coliforms | 10 | 5 | | 5 | 5 | |
| Yeasts and Molds | 10 | 20 | | 10 | 20 | |
| Staphylococcus | neg | neg | | neg | neg | |
| Storage Study 2 Weeks | | | | | | |
| 35°F Organoleptic | | | | | | |
| Shear | | good | | | sl difficult | |
| Odor | | typical | | | typical | |
| Flavor | | typical | | | typical | |
| 73°F | | | | | | |
| Bacteriology | | | | | | |
| SPC | | 1450 | | | | |
| Coliforms | | >10 | | | | |
| yeasts & molds | | 10 | | | | |
| Staphlococcus | | neg | | | | |
| Moisture | | 8.29 | | | 8.18 | |

| Storage Study cont'd | $A_3$ Matrix | | $B_2$ Matrix | |
|---|---|---|---|---|
| 2 Weeks | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| 73°F | | | | |
| Organoleptic | | | | |
| Shear | good | sl difficult | good | difficult |
| Odor | typical | typical | typical | typical |
| Flavor | typical | typical | typical | typical |
| 100°F | | | | |
| Bacteriology | | | | |
| SPC | 1200 | 780 | 550 | 680 |
| Coliforms | <10 | < 10 | <10 | <10 |
| Yeasts & Molds | 30 | 20 | 25 | 25 |
| Moisture | | 11.98 | | 8.73 |
| Organoleptic | | | | |
| Shear | difficult | difficult | difficult | good |
| Odor | typical | typical | typical | acrid odor |
| Flavor | typical | typical | typical | bitter, biting |
| 4 Weeks | | | | |
| 35°F | | | | |
| Organoleptic | | | | |
| Shear | | sl. difficult | | sl. difficult |
| Odor | | typical | | typical |
| flavor | | typical | | typical |
| 73°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | typical | typical | typical | typical |
| Flavor | typical | typical | typical | typical |
| 100°F | | | | |
| Organoleptic | | | | |
| shear | good | good | good | good |
| odor | typical | typical | typical | typical |
| Flavor | typical | typical | typical | typical |

Storage Study cont'd

| 8 Weeks | $A_3$ Matrix | | $B_2$ Matrix | |
|---|---|---|---|---|
| | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| Organoleptic | | | | |
| Shear | | difficult | | difficult |
| Odor | | typical | | typical |
| Flavor | | typical | | typical |
| 73°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | typical | typical | typical | typical |
| Flavor | typical | typical | typical | typical |
| 100°F | | | | |
| Organoleptic | | | | |
| Shear | difficult | good | good | good |
| Odor | typical | typical | typical | typical |
| Flavor | typical/bitter after taste | sl rancid | typical/bitter after taste | typical |
| 13 Weeks | | | | |
| 35°F | | | | |
| Organoleptic | | | | |
| Shear | | good | | good |
| Odor | | typical | | typical |
| Flavor | | typical | | typical |
| 73°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | typical | typical | typical | typical |
| Flavor | typical | typical | typical | typical |
| 100°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | cooked chicken | cooked chicken | cooked chicken | cooked chicken |
| Flavor | typical | typical | typical | typical |

| Storage Study cont'd | $A_3$ Matrix | | $B_2$ Matrix | |
|---|---|---|---|---|
| 26 Weeks | | | | |
| 35°F | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| Organoleptic | | | | |
| Shear | | good | | good |
| Odor | | typical | | typical |
| Flavor | | typical | | typical |
| 73°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | typical | stale chicken | typical | stale chicken |
| Flavor | typical | stale chicken | typical | stale chicken |
| 100°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| odor | typical | stale chic. | typical | stale chic. |
| Flavor | stale chic. | stale chic. | stale chic. | stale chic. |
| 52 Weeks | | | | |
| 72°F | | | | |
| Moisture | | 10.01 | | 7.56 |
| Bacteriology | | | | |
| SPC | 750 | 360 | 220 | 180 |
| Coliforms | <10 | 20 | <10 | <10 |
| Yeasts & Molds | 30 | 10 | 30 | 10 |
| Staphlococcus | neg | neg | neg | neg |
| Salmonella | neg | neg | neg | neg |
| 100°F | | | | |
| Moisture | | 10.80 | | 8.60 |
| Bacteriology | | | | |
| SPC | 230 | 150 | 250 | 100 |
| Coliforms | <10 | <10 | <10 | <10 |
| Yeasts & Molds | 20 | <10 | 10 | 10 |
| Staphlococcus | neg | neg | neg | neg |
| Salmonella | neg | neg | neg | neg |

I. Chocolate Bars

1. Formula

| | |
|---|---|
| Chocolate (Wilbur Chocolate Co. cookie chocolate) | 75% |
| $A_3$ or $B_2$ matrix | 25% |
| Water/1000 gm dry material | 5 ml. |

2. Procedure

The chocolate was first comminuted in a Waring blendor, then weighed into a 12 qt. Hobart mixing bowl and the appropriate matrix added. The whole was mixed until homogenous on #2 speed of the A-200 Hobart mixer. The water was then added by separatory funnel while mixing continued. Depth of fill on the Denison hydraulic press was adjusted so that resulting bars were 1/2" thick. Bars were fabricated at 4000# g.p. (500 psi) and a dwell time of "15%-10 sec." with the lower ram inactivated so that the action of the Carver laboratory press was duplicated. This avoided lamination and cracking of the bar in the horizontal plane. Of the approximately 120 bars fabricated, all of which were dried 20 minutes at 120°F, about 100 were packed in aluminized PVC pouches (pouch stock: 0.5 mil mylar, 0.00035" aluminum foil, 3 mil polyvinyl chloride) and 21 were packed in glass jars under a nitrogen atmosphere. Storage of the pouched bars was begun August 30, 1963 at 0°F, 35°F, 73°F, and 100°F. The nitrogen packed jars began storage on August 30, 1963 also, but at 0°F, 73°F, and 100°F.

3. Results: The following test results were obtained intially.

| Test | $A_3$ Matrix | $B_2$ Matrix |
|---|---|---|
| Odor and Flavor | typical of choc. | typical of choc. |
| Mastication | | |
| a. Shear by Incisors | | |
| (1) 35°F | good | good |
| (2) 70°F | good | good |
| (3) 100°F | good | good |
| b. Chew | | |
| (1) 35°F | good | good |
| (2) 70°F | good | good |
| (3) 100 F | good | good |
| c. Swallow | | |
| (1) 35°F | good | good |
| (2) 70°F | good | good |
| (3) 100°F | good | good |

| Test Cont'd | $A_3$ Matrix | $B_2$ Matrix |
|---|---|---|
| 6 foot drop test | Broke in half on 4th drop | Broke into 3 pcs on 2nd drop |
| Stickiness (24 hrs at 40% humidity and room temp.) | none | none |
| Dimensional Stability (24 hrs. at 120°F. and 5 psi.) | | |
| Before | 17/32"x2 1/32"x4 1/32" | 1/2"x 2 1/32"x4 1/32" |
| After | 1/2" x 2 1/16:x 4 1/32" | 15/32"x2 1/32"x4 1/32" |
| Net change | -1/32" +1/32" 0 | -1/32" 0 0 |
| Percent Change | -5.88 + 1.54 0.00 | -6.25 0.00 0.00 |
| Moisture | | |
| Nitrogen pack | 6.43 | 6.06 |
| Pouch pack | 6.53 | 6.09 |

| Bacteriology | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
|---|---|---|---|---|
| SPC | 1270 | 1090 | completely overgrown with mold before storage could be started. | 830 |
| Coliforms | <10 | <10 | | <10 |
| Yeasts & Molds | 40 | 30 | | 30 |
| Staphylococcus | neg | neg | | neg |

Storage Study
2 Weeks
35°F

| | | |
|---|---|---|
| Organoleptic | | |
| Shear | good | good |
| Odor | typical | typical |
| Flavor | typical | typical |

73°F

| | | |
|---|---|---|
| Bacteriology | | |
| SPC | 2200 | 2300 |
| Coliforms | >10 | >10 |
| Yeasts & Molds | 10 | <10 |
| Staphlococcus | neg | neg |

| Test Cont'd | $A_3$ Matrix | $B_2$ Matrix |
|---|---|---|
| 6 foot drop test | Broke in half on 4th drop | Broke into 3 pcs on 2nd drop |
| Stickiness (24 hrs at 40% humidity and room temp.) | none | none |
| Dimensional Stability (24 hrs. at 120°F. and 5 psi.) | | |
| Before | 17/32"x2 1/32"x4 1/32" | 1/2"x 2 1/32"x4 1/32" |
| After | 1/2" x 2 1/16:x 4 1/32" | 15/32"x2 1/32"x4 1/32" |
| Net change | -1/32" +1/32" 0 | -1/32" 0 0 |
| Percent Change | -5.88 + 1.54 0.00 | -6.25 0.00 0.00 |
| Moisture | | |
| Nitrogen pack | 6.43 | 6.06 |
| Pouch pack | 6.53 | 6.09 |

| Bacteriology | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
|---|---|---|---|---|
| SPC | 1270 | 1090 | completely overgrown with mold before storage could be started. | 830 |
| Coliforms | <10 | <10 | | <10 |
| Yeasts & Molds | 40 | 30 | | 30 |
| Staphylococcus | neg | neg | | neg |

Storage Study
2 Weeks
35°F

| Organoleptic | | |
|---|---|---|
| Shear | good | good |
| Odor | typical | typical |
| Flavor | typical | typical |

73°F

| Bacteriology | | |
|---|---|---|
| SPC | 2200 | 2300 |
| Coliforms | >10 | >10 |
| Yeasts & Molds | 10 | <10 |
| Staphlococcus | neg | neg |

Storage Study cont'd

| 2 weeks 73°F | $A_3$ Matrix | | $B_2$ Matrix | |
|---|---|---|---|---|
| | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| Moisture | | 6.38 | | 6.27 |
| Organoleptic | | | | |
| Shear | good | good | overgrown with mold | good |
| Odor | typical | typical | not tested | typical |
| Flavor | typical | typical | | typical |
| 100°F | | | | |
| Bacteriology | | duplicate sample | | |
| SPC | 1130 | 1050 580 | overgrown with mold; no analysis | |
| Coliforms | <10 | <10 <10 | | |
| Yeasts & Molds | 30 | 30 35 | | |
| Moisture | | 6.40 | | 6.30 |
| Organoleptic | | | | |
| Shear | good | good | moldy not tested | good |
| Odor | typical | typical | | typical |
| 4 Weeks 35°F | | | | |
| Organoleptic | | | | |
| Shear | | good | | good |
| Odor | | typical | | typical |
| Flavor | | typical | | typical |
| 73°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | moldy not tested | good |
| Odor | typical | typical | | typical |
| Flavor | typical | typical | | typical |
| 100°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | typical | typical | typical | typical |
| Flavor | typical | typical | typical | typical |

Storage Study

| | $A_3$ Matrix | | $B_2$ Matrix | |
|---|---|---|---|---|
| 8 Weeks | | | | |
| 35°F. | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| Organoleptic | | | | |
| Shear | | good | | good |
| Odor | | typical | | typical |
| Flavor | | typical | | typical |
| 73°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | moldy | good |
| odor | typical | typical | not tested | typical |
| Flavor | typical | typical | | typical |
| 100°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | moldy | good |
| Odor | typical | stale choc. | not tested | fruity |
| Flavor | typical | stale choc. | | bitter |
| 13 Weeks | | | | |
| 35°F | | | | |
| Organoleptic | | | | |
| Shear | | good | | good |
| odor | | typical | | typical |
| Flavor | | typical | | typical |
| 73°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | good | good |
| Odor | typical | typical | typical | typical |
| Flavor | typical | typical | typical | typical |
| 100°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | moldy | moldy |
| Odor | typical | typical | not tested | not tested |
| Flavor | typical | typical | | |

| Storage Study cont'd | $A_3$ Matrix | | $B_2$ Matrix | |
|---|---|---|---|---|
| | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| 26 weeks | | | | |
| 35°F. | | | | |
| Organoleptic | | | | |
| Shear | | good | | good |
| Odor | | typical | | typical |
| Flavor | | typical | | typical |
| 73°F | | | | |
| Organoleptic | | | | |
| Shear | moldy | good | moldy | moldy |
| Odor | not tested | typical | not tested | not tested |
| Flavor | | typical | | |
| 100°F | | | | |
| Organoleptic | | | | |
| Shear | good | good | moldy | good |
| Odor | typical | typical | not tested | typical |
| Flavor | typical | typical | | typical |
| 52 Weeks | | | | |
| 72°F | | | | |
| Moisture | | 6.30 | | 6.53 |
| Bacteriology | | | | |
| SPC | 570 | 580 | 290 | 790 |
| Coliforms | <10 | <10 | <10 | <10 |
| yeasts & Molds | <10 | <10 | 10 | 280 |
| Staphlococcus | neg | neg | neg | neg |
| Salmonella | neg | neg | neg | neg |
| 100°F | | | | |
| Moisture | | 6.61 | | 6.62 |
| Bacteriology | | | | |
| SPC | 380 | 270 | 810 | 200 |
| Coliforms | <10 | <10 | <10 | <10 |
| Yeasts & Molds | <10 | <10 | 20 | <10 |
| Staphlococcus | neg | neg | neg | neg |
| Salmonella | neg | neg | neg | neg |

J. Bacon Bar

1. Formula

| | |
|---|---|
| Bacon, Prefried (Wilson, "Bits-o-Bacon" | 75% |
| $A_3$ Matrix | 25% |
| Water/100 gm dry materials | 5 ml |

(Use of $B_2$ Matrix resulted in an unsatisfactory bar.)

2. Procedure

The bacon was included into the 12 qt bowl of the Hobart A-200 mixer, and while mixing on speed #2, the water was added by separatory funnel. The matrix was then added, and mixing was continued until homogeneity obtained. The depth of fill on the Denison hydraulic press was adjusted so that resulting bars were 1/2" thick. About 120 bars were fabricated at 3000 #g.p. (375 ps.) with a dwell time of "30%-10 sec." After these were dried at 120°F for 30 minutes about 100 were sealed in aluminized PVC pouches (pouch stock: 0.5 mil mylar, 0.00035" aluminum foil, 3 mil polyvinyl chloride) and 21 were sealed under nitrogen in glass jars. Storage at 0°F, 35°F, 73°F, and 100°F of the pouch packed bars was begun on August 30, 1963 also, but at 0°F, 73°F, and 100°F.

3. Results

Initial test results were as follows:

| Test | $A_3$ Matrix |
|---|---|
| Odor & Flavor | Normal to Wilson prefried bacon |
| Mastication | |
| a. Shear by incisors | |
| (1) 35°F | Good |
| (2) 70°F | Good |
| (3) 100°F | Good |
| b Chew | |
| (1) 35°F | Good |
| (2) 70°F | Good |
| (3) 100°F | Good |

| Test | A3 Matrix |
|---|---|
| Mastication - cont'd | |
| c. Swallow | |
| (1) 35°F | Good |
| (2) 70°F | Good |
| (3) 100°F | Good |
| Dimension Stability (24 hrs. at 120°F and 5 psi). | |
| Before | 17/32" x 2" x 4" |
| After | 1/2 " x 2-1/32" x 4" |
| Net Change | -1/32" +1/32" 0" |
| Percent Change | -5.88 +1.56 0.00 |
| 6 Foot Drop Test | Broke into 4 pieces on 3 rd drop |
| Stickiness (24 hrs. at 40% humidity and room tem.) | None |
| Moisture (16 hr. vacuum oven) | |
| Nitrogen Pack | 12.98% |
| Pouch Pack | 14.04% |

| Bacteriology | Nitrogen Pack | Pouch Pack |
|---|---|---|
| SPC | 2100 | 2410 |
| Coliforms | ≤10 | <5 |
| Yeasts & Molds | 20 | 50 |
| Staphylococcus | Neg. | Neg. |

Storage Study

| 2 Weeks | Nitrogen Pack | Air Pack |
|---|---|---|
| 35°F | | |
| Organoleptic | | |
| Shear | - | Good |
| Odor | - | Typical |
| Flavor | - | Typical |

| Storage Study - cont'd. | $A_3$ Matrix | |
|---|---|---|
| 2 Weeks | Nitrogen Pack | Air Pack |
| 73°F | | |
| Bacteriology | | |
| SPC | - | >3000 |
| Coliforms | - | <10 |
| Yeasts & Molds | - | <10 |
| Staphylococcus | - | Neg. |
| Moisture | - | 13.28 |
| Organoleptic | | |
| Shear | Good | Good |
| Odor | Typical | Typical |
| Flavor | Typical | Typical |
| 100°F | | |
| Bacteriology | | |
| SPC | 2260 | 1480 |
| Coliforms | <10 | >10 |
| Yeasts & Molds | 45 | 30 |
| Moisture | - | 14.46 |
| Organoleptic | | |
| Shear | Good | Good |
| Odor | Typical | Typical |
| Flavor | Typical | Typical |
| 4 Weeks | | |
| 35°F | | |
| Organoleptic | | |
| Shear | - | Good |
| Odor | - | Typical |
| Flavor | - | Typical |

Storage Study - cont'd. $A_3$ Matrix

| 4 Weeks | Nitrogen Pack | Air Pack |
|---|---|---|
| 73°F | | |
| Organoleptic | Good | Good |
| Odor | Typical | Typical |
| Flavor | Typical | Typical |
| 100°F | | |
| Organoleptic | | |
| Shear | Good | Good |
| Odor | Typical | Typical |
| Flavor | Typical | Typical |
| 8 Weeks | | |
| 35°F | | |
| Organoleptic | | |
| Shear | - | Good |
| Odor | - | Typical |
| Flavor | - | Typical |
| 73°F | | |
| Organoleptic | | |
| Shear | Good | Good |
| Odor | Typical | Typical |
| Flavor | Typical | Typical |
| 100°F | | |
| Organoleptic | | |
| Shear | Good | Good |
| Odor | Burned bacon | Rubber |
| Flavor | Burned bacon | Rubber |

Storage Study - cont'd. $A_3$ Matrix

| 13 Weeks | Nitrogen Pack | Air Pack |
|---|---|---|
| 35°F | | |
| Organoleptic | | |
| Shear | - | Good |
| Odor | - | Typical |
| Flavor | - | Typical |
| 73°F | | |
| Organoleptic | | |
| Shear | Good | Good |
| Odor | Typical | Typical |
| Flavor | Typical | Typical |
| 100°F | | |
| Organoleptic | | |
| Shear | Good | Good |
| Odor | Typical | Burned bacon |
| Flavor | Burned | Bitter |
| 26 Weeks | | |
| 35°F | | |
| Organoleptic | | |
| Shear | - | Good |
| Odor | - | Typical |
| Flavor | - | Typical |
| 73°F | | |
| Organoleptic | | |
| Shear | Good | Good |
| Odor | Typical | Burned |
| Flavor | Typical | Burned |

Storage Study - cont'd. $A_3$ Matrix

| 26 Weeks | Nitrogen Pack | Air Pack |
|---|---|---|
| 100°F | | |
| Organoleptic | | |
| Shear | Good | Good |
| Odor | Typical | Burned |
| Flavor | Typical | Burned |
| 52 Weeks | | |
| 72°F | | |
| Moisture | - | 14.85 |
| Bacteriology | | |
| SPC | 320 | 920 |
| Coliforms | <10 | <10 |
| Yeasts & Molds | 20 | <10 |
| Staphylococcus | Neg. | Neg. |
| Salmonella | Neg. | Neg. |
| 100°F | | |
| Moisture | | 15.26 |
| Bacteriology | | |
| SPC | 930 | 170 |
| Coliforms | <10 | <10 |
| Yeasts & Molds | 10 | <10 |
| Staphylococcus | Neg. | Neg. |
| Salmonella | Neg. | Neg. |

K. Raisin Bars

1. Formula

| | |
|---|---|
| Raisins, Myvacet coated, Sunmaid | 75% |
| $A_3$ or $B_2$ Matrix | 25% |
| Water/100 gm dry material | 5 ml |

2. Procedure

Water was added to the raisins in a 5 qt Hobart mixer bowl and mixed by hand to thoroughly wet the surfaces of the raisins. (Attempts to wet the raisins by means of the paddle on #1 speed failed because too many raisins were cut up by the paddle). The respective matrices were added and the whole mixed for 15 seconds on speed #1 of the Hobart N-50 mixer. Eighty gram portions were weighed into the 4" x 2" x 1/2" die on a Carver laboratory press, and the hydraulic pressure was increased to the point where the gauge needle just began to move. The resulting bars were then dried at 120°F for 20 minutes. About 100 bars were sealed in aluminized mylar pouches (pouch stock: 0.5 mil mylar, 0.00035" aluminum foil and 3 mil polyvinyl chloride), and 21 were packed under nitrogen in glass jars. Storage of the pouched bars was begun on August 30, 1963 at 100°F, 73°F, 35°F and 0°F. The nitrogen packed bars began storage at 100°F, 73°F, and 0°F on August 30, 1963.

3. Results

The following test results were obtained initially.

| Test | $A_3$ Matrix | $B_2$ Matrix |
|---|---|---|
| Odor & Flavor | Typical of Raisins | Typical of Raisins |
| Mastication | | |
| a. Shear by Incisors | | |
| (1) 35°F | Good | Good |
| (2) 70°F | Good | Good |
| (3) 100°F | Good | Good |
| b. Chew | | |
| (1) 35°F | Good | Good |
| (2) 70°F | Good | Good |
| (3) 100°F | Good | Good |
| c. Swallow | | |
| (1) 35°F | Good | Good |
| (2) 70°F | Good | Good |
| (3) 100°F | Good | Good |

| Test - cont'd. | $A_3$ Matrix | $B_2$ Matrix |
|---|---|---|
| 6 Foot Drop Test | Broke in half on 21st drop | Broke in 3 pcs on 10th drop |
| Stickiness (24 hrs at 40% humidity and room temp.) | None | None |
| Dimensional Stability (24 hrs at 120°F and 5 psi) | | |
| Before | 9/16" x 1-31/32" x 3-7/8" | 9/16" x 1-31/32" x 3-13/16" |
| After | 17/32" x 1-31/32" x 3-7/8" | 17/32" x 1-31/32" x 3-27/32" |
| Net Change | -1/32" 0 0 | -1/32" +1/16" +1/32" |
| Percent Change | -5.56 0.00 0.00 | -5.56 +3.07 +0.83 |
| Moisture | | |
| Nitrogen Pack | 13.99 | 13.91 |
| Pouch Pack | 14.68 | 14.00 |

| Bacteriology | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
|---|---|---|---|---|
| SPC | 820 | 720 | 1040 | 680 |
| Coliforms | >10 | <10 | >10 | <10 |
| Yeasts & Molds | <10 | <10 | 10 | <10 |
| Staphylococcus | Neg. | Neg. | Neg. | Neg. |

Storage Study

2 Weeks

35°F.

| Organoleptic | | | | |
|---|---|---|---|---|
| Shear | - | - | Good | Good |
| Odor | - | - | Typical | Typical |
| Flavor | - | - | Typical | Typical |

73°F

| Bacteriology | | | | |
|---|---|---|---|---|
| SPC | | 600 | | 260 |
| Coliforms | | >10 | | >5 |
| Yeasts & Molds | | <10 | | <10 |
| Staphylococcus | | Neg. | | Neg. |

| Storage Study - cont'd. | $A_3$ Matrix | | $B_2$ Matrix | |
|---|---|---|---|---|
| 2 Weeks | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| 73°F | | | | |
| Moisture | | 14.69 | | 14.29 |
| Organoleptic | | | | |
| Shear | Good | Difficult | Good | Good |
| Odor | Typical | Typical | Typical | Typical |
| Flavor | Typical | Typical | Typical | Typical |
| 100°F | | | | |
| Bacteriology | | | | |
| SPC | 710 | | 740 | |
| Coliforms | <10 | | <10 | |
| Yeasts & Molds | <10 | | <10 | |
| Moisture | | 15.22 | | 14.72 |
| Organoleptic | | | | |
| Shear | Good | Good | Good | Good |
| Odor | Typical | Typical | Typical | Typical |
| Flavor | Typical | Typical | Typical | Typical |
| 4 Weeks | | | | |
| 35°F | | | | |
| Organoleptic | | | | |
| Shear | - | Good | - | Good |
| Odor | - | Typical | - | Typical |
| Flavor | - | Typical | - | Typical |
| 73°F | | | | |
| Organoleptic | | | | |
| Shear | Good | Good | Good | Good |
| Odor | Typical | Typical | Typical | Typical |
| Flavor | Typical | Typical | Typical | Typical |

| Storage Study - cont d. | A3 Matrix | | B2 Matrix | |
|---|---|---|---|---|
| 4 Weeks | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| 100°F | | | | |
| Organoleptic | | | | |
| Shear | Good | Good | Good | Good |
| Odor | Typical | Typical | Typical | Typical |
| Flavor | Typical | Typical | Typical | Typical |
| 8 Weeks | | | | |
| 35°F | | | | |
| Organoleptic | | | | |
| Shear | - | Good | - | Good |
| Odor | - | Typical | - | Typical |
| Flavor | - | Typical | - | Typical |
| 73°F | | | | |
| Organoleptic | | | | |
| Shear | Good | Good | Good | Good |
| Odor | Typical | Typical | Typical | Typical |
| Flavor | Typical | Typical | Typical | Typical |
| 100°F | | | | |
| Organoleptic | | | | |
| Shear | Good | Good | Good | Good |
| Odor | Honey-like | Honey-like | Honey-like | Honey-like |
| Flavor | Typical | Bitter | Typical | Metallic |
| 13 Weeks | | | | |
| 35°F | | | | |
| Organoleptic | | | | |
| Shear | - | Good | - | Good |
| Odor | - | Typical | - | Typical |
| Flavor | - | Typical | - | Typical |

| Storage Study - cont'd. | A3 Matrix | | B2 Matrix | |
|---|---|---|---|---|
| 4 Weeks | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| 100°F | | | | |
| Organoleptic | | | | |
| Shear | Good | Good | Good | Good |
| Odor | Typical | Typical | Typical | Typical |
| Flavor | Typical | Typical | Typical | Typical |
| 8 Weeks | | | | |
| 35°F | | | | |
| Organoleptic | | | | |
| Shear | - | Good | - | Good |
| Odor | - | Typical | - | Typical |
| Flavor | - | Typical | - | Typical |
| 73°F | | | | |
| Organoleptic | | | | |
| Shear | Good | Good | Good | Good |
| Odor | Typical | Typical | Typical | Typical |
| Flavor | Typical | Typical | Typical | Typical |
| 100°F | | | | |
| Organoleptic | | | | |
| Shear | Good | Good | Good | Good |
| Odor | Honey-like | Honey-like | Honey-like | Honey-like |
| Flavor | Typical | Bitter | Typical | Metallic |
| 13 Weeks | | | | |
| 35°F | | | | |
| Organoleptic | | | | |
| Shear | - | Good | - | Good |
| Odor | - | Typical | - | Typical |
| Flavor | - | Typical | - | Typical |

| Storage Study - cont'd. | $A_3$ Matrix | | $B_2$ Matrix | |
|---|---|---|---|---|
| 13 Weeks | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| 73°F | | | | |
| Organoleptic | | | | |
| Shear | Good | Good | Good | Good |
| Odor | Honey-like | Typical | Typical | Typical |
| Flavor | Typical | Typical | Typical | Typical |
| 100°F | | | | |
| Organoleptic | | | | |
| Shear | Good | Good | Good | Good |
| Odor | Honey-like | Honey-like | Honey-like | Honey-like |
| Flavor | Bitter | Bitter | Bitter | Bitter |
| 26 Weeks | | | | |
| 35°F | | | | |
| Organoleptic | | | | |
| Shear | - | Good | - | Good |
| Odor | - | Typical | - | Typical |
| Flavor | - | Typical | - | Typical |
| 73°F | | | | |
| Organoleptic | | | | |
| Shear | Good | Good | Good | Good |
| Odor | Typical | Typical | Typical | Typical |
| Flavor | Typical | Typical | Typical | Typical |
| 100°F | | | | |
| Organoleptic | | | | |
| Shear | Good | Good | Good | Good |
| Odor | Typical | Typical | Typical | Typical |
| Flavor | Typical | Typical | Typical | Typical |

| Storage Study - cont'd. | $A_3$ Matrix | | $B_2$ Matrix | |
|---|---|---|---|---|
| 52 Weeks | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| 72°F | | | | |
| Moisture | | 14.42 | | 14.57 |
| Bacteriology | | | | |
| SPC | 220 | 210 | 160 | 150 |
| Coliforms | <10 | <10 | <10 | <10 |
| Yeasts & Molds | <10 | 10 | <10 | <10 |
| Staphylococcus | Neg. | Neg. | Neg. | Neg. |
| Salmonella | Neg. | Neg. | Neg. | Neg. |
| 100°F | | | | |
| Moisture | | 16.55 | | 15.92 |
| Bacteriology | | | | |
| SPC | <10 | 0 | 10 | 30 |
| Coliforms | <10 | <10 | <10 | <10 |
| Yeasts & Molds | <10 | <10 | <10 | <10 |
| Staphylococcus | Neg. | Neg. | Neg. | Neg. |
| Salmonella | Neg. | Neg. | Neg. | Neg. |

L. Fruit Preserves at 20% Moisture

No food bar could be made by compression using either matrix and fruit preserves at 20% moisture. All attempts to mix the matrices intimately with the fruit preserves resulted in a toffee-like mass whose surface was quite sticky. Bars could be molded from this material by hand but not by using the Carver laboratory press (and therefore not by the Denison press either), even where the punches of the die were coated with release paper. The hand molded bars were quite plastic and would fail the 5 psi dimensional stability test and the stickiness test. Consequently, because this food bar would not lend itself to compression forming, no fruit preserves bars were manufactured.

M. Herring Bars

1. Formula

| | |
|---|---|
| Herring, Dried Smoked | 75% |
| $A_3$ Matrix | 25% |
| Water/100 gm Dry Material | 5 mil |

(Attempts at using $B_2$ Matrix were not successful with this product.)

2. Procedure

The herring was comminuted on a Waring blendor, mixed intimately with the matrix in a 12 qt bowl on the A-200 Hobart mixer on speed #2, and the water was added by separatory funnel while mixing continued. Depth of fill on the Denison hydraulic press was adjusted so that the resulting bars were 1/2" thick. Bars were then pressed at 3000 #gp (375 psi) and a dwell time of "30%-10 sec." with only the upper ram activated. This prevented stratification (cracking of the bar in the horizontal plane). The resulting bars were dried at 120°F for 20'. Approximately 100 bars were sealed in aluminized mylar pouches (pouch stock: 0.5 mil mylar, 0.00035" aluminum foil and 3 mil polyvinyl chloride) and 21 were packed under nitrogen in glass jars. Storage of the pouched bars began August 30, 1963 at 100°F, 73°F, 35°F and 0°F. The nitrogen packed bars began storage at 100°F, 73°F and 0°F on August 30, 1963.

3. Results

The following test results were obtained initially.

| Test | |
|---|---|
| Odor & Flavor | Typical of dried, smoked herring |
| Mastication | |
| a. Shear by Incisors | |
| (1) 35°F | Good |
| (2) 70°F | Good |
| (3) 100°F | Good |
| b. Chew | |
| (1) 35°F | Good |
| (2) 70°F | Good |
| (3) 100°F | Good |

| Test - cont'd. | $A_3$ Matrix | | |
|---|---|---|---|
| Mastication | | | |
| c. Swallow | | | |
| (1) 35°F | Good | | |
| (2) 70°F | Good | | |
| (3) 100°F | Good | | |
| 6 Foot Drop Test | Broke into 2 pcs on 12th drop | | |
| Stickiness (24 hrs @ 120°F and 5 psi) | | | |
| Before | 9/16" x 2" x 4" | | |
| After | 7/16" x 2" x 4" | | |
| Net Change | -1/8" | 0 | 0 |
| Percent Change | -22.22 | 0.00 | 0.00 |
| Moisture (16 hr vacuum oven) | | | |
| Nitrogen Pack | 29.76 | | |
| Pouch Pack | 33.86 | | |

| Bacteriology | Nitrogen Pack | Pouch Pack |
|---|---|---|
| SPC | 1220 | 1150 |
| Coliforms | <10 | <10 |
| Yeasts & Molds | 30 | 60 |
| Staphylococcus | Neg. | Neg. |
| Salmonella | Neg. | Neg. |

Storage Study

2 Weeks

35°F

| Organoleptic | | |
|---|---|---|
| Shear | - | Good |
| Odor | - | Typical |
| Flavor | - | Typical |

| Storage Study - cont'd. | A3 Matrix | |
|---|---|---|
| 2 Weeks | Nitrogen Pack | Pouch Pack |
| 73°F | | |
| Bacteriology | | |
| SPC | | 630 |
| Coliforms | | < 10 |
| Yeasts & Molds | | < 10 |
| Staphylococcus | | Neg. |
| Moisture | | 12.92 |
| Organoleptic | | |
| Shear | Good | Good |
| Odor | Typical | Typical |
| Flavor | Typical | Typical |
| 100°F | | |
| Bacteriology | | |
| SPC | >90 | |
| Coliforms | <10 | |
| Yeasts & Molds | 50 | |
| Moisture | | 11.50 |
| Organoleptic | | |
| Shear | Good | Good |
| Odor | Typical | Typical |
| Flavor | Typical | Typical |
| 4 Weeks | | |
| 35°F | | |
| Organoleptic | | |
| Shear | - | Good |
| Odor | - | Typical |
| Flavor | - | Typical |

Storage Study - cont'd. $A_3$ Matrix

| 4 Weeks | Nitrogen Pack | Pouch Pack |
|---|---|---|
| 73°F | | |
| Organoleptic | | |
| Shear | Good | Good |
| Odor | Typical | Typical |
| Flavor | Typical | Typical |
| 100°F | | |
| Organoleptic | | |
| Shear | Good | Good |
| Odor | Typical | Typical |
| Flavor | Typical | Typical |
| 8 Weeks | | |
| 35°F | | |
| Organoleptic | | |
| Shear | - | Good |
| Odor | - | Typical |
| Flavor | - | Typical |
| 73°F | | |
| Organoleptic | | |
| Shear | Good | Good |
| Odor | Typical | Typical |
| Flavor | Typical | Typical |
| 100°F | | |
| Organoleptic | | |
| Shear | Good | Good |
| Odor | Typical | Burned herring |
| Flavor | Typical | Burned herring |

Storage Study - cont'd. $A_3$ Matrix

| 13 Weeks | Nitrogen Pack | Pouch Pack |
|---|---|---|
| 35°F | | |
| Organoleptic | | |
| Shear | - | Good |
| Odor | - | Typical |
| Flavor | - | Typical |
| 73°F | | |
| Organoleptic | | |
| Shear | Good | Good |
| Odor | Typical | Typical |
| Flavor | Typical | Typical |
| 100°F | | |
| Organoleptic | | |
| Shear | Good | Good |
| Odor | Typical | Typical |
| Flavor | Sl. bitter | Si. bitter |
| 26 Weeks | | |
| 35°F | | |
| Organoleptic | | |
| Shear | - | Good |
| Odor | - | Typical |
| Flavor | - | Typical |
| 73°F | | |
| Organoleptic | | |
| Shear | Good | Good |
| Odor | Typical | Typical |
| Flavor | Typical | Typical |

Storage Study - cont'd. $A_3$ Matrix

| 26 Weeks | Nitrogen Pack | Pouch Pack |
|---|---|---|
| 100°F | | |
| Organoleptic | | |
| Shear | Good | Considerable |
| Odor | Burned fish | Gas in pouch |
| Flavor | Bitter; obnoxious | Not tested |
| 52 Week | | |
| 72°F | | |
| Moisture | | 31.52 |
| Bacteriology | | |
| SPC | 2250 | 500 |
| Coliforms | <10 | <10 |
| Yeasts & Molds | 45 | <10 |
| Staphylococcus | Neg. | Neg. |
| Salmonella | Neg. | Neg. |
| 100°F | | |
| Moisture | | 34.08 |
| Bacteriology | | |
| SPC | 220 | 190 |
| Coliforms | <10 | <10 |
| Yeasts & Molds | <10 | <10 |
| Staphylococcus | Neg. | Neg. |
| Salmonella | Neg. | Neg. |

N. Precooked Egg Bars

1. Formula

| | |
|---|---|
| Precooked Freeze Dried Egg | 75% |
| $A_3$ or $B_2$ Matrix | 25% |
| Water/100 gm Dry Materials | 5 ml |
| Salt/100 gm Dry Materials | 1 gm |

2. Procedure

The egg, matrix, and salt were mixed until homogenous on speed #2 of the A-200 Hobart mixer. Water was then added to the 12 qt bowl by separatory funnel while mixing was continued. Depth of fill on the Denison hydraulic press was adjusted so that the resulting bar was 1/2" thick. About 120 bars were fabricated at "5500# g.p." (687.5 psi) with a dwell time of "15%-10 sec." and normal action of both upper and lower rams of the press. Bars were dried 120°F for 20 minutes and about 100 were sealed into aluminized PVC pouches (pouch stock: 0.5 mil mylar, 0.00035" aluminum foil, 3 mil polyvinyl chloride) and 21 were sealed under nitrogen in glass jars. Storage of the pouched bars began on August 30, 1963 at 0°F, 35°F, 73°F, and 100°F, and the nitrogen packed bars were placed in storage at 0°F, 73°F and 100°F on August 30, 1963.

3. Results

The following test results were obtained initially.

| Test | $A_3$ Matrix | $B_2$ Matrix |
|---|---|---|
| Odor & Flavor | Typical of Eggs | Typical of Eggs |
| Masticiation | | |
| a. Shear by Incisors | | |
| (1) 35°F | Good | Good |
| (2) 70°F | Good | Good |
| (3) 100°F | Good | Good |
| b. Chew | | |
| (1) 35°F | Good | Good |
| (2) 70°F | Good | Good |
| (3) 100°F | Good | Good |
| c. Swallow | | |
| (1) 35°F | Good | Good |
| (2) 70°F | Good | Good |
| (3) 100°F | Good | Good |
| 6 Foot Drop Test | Broke in half on 1st drop | Broke in half on 1st drop |

| Test - cont'd. | $A_3$ Matrix | $B_2$ Matrix |
|---|---|---|
| Stickiness (24 hrs at 40% humidity) and room temp.) | None | None |
| Dimensional Stability (24 hrs at 120°F and 5 psi) | | |
| Before | 17/32" x 2-1/32" x 4-1/32" | 9/16" x 2-1/32" x 4-1/32" |
| After | 1/2" x 2 x 4-1/32" | 17/32" x 2" x 4" |
| Net Change | -1/32" -1/32" 0 | -1/32" -1/32" -1/32" |
| Percent Change | -5.88 -1.54 0.00 | -5.88 -1.53 -0.78 |
| Moisture (16 hr. vacuum oven) | | |
| Nitrogen Pack | 5.36 | 5.26 |
| Pouch Pack | 5.42 | 5.19 |

| Bacteriology | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
|---|---|---|---|---|
| SPC | 1260 | 430 | 840 | 830 |
| Coliforms | <10 | >10 | >10 | <10 |
| Staphylococcus | Neg. | Neg. | Neg. | Neg. |
| Yeasts & Molds | 40 | 70 | 50 | 30 |
| Salmonella | Neg. | Neg. | Neg. | Neg. |

Storage Study

2 Weeks

35°F

| Organoleptic | | | | |
|---|---|---|---|---|
| Shear | - | Good | - | Good |
| Odor | - | Typical | - | Typical |
| Flavor | - | Typical | - | Typical |

73°F

| Bacteriology | | |
|---|---|---|
| SPC | 2090 | 1550 |
| Coliforms | <10 | <10 |
| Yeasts & Molds | <10 | <10 |
| Staphylococcus | Neg. | Neg. |

| Storage Study - cont'd. | $A_3$ Matrix | | $B_2$ Matrix | |
|---|---|---|---|---|
| 2 Weeks | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| 73°F | | | | |
| Moisture | | 5.48 | | 5.28 |
| Organoleptic | | | | |
| Shear | Good | Good | Good | Good |
| Odor | Typical | Typical | Typical | Typical |
| Flavor | Typical | Typical | Typical | Typical |
| 100°F | | | | |
| Bacteriology | | | | |
| SPC | 770 | 580 | 520 | 550 |
| Coliforms | >10 | >10 | >10 | >10 |
| Yeasts & Molds | 45 | 75 | 65 | 65 |
| Moisture | | 5.66 | | 4.62 |
| Organoleptic | | | | |
| Shear | Good | Good | Good | Good |
| Odor | Acrid | Acrid | Acrid | Acrid |
| Flavor | Bitter | Biting | Bicter | Biting |
| 4 Weeks | | | | |
| 35°F | | | | |
| Organoleptic | | | | |
| Shear | - | Good | - | Good |
| Odor | - | Typical | - | Typical |
| Flavor | - | Typical | - | Typical |
| 73°F | | | | |
| Organoleptic | | | | |
| Shear | Good | Good | Good | Good |
| Odor | Typical | Typical | Typical | Typical |
| Flavor | Typical | Typical | Typical | Typical |

| Storage Test - cont'd. | $A_3$ Matrix | | $B_2$ Matrix | |
|---|---|---|---|---|
| 4 Weeks | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| 100°F | | | | |
| Organoleptic | | | | |
| Shear | Good | Good | Good | Good |
| Odor | Typical | Typical | Typical | Typical |
| Flavor | Typical | Typical | Typical | Typical |
| 8 Weeks | | | | |
| 35°F. | | | | |
| Organoleptic | | | | |
| Shear | - | Good | - | Good |
| Odor | - | Typical | - | Typical |
| Flavor | - | Typical | - | Typical |
| 73°F | | | | |
| Organoleptic | | | | |
| Shear | Good | Good | Good | Good |
| Odor | Typical | Typical | Typical | Typical |
| Flavor | Typical | Typical | Typical | Typical |
| 100°F | | | | |
| Organoleptic | | | | |
| Shear | Good | Good | Good | Good |
| Odor | Sl. rancid | Typical | Typical | Typical |
| Flavor | Very bitter | Typical | Typical | Typical |
| 13 Weeks | | | | |
| 35°F | | | | |
| Organoleptic | | | | |
| Shear | - | Good | - | Good |
| Odor | - | Typical | - | Typical |
| Flavor | - | Typical | - | Typical |

| Storage Study - cont'd. | A3 Matrix | | B2 Matrix | |
|---|---|---|---|---|
| 13 Weeks | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| 73°F | | | | |
| Organoleptic | | | | |
| Shear | Good | Good | Good | Good |
| Odor | Typical | Typical | Typical | Typical |
| Flavor | Typical | Typical | Typical | Typical |
| 100°F | | | | |
| Organoleptic | | | | |
| Shear | Good | Good | Good | Good |
| Odor | Typical | Typical | Typical | Typical |
| Flavor | Typical | Typical | Typical | Typical |
| 26 Weeks | | | | |
| 35°F | | | | |
| Organoleptic | | | | |
| Shear | - | Good | - | Good |
| Odor | - | Typical | - | Typical |
| Flavor | - | Typical | - | Typical |
| 73°F | | | | |
| Organoleptic | | | | |
| Shear | Good | Good | Good | Good |
| Odor | Typical | Typical | Typical | Typical |
| Flavor | Good | Stale Egg | Good | Stale Egg |
| 100°F | | | | |
| Organoleptic | | | | |
| Shear | Good | Good | Good | Good |
| Odor | Good | Good | Good | Good |
| Flavor | Stale Egg | Sl. Bitter | Stale Egg | Sl. Bitter |

| Storage Study - cont'd. | $A_3$ Matrix | | $B_2$ Matrix | |
|---|---|---|---|---|
| 52 Weeks | Nitrogen Pack | Pouch Pack | Nitrogen Pack | Pouch Pack |
| 72°F | | | | |
| Moisture | | 5.03 | | 5.42 |
| Bacteriology | | | | |
| SPC | 1090 | 1110 | 780 | 370 |
| Coliforms | <10 | <10 | 20 | 20 |
| Yeasts & Molds | 20 | 40 | 70 | 60 |
| Staphylococcus | Neg. | Neg. | Neg. | Neg. |
| Salmonella | Neg. | Neg. | Neg. | Neg. |
| 100°F | | | | |
| Moisture | | 6.23 | | 5.56 |
| Bacteriology | | | | |
| SPC | 440 | 160 | 410 | 210 |
| Coliforms | <10 | <10 | <10 | <10 |
| Yeasts & Molds | 20 | 10 | 80 | 30 |
| Staphylococcus | Neg. | Neg. | Neg. | Neg. |
| Salmonella | Neg. | Neg. | Neg. | Neg. |

O. Romano Cheese Bar

1. Formula

| | |
|---|---|
| Romano Cheese, Grated | 75% |
| $A_3$ Matrix | 25% |
| Water/100 gm Dry Material | ɔ m |

($B_2$ Matrix did not make a satisfactory bar.)

2. Procedure

The cheese and matrix were weigned into a 12 qt Hobart mixer bowl and mixed on speed #2 of the A-200 Hobart until homogenous. The water was added by separatory funnel while mixing. Depth of fill on the Denison hydraulic press was adjusted so that resulting bars were 1/2" thick. Bars were fabricated at "2500 #g.p." (312.5 psi), and a dwell time

of "25%-10 sec." and normal action of both upper and lower rams. From a total of about 120 bars which were dried at 120°F for 20 minutes, about 100 were sealed in aluminized PVC pouches (pouch stock: 0.5 mil mylar, 0.00035" aluminum foil, and 3 mil polyvinyl chloride) and about 21 were packed under nitrogen in glass jars. Pouched bars began storage on August 30, 1963 at 0°F, 35°F, 73°F, and 100°F. Nitrogen packed bars were placed in storage on August 30, 1963 at 0°F, 73°F, and 100°F.

3. Results

The following test results were obtained initially.

| Test | $A_3$ Matrix |
|---|---|
| Odor & Flavor | Typical of Romano Cheese |
| Mastication | |
| a. Shear by Incisors | |
| (1) 35°F | Good |
| (2) 70°F | Good |
| (3) 100°F | Good |
| b. Chew | |
| (1) 35°F | Good |
| (2) 70°F | Good |
| (3) 100°F | Good |
| c. Swallow | |
| (1) 35°F | Good |
| (2) 70°F | Good |
| (3) 100°F | Good |
| Six Foot Drop Test | Broke into 3 pieces on 2nd drop |
| Stickiness (24 hrs at 40% humidity and room temp.) | None |
| Dimensional Stability (24 hrs at 120°F and 5 psi) | |
| Before | 1/2" x 1-31/32" x 3-29/32" |
| After | 1/2" x 1-31/32" x 3-29/32" |

| Test - cont'd. | | A3 Matrix | |
|---|---|---|---|
| Dimensional Stability (24 hrs at 120°F and psi) | | | |
| Net Change | 0 | 0 | 0 |
| Percent Change | 0.00 | 0.00 | 0.00 |
| Moisture (16 hr vacuum oven) | | | |
| Nitrogen Pack | | 14.51 | |
| Pouch Pack | | 13.56 | |
| Bacteriology | Nitrogen Pack | | Pouch Pack |
| SPC | 1870 | | 2180 |
| Coliforms | <10 | | <10 |
| Yeasts & Molds | <10 | | 20 |
| Staphylococcus | Neg. | | Neg. |
| Storage Study | | | |
| 2 Weeks | | | |
| 35°F | | | |
| Organoleptic | | | |
| Shear | - | | Good |
| Odor | - | | Typical |
| Flavor | - | | Sl. sour |
| 73°F | | | |
| Bacteriology | | | |
| SPC | | | 1390 |
| Coliforms | | | <10 |
| Yeasts & Molds | | | <10 |
| Staphylococcus | | | Neg. |
| Moisture | | | 14.60 |
| Organoleptic | | | |
| Shear | Good | | Good |
| Odor | Typical | | Typical |
| Flavor | Typical | | Typical |

| 2 Weeks | Nitrogen Pack | Pouch Pack |
|---|---|---|
| 100°F | | |
| Bacteriology | | |
| SPC | 1490 | 910 |
| Coliforms | < 10 | < 10 |
| Yeasts & Molds | 35 | 10 |
| Moisture | | 13.41 |
| Organoleptic | | |
| Shear | Good | Good |
| Odor | Typical | Typical |
| Flavor | Typical | Typical |
| 4 Weeks | | |
| 35°F | | |
| Organoleptic | | |
| Shear | - | Good |
| Odor | - | Typical |
| Flavor | - | Typical |
| 73°F | | |
| Organoleptic | | |
| Shear | Good | Good |
| Odor | Typical | Typical |
| Flavor | Typical | Typical |
| 100°F | | |
| Organoleptic | | |
| Shear | Good | Good |
| Odor | Burned cheese | Burned cheese |
| Flavor | Bitter | Burned cheese |

Storage Study - cont'd.

A3 Matrix

| 8 Weeks | Nitrogen Pack | Pouch Pack |
|---|---|---|
| 35°F | | |
| Organoleptic | | |
| Shear | - | Good |
| Odor | - | Typical |
| Flavor | - | Typical |
| 73°F | | |
| Organoleptic | | |
| Shear | Good | Good |
| Odor | Typical | Typical |
| Flavor | Typical | Bitter |
| 100°F | | |
| Shear | Good | Good |
| Odor | Burned cheese | Burned cheese |
| Flavor | Bitter | Bitter |
| 13 Weeks | | |
| 35°F | | |
| Organoleptic | | |
| Shear | - | Good |
| Odor | - | Typical |
| Flavor | - | Typical |
| 73°F | | |
| Organoleptic | | |
| Shear | Good | Good |
| Odor | Typical | Typical |
| Flavor | Typical | Bitter |
| 100°F | | |
| Organoleptic | | |
| Shear | Good | Good |
| Odor | Burned cheese | Burned cheese |
| Flavor | Bitter | Bitter |

| Storage Study - cont'd. | $A_3$ Matrix | |
|---|---|---|
| 26 Weeks | Nitrogen Pack | Pouch Pack |
| 35°F | | |
| Organoleptic | | |
| Shear | - | Good |
| Odor | - | Typical |
| Flavor | - | Typical |
| 73°F | | |
| Organoleptic | | |
| Shear | Good | Good |
| Odor | Typical | Typical |
| Flavor | Typical | Typical |
| 100°F | | |
| Organoleptic | | |
| Shear | Good | Gas in pouch |
| Odor | Burned cheese | Not tested |
| Flavor | Bitter; obnoxious | Not tested |
| 52 Weeks | | |
| 72°F | | |
| Moisture | | 16.75 |
| Bacteriology | | |
| SPC | 270 | 180 |
| Coliforms | <10 | 5 |
| Yeasts & Molds | <10 | <10 |
| Staphylococcus | Neg. | Neg. |
| Salmonella | Neg. | Neg. |
| 100°F | | |
| Moisture | | 16.04 |

| Storage Study - cont'd. | $A_3$ Matrix | |
|---|---|---|
| 52 Weeks | Nitrogen Pack | Pouch Pack |
| 100°F. | | |
| Bacteriology | | |
| SPC | 340 | 50 |
| Coliforms | $\lesssim 10$ | $\lesssim 10$ |
| Yeasts & Molds | $\lesssim 10$ | $\lesssim 10$ |
| Staphylococcus | Neg. | Neg. |
| Salmonella | Neg. | Neg. |

III. Complete Food Bars (Phase II)

A. Beef Stew Food Bars

1. Formula

| | % |
|---|---|
| Beef Cubes, Freeze-dried (Wilson) | 40.00 |
| $B_2$ Matrix | 21.00 |
| Potato Flakes, Pillsbury | 14.50 |
| Celery, Freeze-dried, C.V.C. | 2.00 |
| Peas, Whole, Freeze-dried, C.V.C. | 6.65 |
| Corn, Whole, Freeze-dried, C.V.C. | 6.00 |
| Onion Flakes, Dried, Durkee | 1.50 |
| Salt, Flour | 2.00 |
| Pepper, Black, Ground, Malbar | 0.25 |
| Tomato Powder, I.D.I.T. S.p.A. | 5.00 |
| Monosodium Glutamate, Merck | 1.00 |
| Caramel Color | 0.10 |
| | 100.00 |
| Water per 100 gm dry ingredients | 10.6 ml |

2. Procedure

a. The beef was added to the 12 qt bowl of an A-200 Hobart mixer and shredded.

b. The remainder of the dry ingredients were added and the whole mixed until homogenous.

c. Water, previously measured, was added while mixing continued by means of a separatory funnel.

d. The resulting 1600 gm batch was pressed into bars on the Denison Hydraulic Press at 5 tons pressure with a dwell time of 2-3 sec.

e. The finished bars were dried for 4 hours in a forced air oven at 130°F.

f. The bars were then sealed in aluminized PVC pouches under air and under nitrogen atmospheres.

3. Results

a. Odor and flavor - acceptable in dry bars and in stew reconstituted at 40% solids.

b. Six foot drop test - good (only about 1/20 of the bar broke off one corner).

c. Stickiness (24 hours at room temperature and 40% relative humidity) - none.

d. Mastication

| Temp. - °F. | 35 | 70 | 100 |
|---|---|---|---|
| Shear | good | good | good |
| Chew | good | good | good |
| Swallow | good | good | good |

e. Dimensional Stability (24 hrs at 120°F 5 psi)

| | | | | | |
|---|---|---|---|---|---|
| Before | 17/32" | x | 2-1/32" | x | 4-1/32" |
| After | 1/2" | x | 2-1/32" | x | 4-1/32" |
| Percent Change | -5.88 | | 0 | | 0 |

f. Moisture 3.81%

4. Storage Studies

Storage Studies - cont'd.

| | Air Pack | | | Nitrogen Pack | | |
|---|---|---|---|---|---|---|
| a. 2 Weeks | | | | | | |
| Temp (°F) | 35 | 73 | 100 | 35 | 73 | 100 |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Stew | Good | Good | Good | Good | Good | Good |
| b. 4 Weeks | | | | | | |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Stew | Good | Good | Good | Good | Good | Good |
| (5) Moisture | | 3.77 | 3.74 | | | |
| c. 8 Weeks | | | | | | |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Stew | Good | Good | Good | Good | Good | Good |
| d. 13 Weeks | | | | | | |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Stew | Good | Good | Good | Good | Good | Good |
| (5) Moisture | | 3.70 | 3.91 | | | |
| (6) Bacteriology | | | | | | |
| SPC | | 1400 | 1130 | | | 1120 |
| Coliforms | | Neg. | Neg. | | | Neg. |
| Molds & Yeasts | | 140 | 320 | | | 260 |

B. Barbecued Ground Beef Food Bar

1. Formula

| | % |
|---|---|
| Beef, Precooked, Freeze-dried, 3/16" Grind, Wilson | 53.00 |
| $B_2$ Matrix | 25.00 |
| Barbecue Sauce (ref. Para. IV D, p. 14) | 12.00 |
| Tomato Powder, I.D.I.T. S.p.A. | 10.00 |
| | 100.00 |

Water per 100 gm Dry Ingredients 10 ml

Buffer per 100 gm Dry Ingredients 0.32 Sodium Bicarbonate

2. Procedure

a. All dry ingredients were weighed into a 12 qt bowl on an A-200 Hobart mixer.

b. The whole was mixed until uniform and water was added by separatory funnel while mixing continued.

c. Bars were then pressed on the Denison Hydraulic Press at 3 tons pressure and a dwell time of 1.5 sec.

d. The resulting bars were dried for 4 hrs in a forced air oven at 130°F.

e. The finished bars were then packed under air and nitrogen atmospheres in aluminized PVC pouches.

3. Results

a. Odor and flavor - acceptable in dry bars and in stew reconstituted at 40% solids.

b. Six foot drop test -good (broke in halves).

c. Stickiness (24 hrs at room temperature and 40% relative humidity) - none.

d. Mastication

| Temp °F | 35 | 70 | 100 |
|---|---|---|---|
| Shear | good | good | good |
| Chew | good | good | good |
| Swallow | good | good | good |

B. Barbecued Ground Beef Food Bar

1. Formula

| | % |
|---|---|
| Beef, Precooked, Freeze-dried, 3/16" Grind, Wilson | 53.00 |
| $B_2$ Matrix | 25.00 |
| Barbecue Sauce (ref. Para. IV D, p. 14) | 12.00 |
| Tomato Powder, I.D.I.T. S.p.A. | 10.00 |
| | 100.00 |

Water per 100 gm Dry Ingredients 10 ml

Buffer per 100 gm Dry Ingredients 0.32 Sodium Bicarbonate

2. Procedure

a. All dry ingredients were weighed into a 12 qt bowl on an A-200 Hobart mixer.

b. The whole was mixed until uniform and water was added by separatory funnel while mixing continued.

c. Bars were then pressed on the Denison Hydraulic Press at 3 tons pressure and a dwell time of 1.5 sec.

d. The resulting bars were dried for 4 hrs in a forced air oven at 130°F.

e. The finished bars were then packed under air and nitrogen atmospheres in aluminized PVC pouches.

3. Results

a. Odor and flavor - acceptable in dry bars and in stew reconstituted at 40% solids.

b. Six foot drop test -good (broke in halves).

c. Stickiness (24 hrs at room temperature and 40% relative humidity) - none.

d. Mastication

| Temp °F | 35 | 70 | 100 |
|---|---|---|---|
| Shear | good | good | good |
| Chew | good | good | good |
| Swallow | good | good | good |

e. Dimensional Stability (24 hrs at 120°F 5 psi)

| | |
|---|---|
| Before | 17/32" x 2-1/32" x 4-1/32" |
| After | 17/32" x 2-1/32" x 4-1/32" |
| Percent Change | None |

f. Moisture 2.66

4. Storage Studies

| | Air Pack | | | Nitrogen Pack | | |
|---|---|---|---|---|---|---|
| a. 2 Weeks | | | | | | |
| Temp °F | 35 | 73 | 100 | 35 | 73 | 100 |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Stew | Good | Good | Good | Good | Good | Good |
| b. 4 Weeks | | | | | | |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Stew | Good | Good | Good | Good | Good | Good |
| (5) Moisture | | 3.77 | 3.74 | | | |
| c. 8 Weeks | | | | | | |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Stew | Good | Good | Good | Good | Good | Good |
| d. 13 Weeks | | | | | | |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Stew | Good | Good | Good | Good | Good | Good |

| 13 Weeks - cont'd. | Air Pack | | | Nitrogen Pack | | |
|---|---|---|---|---|---|---|
| Temp. °F | 35 | 73 | 100 | 35 | 73 | 100 |
| (5) Moisture | | 2.24 | 2.56 | | | |
| (6) Bacteriology | | | | | | |
| SPC | | 880 | 820 | | | 810 |
| Coliforms | | Neg. | Neg. | | | Neg. |
| Yeasts & Molds | | <10 | 10 | | | <10 |

C. Chili Con Carne with Beans Food Bar

1. Formula

| | % |
|---|---|
| Beans, Precooked, Freeze-dried (ref. Par. IV A, p. 13) | 20.00 |
| $B_2$ Matrix | 25.00 |
| Onion Powder, Soluble | 0.50 |
| Beef, Precooked, Freeze Dried, 3/16" Grind, Wilson | 25.00 |
| Tomato Powder, I.D.I.T. S.p.A. | 23.98 |
| Sodium Bicarbonate | 0.08 |
| Chili Powder | 2.50 |
| Cumin | 0.22 |
| Salt, Flour | 2.00 |
| | 100.00 |
| Water per 100 gm Dry Ingredients | 3 ml |

2. Procedure

a. All dry ingredients except meat and beans were weighed into the 12 qt bowl of the A-200 Hobart mixer and mixed until uniform.

b. The water was added by separatory funnel while mixing continued.

c. The meat and beans were then added and mixed briefly to avoid destroying particle identity.

d. The resulting batch was pressed into bars on the Denison Hydraulic Press at 3 tons gauge pressure.

e. The finished bars were dried at 130°F for 4 hours in a forced air oven.

f. Under air and nitrogen atmosphere, the bars were packed in aluminized PVC pouches.

3. Results

a. Odor and flavor - very good as dry bar and when reconstituted at 40% solids as stew.

b. Six foot drop test - fair - 4 piece break (1/8, 1/8, 1/4, 1/2)

c. Stickiness (24 hours at room temperature and 40% relative humidity ) - none.

d. Mastication

| Temp °F | 35 | 73 | 100 |
|---|---|---|---|
| Shear | Good | Good | Good |
| Chew | Good | Good | Good |
| Swallow | Good | Good | Good |

e. Dimensional Stability (24 hrs at 120°F 5 psi)

| | | | |
|---|---|---|---|
| Before | 17/32" x 2-1/32" x 4" | | |
| After | 1/2 " x 2-1/32" x 4" | | |
| Percent Change | -5.88 | 0 | 0 |

f. Moisture 3.95

4. Storage Studies

a. 2 Weeks

| | Air Pack | | | Nitrogen Pack | | |
|---|---|---|---|---|---|---|
| Temp (°F) | 35 | 73 | 100 | 35 | 73 | 100 |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Stew | Good | Good | Good | Good | Good | Good |

b. 4 Weeks

| | | | | | | |
|---|---|---|---|---|---|---|
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Stew | Good | Good | Good | Good | Good | Good |

| Storage Studies - cont'd. | Air Pack | | | Nitrogen Pack | | |
|---|---|---|---|---|---|---|
| Temp (°F) | 35 | 73 | 100 | 35 | 73 | 100 |
| (5) Moisture | | 3.71 | 3.77 | | | |
| c. 8 Weeks | | | | | | |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Stew | Good | Good | Good | Good | Good | Good |
| d. 13 Weeks | | | | | | |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Stew | Good | Good | Good | Good | Good | Good |
| (5) Moisture | | 3.41 | 3.92 | | | |
| (6) Bacteriology | | | | | | |
| SPC | | 490 | 530 | | | 520 |
| Coliforms | | Neg. | Neg. | | | Neg. |
| Yeasts & Molds | | 20 | 20 | | | 10 |

D. Shrimp Creole Food Bars

1. Formula

| | % |
|---|---|
| Shrimp, Precooked, Freeze-dried, Wilson | 41.05 |
| $B_2$ Matrix | 25.00 |
| Onion Powder, Soluble | 0.50 |
| Tomato Powder, I.D.I.T. S.p.A. | 14.00 |
| Salt, Flour | 2.00 |
| Cayenne Pepper | 0.05 |
| Greer Bell Pepper, Dried, C.V.C. | 4.40 |
| Rice, Precooked, Freeze-dried (Ref. Par. IV B, p. 13) | 13.00 |
| | 100.00 |
| Water per 100 gm Dry Ingredients | 5 ml |

2. Procedure

a. The shrimp were weighed into the 12 qt bowl of the A-200 Hobart mixer and shredded.

b. The remainder of the dry ingredients were then added and the whole mixed until homogenous.

c. Water was added by separatory funnel while mixing continued.

d. The resulting 2.5 Kgm batch was pressed into bars on the Denison Hydraulic Press at 4.5 tons ram pressure and a dwell time of 2 sec.

e. The finished bars were dried for 4 hrs at 130°F.

f. The completed bars were sealed in aluminized PVC pouches under air and nitrogen atmospheres.

3. Results

a. Odor and flour - excellent as dry bar and reconstituted at 40% solids in stew.

b. Six foot drop test - excellent, broke into halves on 3rd drop

c. Stickiness (24 hrs at room temperature and 40% relative humidity) - none.

d. Mastication

| Temp °F | 35 | 70 | 100 |
|---|---|---|---|
| Shear | good | good | good |
| Chew | good | good | good |
| Swallow | good | good | good |

e. Dimensional Stability (24 hrs at 120°F 5 psi)

| | |
|---|---|
| Before | 17/32" x 2-1/32" x 4-1/32" |
| After | 17/32" x 2-1/32" x 4-1/32" |
| Percent Change | None |

f. Moisture 2.37%

4. Storage Studies

| a. 2 Weeks | Air Pack | | | Nitrogen Pack | | |
|---|---|---|---|---|---|---|
| Temp (°F) | 35 | 73 | 100 | 35 | 73 | 100 |
| (1) Shear | Good | Good | Good | Good | Good | Good |

Storage Studies - cont'd

| 2 Weeks | Air Pack | | | Nitrogen Pack | | |
|---|---|---|---|---|---|---|
| Temp (°F) | 35 | 73 | 100 | 35 | 73 | 100 |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Stew | Good | Good | Good | Good | Good | Good |
| b. 4 Weeks | | | | | | |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Stew | Good | Good | Good | Good | Good | Good |
| (5) Moisture | | 2.77 | 2.81 | | | |
| c. 8 Weeks | | | | | | |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Stew | Good | Good | Good | Good | Good | Good |
| d. 13 Weeks | | | | | | |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Wet cardboard, off odor | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Stew | Good | Good | Good | Good | Good | Good |
| (5) Moisture | | 3.16 | 3.00 | | | |
| (6) Bacteriology | | | | | | |
| SPC | | 800 | 120 | | | 120 |
| Coliforms | | Neg. | Neg. | | | Neg. |
| Molds & Yeasts | | <10 | 100 | | | 100 |

E. Ground Beef with Rice Food Bars

1. Formula

| | % |
|---|---|
| $B_2$ Matrix | 15.0 |
| Beef, Precooked, Freeze-dried, 3/16" Grind, Wilson | 65.0 |
| Rice, Precooked, Freeze-dried, (ref. par. IV B, p. 13) | 16.5 |
| Onion Powder, Soluble | 1.0 |
| Celery Salt | 0.5 |
| Pepper, Malabar, Ground | 0.5 |
| Salt, Flour | 1.5 |
| | 100.0 |
| Water per 100 gm Dry Ingredients | 5 ml |

2. Procedure

a. All dry ingredients except rice and beef were mixed until homogeneous in the 12 qt bowl of the A-200 Hobart mixer.

b. Water was added by separatory funnel while mixing continued.

c. The rice and beef were then added and mixed briefly to preserve particle identity.

d. Bars were pressed from the resulting 2.5 Kgm batch on the Denison Hydraulic Press at 5 tons ram pressure with a dwell time of 2-4 sec.

e. The finished bars were dried for four hours at 130°F in a forced air oven.

f. The dried bars were sealed into aluminized PVC pouches under air and nitrogen atmospheres.

3. Results

a. Odor and flavor - acceptable as a dry bar and as a stew reconstituted at 40% solids.

b. Six foot drop test - fair, broke in 3 pieces - 1/4, 1/4, 1/2.

c. Stickiness (24 hours at room temperature and 40% relative humidity) - none.

d. Mastication

| Temp (°F) | 35 | 73 | 100 |
|---|---|---|---|
| Shear | Good | Good | Good |
| Chew | Good | Good | Good |
| Swallow | Good | Good | Good |

e. Dimensional Stability (24 hours at 120°F 5 psi)

| | | | |
|---|---|---|---|
| Before | 1/2" x 2-1/32" x 4-1/32" | | |
| After | 15/32" x 2-1/32" x 4" | | |
| Percent Change | -6.25 | 0 | -0.77 |

f. Moisture 7.17

4. Storage Studies

| a. 2 Weeks | Air Pack | | | Nitrogen Pack | | |
|---|---|---|---|---|---|---|
| Temp (°F) | 35 | 73 | 100 | 35 | 73 | 100 |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Stew | Good | Good | Good | Good | Good | Good |
| b. 4 Weeks | | | | | | |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Stew | Good | Good | Good | Good | Good | Good |
| (5) Moisture | | 3.47 | 3.03 | | | |
| c. 8 Weeks | | | | | | |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Stew | Good | Good | Good | Good | Good | Good |

Storage Studies - cont'd.

d. 13 Weeks

| | Air Pack | | | Nitrogen Pack | | |
|---|---|---|---|---|---|---|
| Temp (°F) | 35 | 73 | 100 | 35 | 73 | 100 |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Stew | Good | Good | Good | Good | Good | Good |
| (5) Moisture | | 3.15 | 3.10 | | | |
| (6) Bacteriology | | | | | | |
| SPC | | >3000 | 3000 | | | >3000 |
| Coliforms | | Neg. | Neg. | | | Neg. |
| Molds & Yeasts | | 360 | 500 | | | 400 |

F. Creamed Ground Beef Food Bar

1. Formula

| | % |
|---|---|
| $B_2$ Matrix | 44.00 |
| Beef, Precooked, Freeze-dried, 3/16" Grind, Wilson | 41.00 |
| Dextrinized Starch | 10.82 |
| Salt, Flour | 3.00 |
| Monosodium Glutamate | 1.00 |
| Pepper, Ground, Malabar | 0.18 |
| | 100.00 |
| Water per 100 gm Dry Ingredients | 3 ml |

2. Procedure

a. All dry ingredients were weighed into the 12 qt bowl of the A-200 Hobart mixer and mixed until homogenous.

b. Water was added by separatory funnel while mixing continued.

c. The resulting 1600 gm batch was pressed into bars on the Denison Hydraulic Press at 3 tons ram pressure with a dwell time of 1.5 sec.

d. The finished bars were dried at 130°F for 4 hours in a forced air oven.

e. The dried bars were packed under air and nitrogen atmospheres in aluminized PVC pouches.

3. Results

a. Odor and flavor - acceptable as the dry bar and when reconstituted as a stew at 40% solids.

b. Six foot drop test - excellent - broke into 1/2 and fragments on 2nd drop

c. Stickiness (24 hours at room temperature and 40% relative humidity) - none.

d. Mastication

| Temp (°F) | 35 | 70 | 100 |
|---|---|---|---|
| Shear | Good | Good | Good |
| Chew | Good | Good | Good |
| Swallow | Good | Good | Good |

e. Dimensional Stability (24 hours at 120°F 5 psi)

| | |
|---|---|
| Before | 1/2" x 2-1/32" x 4-1/32" |
| After | 1/2" x 2-1/32" x 4-1/32" |
| Percent Change | None |

f. Moisture 2.75%

4. Storage Studies

a. 2 Weeks

| | Air Pack | | | Nitrogen Pack | | |
|---|---|---|---|---|---|---|
| Temp (°F) | 35 | 73 | 100 | 35 | 73 | 100 |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Stew | Good | Good | Good | Good | Good | Good |

b. 4 Weeks

| | | | | | | |
|---|---|---|---|---|---|---|
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Stew | Good | Good | Good | Good | Good | Good |
| (5) Moisture | | 3.11 | 3.21 | | | |

Storage Studies - cont'd.

| c. 8 Weeks | Air Pack | | | Nitrogen Pack | | |
|---|---|---|---|---|---|---|
| Temp (°F) | 35 | 73 | 100 | 35 | 73 | 100 |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Stew | Good | Good | Good | Good | Good | Good |
| d. 13 Weeks | | | | | | |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Stew | Good | Good | Good | Good | Good | Good |
| (5) Moisture | | 3.15 | 3.10 | | | |
| (6) Bacteriology | | | | | | |
| SPC | | >3000 | 2400 | | | 2300 |
| Coliforms | | Neg. | Neg. | | | Neg. |
| Yeasts & Molds | | 150 | 210 | | | 200 |

G. Chicken a la King Food Bar

1. Formula

| | % |
|---|---|
| Chicken, Precooked, Freeze-dried, 1/4" dices, Wilson | 50.00 |
| Morel Powder, S.P.I. | 1.00 |
| Mushrooms, 1/4" Dice | 5.50 |
| Pimientos, Freeze-dried (ref. Par IV E, p. 14) | 3.00 |
| $B_2$ Matrix | 27.50 |
| Pregelatinized Waxy Maize Starch | 8.00 |
| Salt | 5.00 |
| | 100.00 |

Water per 100 gm Dry Ingredients 5 ml

2. Procedure

a. All dry ingredients were mixed until homogenous in the A-200 Hobart mixer in the 12 qt bowl.

b. The water was then added by separatory funnel while mixing continued.

c. The resulting 2.5 Kgm batch was pressed into bars on the Denison Press at 3 ton ram pressure and a dwell time of 2 sec.

d. Finished bars were dried at 130°F for 4 hours.

e. The dry bars were packed into aluminized PVC pouches under nitrogen and air atmosphere.

3. Results

a. Odor and flavor - good as dry bar and as stew when reconstituted at 30% solids.

b. Six foot drop test - excellent, broke into 1/2, 1/4 and 1/4 on 2nd drop.

c. Stickiness (24 hours at room temperature and 40% relative humidity) - none.

d. Mastication

| Temp (°F) | 35 | 70 | 100 |
|---|---|---|---|
| Shear | Good | Good | Good |
| Chew | Good | Good | Good |
| Swallow | Good | Good | Good |

e. Dimensional Stability (24 hours at 120°F 5 psi)

| | | | |
|---|---|---|---|
| Before | 17/32" x 2-1/32" x 4-1/32" | | |
| After | 1/2" | x 2-1/32" x 4-1/32" | |
| Percent Change | -5.88 | 0 | 0 |

f. Moisture 3.35

4. Storage Studies

a. 2 Weeks

| | Air Pack | | | Nitrogen Pack | | |
|---|---|---|---|---|---|---|
| Temp (°F) | 35 | 73 | 100 | 35 | 73 | 100 |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Stew | Good | Good | Good | Good | Good | Good |

Storage Studies - cont'd.

| | | Air Pack | | | Nitrogen Pack | | |
|---|---|---|---|---|---|---|---|
| b. 4 Weeks | | | | | | | |
| | Temp (°F) | 35 | 73 | 100 | 35 | 73 | 100 |
| | (1) Shear | Good | Good | Good | Good | Good | Good |
| | (2) Odor | Good | Good | Good | Good | Good | Good |
| | (3) Flavor | Good | Good | Good | Good | Good | Good |
| | (4) Stew | Good | Good | Good | Good | Good | Good |
| | (5) Moisture | | 3.23 | 3.18 | | | |
| c. 8 Weeks | | | | | | | |
| | (1) Shear | Good | Good | Good | Good | Good | Good |
| | (2) Odor | Good | Good | Good | Good | Good | Good |
| | (3) Flavor | Good | Good | Good | Good | Good | Good |
| | (4) Stew | Good | Good | Good | Good | Good | Good |
| d. 13 Weeks | | | | | | | |
| | (1) Shear | Good | Good | Good | Good | Good | Good |
| | (2) Odor | Good | Good | Good | Good | Good | Good |
| | (3) Flavor | Good | Good | Good | Good | Good | Good |
| | (4) Stew | Good | Good | Good | Good | Good | Good |
| | (5) Moisture | | 3.19 | 3.00 | | | |
| | (6) Bacteriology | | | | | | |
| | SPC | | >3000 | 2000 | | | 1900 |
| | Coliforms | | Neg. | Neg. | | | Neg. |
| | Yeasts & Molds | | <10 | <10 | | | <10 |

H. Cream of Mushroom Soup Food Bars

1. Formula

| | % |
|---|---|
| $B_2$ Matrix | 50.00 |
| Non-Fat Dry Milk Solids, Maple Island, Instant | 25.00 |
| Mushrooms, 1/4" Dice | 10.00 |
| Salt, Flour | 5.00 |

| Formula - cont'd. | % |
|---|---|
| Pregelatinized Waxy Maize Starch | 5.00 |
| Morel Powder S.P.I. | 2.50 |
| Onion Powder, Soluble | 7.00 |
| Monosodium Glutamate | 0.50 |
| | 100.00 |
| Water per 100 gm Dry Ingredients | 3 ml |

2. Procedure

a. All dry ingredients were mixed until homogenous in the 12 qt bowl of the A-200 Hobart mixer, the water was then added by separatory funnel while mixing continued.

b. From the resulting 1.6 Kgm batch, bars were formed on the Denison Hydraulic Press at 2-2/3 tons pressure on the ram at a dwell time of 15-20% of 10 sec.

c. The finished bars were dried in the forced air oven for four hours at 130°F.

d. The dried bars were packed in aluminized PVC pouches under nitrogen and under air atmospheres.

3. Results

a. Odor and flavor - good as dry bar and as soup reconstituted at 20% solids.

b. Six foot drop test - fair for pieces about 1/4 of bar each.

c. Stickiness (24 hours at room temperature and 40% relative humidity) - none.

d. Mastication

| Temp (°F) | 35 | 70 | 100 |
|---|---|---|---|
| Shear | Good | Good | Good |
| Chew | Good | Good | Good |
| Swallow | Good | Good | Good |

e. Dimensional Stability (24 hours at 120°F 5 psi)

| | |
|---|---|
| Before | 17/32" x 2-1/32" x 4-1/32" |
| After | 17/32" x 2-1/32" x 4-1/32" |
| Percent Change | None |

f. Moisture 5.51%

4. Storage Studies

| | Air Pack | | | Nitrogen Pack | | |
|---|---|---|---|---|---|---|
| a. 2 Weeks | | | | | | |
| Temp (°F) | 35 | 73 | 100 | 35 | 73 | 100 |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Soup | Good | Good | Good | Good | Good | Good |
| b. 4 Weeks | | | | | | |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Soup | Good | Good | Good | Good | Good | Good |
| (5) Moisture | | 2.75 | 2.53 | | | |
| c. 8 Weeks | | | | | | |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Soup | Good | Good | Good | Good | Good | Good |
| d. 13 Weeks | | | | | | |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Soup | Good | Good | Good | Good | Good | Good |
| (5) Moisture | | 2.92 | 2.51 | | | |
| (6) Bacteriology | | | | | | |
| SPC | | 2000 | 1800 | | | 1480 |
| Coliforms | | Neg. | Neg. | | | Neg. |
| Yeasts & Molds | | 20 | 20 | | | 20 |

1. Cream of Tomato Soup Food Bars

1. Formula

| | % |
|---|---|
| $A_3$ Matrix | 50.00 |
| Tomato Powder, I.D.I.T. S.p.A. | 25.00 |
| Non-Fat Dry Milk, Maple Island Instant | 10.00 |
| Pregelatinized Waxy Maize Starch | 10.97 |
| Salt, Flour | 4.00 |
| Cayenne Pepper | 0.03 |
| | 100.00 |
| Water per 100 gm Dry Ingredients | 2 ml |

2. Procedure

a. All dry materials were mixed until homogenous in a one cubic foot Patterson-Kelley twin cone blender with intensifier bar.

b. The water was added through the intensifier bar during mixing.

c. The resulting 1.6 Kgm batch was pressed into bars on the Denison Hydraulic Press at 2-2/3 ton ram pressure and dwell time of 10-25% of 10 sec.

d. The finished bars were dried for 4 hours at 130°C in a forced air oven.

e. The dried bars were sealed in alumnized PVC pouches under nitrogen and air atmosphere.

3. Results

a. Odor and flavor - good as dry bar and as soup reconstituted at 15% solids.

b. Six foot drop test - fair, broke into eight, approximately equal, pieces.

c. Stickiness (24 hours at room temperature and 40% relative humidity) - none.

d. Mastication

| Temp (°F) | 35 | 70 | 100 |
|---|---|---|---|
| Shear | Good | Good | Good |
| Chew | Good | Good | Good |
| Swallow | Good | Good | Good |

e. Dimensional Stability (24 hours at 120°F 5 psi)

| | | | |
|---|---|---|---|
| Before | 17/32" | x 2-1/32" | x 4-1/32" |
| After | 1/2" | x 2 | x 4 |
| Percent Change | -5.88 | -1.53 | -0.77 |

4. Storage Studies

| | Air Pack | | | Nitrogen Pack | | |
|---|---|---|---|---|---|---|
| a. 2 Weeks | | | | | | |
| Temp (°F) | 35 | 73 | 100 | 35 | 73 | 100 |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Soup | Good | Good | Good | Good | Good | Good |
| b. 4 Weeks | | | | | | |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Soup | Good | Good | Good | Good | Good | Good |
| (5) Moisture | | 4.24 | 4.30 | | | |
| c. 8 Weeks | | | | | | |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Soup | Good | Good | Good | Good | Good | Good |
| d. 13 Weeks | | | | | | |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Soup | Good | Good | Good | Good | Good | Good |
| (5) Moisture | | 4.10 | 4.46 | | | |
| (6) Bacteriology | | | | | | |
| SPC | | 1090 | 520 | | | 490 |
| Coliforms | | Neg. | >10 | | | > 10 |
| Yeasts & Molds | | 10 | >0 | | | > 0 |

J. Lemon Pie Filling Food Bar

1. Formula

| | % |
|---|---|
| $A_3$ Matrix | 50.00 |
| Sucrose, 6X | 24.45 |
| Non-Fat Dry Milk Solids, Maple Island, Instant | 20.00 |
| Starch | 5.00 |
| Lemon Flavor, Florasynth | 0.45 |
| Keltose S.G. | 0.10 |
| | 100.00 |

Water (containing 0.07 ml. 4% FD&C Yellow No. 6/100 ml.) 2 ml. per 100 g. dry ingredients.

2. Procedure

a. The matrix was weighed into the one cubic foot Patterson Kelly twin cone blendor with intensifier bar.

b. The water was added through the intensifier bar while mixing continued.

c. The remainder of the ingredients was then added and the whole mixed until homogeneous.

d. Bars were formed from the resulting 1.6 Kgm batch on the Denison Hydraulic Press at 2.75 tons ram pressure and a dwell time of 50% of 1 second.

e. The finished bars were packed without drying in aluminized PVC pouches under air and nitrogen atmospheres.

3. Results

a. Odor and flavor - good as dry bars and when reconstituted at 30% solids for pie filling.

b. Six-foot drop test - fair, broke into eight pieces.

c. Stickiness (24 hours at room temperature and 40% relative humidity) none.

d. Mastication

| Temp. (°F) | 35 | 70 | 100 |
|---|---|---|---|
| Shear | Good | Good | Good |
| Chew | Good | Good | Good |
| Swallow | Good | Good | Good |

e. Dimensional Stability (24 hours @ 120° F 5 psi)

| | |
|---|---|
| Before | 17/32" x 2-1/32" x 4-1/32" |
| After | 17/32" x 2-1/32" x 4-1/32" |
| Percent Change | None |

f. Moisture 5.40%

4. Storage Studies

| a. 2 Weeks | Air Pack | | | Nitrogen Pack | | |
|---|---|---|---|---|---|---|
| Temp (°F) | 35 | 73 | 100 | 35 | 73 | 100 |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Pudding | Good | Good | Good | Good | Good | Good |

| b. 4 Weeks | | | | | | |
|---|---|---|---|---|---|---|
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Scorched Milk | Good | Good | Scorched Milk |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Pudding | Good | Good | Good | Good | Good | Good |
| (5) Moisture | | 4.96 | 4.95 | | | |

| c. 8 Weeks | | | | | | |
|---|---|---|---|---|---|---|
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Pudding | Good | Good | Good | Good | Good | Good |

| d. 13 Weeks | | | | | | |
|---|---|---|---|---|---|---|
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Sl. Burned | Sl. Burned | Good | Sl. Burned | Sl. Burned |
| (3) Flavor | Good | Sl. Burned | Sl. Burned | Good | Sl. Burned | Sl. Burned |
| (4) Pudding | Good | Sl. Burned | Sl. Burned | Good | Sl. Burned | Sl. Burned |

| d. 13 Weeks - Cont'd. | | Air Pack | | | Nitrogen Pack | |
|---|---|---|---|---|---|---|
| Temp (°F) | 35 | 73 | 100 | 35 | 73 | 100 |
| (5) Moisture | | 4.93 | 5.22 | | | |
| (6) Bacteriology | | | | | | |
| SPC | | 1460 | 1900 | | | 1800 |
| Coliforms | <10>1.0 | Neg. | | | | Neg. |
| Yeasts & Molds | 180 | <10 | | | | < 10 |

K. Barley Soup with Beef Food Bar

1. Formula

| | % |
|---|---|
| Barley, Freeze-dried, Precooked (ref. Para. IV C, p. 13) | 48.00 |
| Bouillon, Maggi | 20.00 |
| $B_2$ Matrix | 17.00 |
| Beef, Precooked, Freeze-dried, Wilson | 13.75 |
| Pepper, Malabar, Ground | 0.25 |
| Celery Seed | 0.25 |
| Parsley, Dried, C.V.C. | 0.25 |
| Monosodium Glutamate | 0.50 |
| | 100.00 |
| Water per 100 gm Dry Ingredients | 5 ml |

2. Procedure

a. The beef was weighed into the 12 qt bowl of the A-200 Hobart mixer and broken up into shreds.

b The remainder of the dry ingredients was then added and the whole mixed until homogeneous.

c. Water was added by separatory funnel while mixing continued.

d. The resulting 2.5 Kgm batch was pressed into bars on the Denison Hydraulic Press at 5 tons ram pressure and a dwell time of 1 sec.

e. The finished bars were dried for four hours at 130°F.

f. The dried bars were sealed into aluminized PVC pouches under nitrogen and air atmospheres.

3. Results

a. Odor and flavor - good as dry bar and as soup reconstituted at 15% solids.

b. Six foot drop test - excellent - broke in half on second drop.

c. Stickiness (24 hours at room temperature and 40% relative humidity) - none.

d. Mastication

| Temp (°F) | 35 | 70 | 100 |
|---|---|---|---|
| Shear | Good | Good | Good |
| Chew | Good | Good | Good |
| Swallow | Good | Good | Good |

e. Dimensional Stability (24 hours at 120°F 5 psi)

| | | | |
|---|---|---|---|
| Before | 17/32" x 2-1/32" x 4-1/32" | | |
| After | 1/2" x 2-1/32" x 4-1/32" | | |
| Percent Change | -5.88 | 0 | 0 |

f. Moisture 3.64

4. Storage Studies

| a. 2 Weeks | Air Pack | | | Nitrogen Pack | | |
|---|---|---|---|---|---|---|
| Temp (°F) | 35 | 73 | 100 | 35 | 73 | 100 |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Soup | Good | Good | Good | Good | Good | Good |
| b. 4 Weeks | | | | | | |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Soup | Good | Good | Good | Good | Good | Good |
| (5) Moisture | | 3.74 | 3.42 | | | |

Storage Studies - cont'd.

| c. 8 Weeks | Air Pack | | | Nitrogen Pack | | |
|---|---|---|---|---|---|---|
| Temp (°F) | 35 | 73 | 100 | 35 | 73 | 100 |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Soup | Good | Good | Good | Good | Good | Good |
| d. 13 Weeks | | | | | | |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Soup | Good | Good | Good | Good | Good | Good |
| (5) Moisture | | 3.43 | 3.47 | | | |
| (6) Bacteriology | | | | | | |
| SPC | | >3000 | >3000 | | | >3000 |
| Coliforms | | Neg. | Neg. | | | Neg. |
| Yeasts & Molds | | 220 | 220 | | | 210 |

L. Shrimp Bisque Food Bar

1. Formula

| | % |
|---|---|
| Shrimp, Freeze-dried, Wilson | 53.00 |
| $B_2$ Matrix | 25.00 |
| Non-Fat Dry Milk Solids, Maple Island, Instant | 18.95 |
| Onion Powder, Soluble | 0.50 |
| Salt, Flour | 2.00 |
| Pepper, White, Ground | 0.25 |
| Nutmeg, Ground | 0.10 |
| Parsley, Dried, C.V.C. | 0.20 |
| | 100.00 |
| Water per 100 gm Dry Ingredients | 5 ml |

2. Procedure

a. The shrimp was weighed into the 12 qt bowl of the A-200 Hobart mixer and shredded.

b. The balance of the dry ingredients was then added and the whole mixed until homogeneous.

c. The water was then added, while mixing continued, by separatory funnel.

d. Bars from the resulting 2.5 Kgm batch were pressed on the Denison Hydraulic Press at 5 tons ram pressure and a dwell time of 1 sec.

e. The finished bars were dried 3 hours at 130°F.

f. The dry bars were sealed into aluminized PVC pouches.

3. Results

a. Odor and flavor - excellent as dry bar and as a soup when reconstituted at 25% solids.

b. Six foot drop test - excellent - broke in half on fourth drop.

c. Stickiness (24 hours at room temperature and 40% relative humidity) - none.

d. Mastication

| Temp (°F) | 35 | 70 | 100 |
|---|---|---|---|
| Shear | Good | Good | Good |
| Chew | Good | Good | Good |
| Swallow | Good | Good | Good |

e. Dimensional Stability (24 hours at 120°F 5 psi)

| | |
|---|---|
| Before | 1/2" x 2-1/32" x 4-1/32" |
| After | 1/2" x 2-1/32" x 4-1/32" |
| Percent Change | None |

f. Moisture 3.10%

4. Storage Studies

a. 2 Weeks

| | Air Pack | | | Nitrogen Pack | | |
|---|---|---|---|---|---|---|
| Temp (°F) | 35 | 73 | 100 | 35 | 73 | 100 |
| (1) Shear | Good | Good | Good | Good | Good | Good |

Storage Studies - cont'd.

| 2 Weeks | Air Pack | | | Nitrogen Pack | | |
|---|---|---|---|---|---|---|
| Temp (°F) | 35 | 73 | 100 | 35 | 73 | 100 |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Soup | Good | Good | Good | Good | Good | Good |
| b. 4 Weeks | | | | | | |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Soup | Good | Good | Good | Good | Good | Good |
| (5) Moisture | | 2.97 | 2.96 | | | |
| c. 8 Weeks | | | | | | |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Soup | Good | Good | Good | Good | Good | Good |
| d. 13 Weeks | | | | | | |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Soup | Good | Good | Good | Good | Good | Good |
| (5) Moisture | | 3.11 | 3.10 | | | |
| (6) Bacteriology | | | | | | |
| SPC | | 680 | 840 | | | 830 |
| Coliforms | | Neg. | Neg. | | | Neg. |
| Yeasts & Molds | | 20 | 120 | | | 100 |

M. Coffee with Cream and Sugar Food Bars

1. Formula

| | % |
|---|---|
| Sucrose, granulated | 45.1 |

| | |
|---|---|
| $A_3$ Matrix | 22.5 |
| Non-Fat Dry Milk Solids, Maple Island, Instant | 13.5 |
| Coffee, Instant, Maxwell House | 12.0 |
| Corn Syrup Solids | 6.0 |
| Felcofix, Felton Chemical Co. | 0.9 |
| | 100.0 |
| Water (containing 4% Dibasic Potassium Phosphate)per 100 gm Dry Ingredients | 3 ml |

2. Procedure

a. All dry ingredients were weighed into a one cubic foot Patterson Kelly twin cone blender and mixed until homogeneous.

b. The water was added through the intensifier bar while mixing continued.

c. The resulting 2.5 Kgm batch was pressed into bars on the Denison Hydraulic Press at 3 tons ram pressure and a dwell time of 60% of 1 sec.

d. The bars were not dried, but sealed into aluminized PVC pouches under air and nitrogen atmospheres.

3. Results

a. Odor and flavor - good as dry bars and when reconstituted at 4.3% solids as a beverage.

b. Six foot drop test - fair, broke into 5 pieces.

c. Stickiness (24 hours at room temperature and 40% relative humidity) - none.

d. Mastication

| Temp (°F) | 35 | 70 | 100 |
|---|---|---|---|
| Shear | Good | Good | Good |
| Chew | Good | Good | Good |
| Swallow | Good | Good | Good |

e. Dimensional Stability (24 hours at 120°F 5 psi)

| | |
|---|---|
| Before | 1/2" x 2-1/32" x 4-1/32" |
| After | 1/2" x 2-1/32" x 4-1/32" |
| Percent Change | None |

f. Moisture 4.71

4. Storage Studies

| a. 2 Weeks | Air Pack | | | Nitrogen Pack | | |
|---|---|---|---|---|---|---|
| Temp (°F) | 35 | 73 | 100 | 35 | 73 | 100 |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Drink | Good | Good | Good | Good | Good | Good |
| b. 4 Weeks | | | | | | |
| (1) Shear | Good | Good | Difficult | Good | Good | Difficult |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Drink | Good | Good | Good | Good | Good | Good |
| (5) Moisture | | 4.47 | 4.39 | | | |
| c. 8 Weeks | | | | | | |
| (1) Shear | Good | Good | Difficult | Good | Good | Difficult |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Sl. bitter | Good | Good | Sl. bitter |
| (4) Drink | Good | Good | Sl. bitter | Good | Good | Sl. bitter |
| d. 13 Weeks | | | | | | |
| (1) Shear | Sl. Difficult | Sl. Difficult | Difficult | Sl. Difficult | Sl. Difficult | Difficult |
| (2) Odor | Good | Good | Sl. burned | Good | Good | Sl. Burned |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Drink | Good | Good | Good | Good | Good | Good |

| 13 Weeks - cont'd. | Air Pack | | | Nitrogen Pack | | |
|---|---|---|---|---|---|---|
| Temp (°F) | 35 | 73 | 100 | 35 | 73 | 100 |
| (5) Moisture | | 4.42 | 4.42 | | | |
| (6) Bacteriology | | | | | | |
| SPC | | 340 | 270 | | | 280 |
| Coliforms | | Neg. | Neg. | | | Neg. |
| Yeasts & Molds | | < 10 | < 10 | | | < 10 |

N. Tomato Juice Cocktail Food Bars

1. Formula

| | % |
|---|---|
| Tomato Powder, I.D.I.T. S.p.A. | 67.95 |
| Solu-Pro, Wilson | 25.00 |
| Salt, Flour | 5.00 |
| Celery Salt | 2.00 |
| Cayenne Pepper, Ground | 0.05 |
| | 100.00 |
| Water per 100 gm Dry Ingredients | 1 ml |

2. Procedure

a. All dry ingredients were weighed into the one cubic foot Patterson Kelly twin cone blendor with intensifier bar and mixed until homogeneous.

b. The water was added through the intensifier bar while mixing continued.

c. The resulting 2.5 Kgm batch was pressed into bars on the Denison Hydraulic Press at 2.5 tons ram pressure and a dwell time of 20% of 10 sec.

d. The finished bars were packed without drying into aluminized PVC pouches.

3. Results

a. Odor and flavor - good as dry bar and as beverage reconstituted at 10% solids.

b. Six foot drop test - fair, broke into 8 pieces.

c. Stickiness (24 hours at room temperature and 40% relative humidity) - none.

d. Mastication

| Temp (°F) | 35 | 70 | 100 |
|---|---|---|---|
| Shear | Good | Good | Good |
| Chew | Good | Good | Good |
| Swallow | Good | Good | Good |

e. Dimensional Stability (24 hours at 120°F 5 psi)

| | | | |
|---|---|---|---|
| Before | 17/32" x 2-1/32" x 4-1/32" | | |
| After | 1/2" x 2" | x 4-1/32" | |
| Percent Change | -5.88 | -1.53 | 0 |

f. Moisture 8.66

4. Storage Studies

| a. 2 Weeks | Air Pack | | | Nitrogen Pack | | |
|---|---|---|---|---|---|---|
| Temp (°F) | 35 | 73 | 100 | 35 | 73 | 100 |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Drink | Good | Good | Good | Good | Good | Good |

b. 4 Weeks

| | | | | | | |
|---|---|---|---|---|---|---|
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Drink | Good | Good | Good | Good | Good | Good |
| (5) Moisture | | 7.76 | 8.46 | | | |

c. 8 Weeks

| | | | | | | |
|---|---|---|---|---|---|---|
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Drink | Good | Good | Good | Good | Good | Good |

c. 13 Weeks

| | Air Pack | | | Nitrogen Pack | | |
|---|---|---|---|---|---|---|
| Temp (°F) | 35 | 73 | 100 | 35 | 73 | 100 |
| (1) Shear | Sl. Diffi-cult | Sl. Diffi-cult | Diffi-cult | Sl. Diff-cult | Sl. Diffi-cult | Diffi- |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Bitter | Good | Good | bitter |
| (4) Drink | Good | Good | Bitter | Good | Good | Bitter |
| (5) Moisture | | 7.17 | 8.04 | | | |
| (6) Bacteriology | | | | | | |
| SPC | | > 3000 | 2350 | | | 2300 |
| Coliforms | | Neg. | Neg. | | | Neg. |
| Yeasts & Molds | | 30 | 40 | | | 30 |

O. Orange Juice Food Bar

1. Formula

| | % |
|---|---|
| Orange Juice Powder, Calif. Citrus Growers | 38.00 |
| Corn Syrup Solids | 32.00 |
| Sucrose | 20.00 |
| Solu-Pro, Wilson | 10.00 |
| | 100.00 |
| Water per 100 gm Dry Ingredients | 3 ml |

2. Procedure

a. All dry ingredients were weighed into the one cubic foot Patterson Kelly twin cone blendor with intensifier bar and mixed until homogeneous.

b. The water was added through the intensifier bar while mixing continued.

c. The resulting 2.5 Kgm batch was pressed into bars on the Denison Hydraulic Press with a dwell time of 35% of 10 sec. at 3 tons ram pressure.

d. The finished bars were not dried, but packed in aluminized PVC pouches under air and nitrogen atmospheres.

3. Results

a. Odor and flavor - good as dry bar and as beverage reconstituted at 22% solids.

b. Six foot drop test - fair, broke into six pieces.

c. Stickiness (24 hours at room temperature and 40% relative humidity) - none.

d. Mastication

| Temp (°F) | 35 | 70 | 100 |
|---|---|---|---|
| Shear | Good | Good | Good |
| Chew | Good | Good | Good |
| Swallow | Good | Good | Good |

e. Dimensional Stability (24 hours at 120°F 5 psi)

| | |
|---|---|
| Before | 17/32" x 2-1/32" x 4-1/32" |
| After | 17/32" x 2-1/32" x 4-1/32" |
| Percent Change | None |

f. Moisture 4.91

4. Storage Studies

a. 2 Weeks

| | Air Pack | | | Nitrogen Pack | | |
|---|---|---|---|---|---|---|
| Temp (°F) | 35 | 73 | 100 | 35 | 73 | 100 |
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Drink | Good | Good | Good | Good | Good | Good |

b. 4 Weeks

| | | | | | |
|---|---|---|---|---|---|
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Drink | Good | Good | Good | Good | Good | Good |
| (5) Moisture | | 4.87 | 4.86 | | | |

c. 8 Weeks

| | | | | | |
|---|---|---|---|---|---|
| (1) Shear | Good | Good | Good | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Drink | Good | Good | Good | Good | Good | Good |

Storage Studies - cont'd.

d. 13 Weeks

| | Air Pack | | | Nitrogen Pack | | |
|---|---|---|---|---|---|---|
| Temp (°F) | 35 | 73 | 100 | 35 | 73 | 100 |
| (1) Shear | Good | Good | Sl. Difficult | Good | Good | Good |
| (2) Odor | Good | Good | Good | Good | Good | Good |
| (3) Flavor | Good | Good | Good | Good | Good | Good |
| (4) Drink | Good | Good | Good | Good | Good | Good |
| (5) Moisture | | 4.86 | 5.04 | | | |
| (6) Bacteriology | | | | | | |
| SPC | | 60 | 30 | | | 20 |
| Coliforms | | Neg. | Neg. | | | Neg. |
| Yeasts & Molds | | $\angle$ 10 | $\angle$ 10 | | | $\angle$ 10 |

## CONCLUSIONS

In the sense and meaning of paragraph 1 of the Scope of the Contract, this contract has been fulfilled. The matrices developed and discovered have successfully been used in the fabrication of food bars from nearly any food having reasonable physical stability. The chemical and microbiological instability of certain of these foods, notably the peanut and sweet chocolate food bars were previously well known and were again demonstrated during these storage studies. In no case could any objectionable flavors or odors be assigned to the matrices.

## PROPOSALS FOR FUTURE RESEARCH

Some of our related exploratory work indicates that these matrices, when used as coatings, can protect foods against oxidation and some microbiological deterioration. These coatings are much the same in formula as the matrices but the water level is raised to about 60% giving it the consistency of molasses. The foods are dipped into this coating and the resulting "bit" is dried to a 4-6% moisture level. It is conceivable that food particles could be individually coated, then the coated particles compressed into food bars, thus completely coating the food and providing an oxygen barrier. This would extend the organoleptic and microbiological stability of the food material.

PRODUCTION DESIGN FOR 6,000 FOOD BARS PER HOUR

| Operation | Equipment Required |
|---|---|
| Weighing | Ingredient storage bins. 30 cu ft scale hopper, 200# scale levers and dial |
| Mixing | 30 cu ft Ribbon blender - Strong Scott IN 30 or equal with liquid manifold and spray nozzles. P.K. Blendor with intesifier bar or equal |
| Transfer | Gravity spouts, food grade belt or stainless steel flight conveyor |
| Surge hoppers | One 30 cu ft hopper |
| Hydraulic Press | 45 ton force, 6½ second cycle to 1 feed in 2 compress 3 eject<br>12 units per die, each unit 2" x 4" with 4¼ deep cavity compress to 2" x 4" by 1/2" thick<br>Denison Multipress with automatic feed (or equal) |
| Packaging | Seal in metalized polyethylene polyester pouches. Modify Barfelt Model IM6 to handle food bars. Nitrogen metering and pouch vacuumizing accessories required. |
| Spray Drying | 200#/hr weight capacity (dry) |

PRODUCTION UNIT

The basis for design is as follows:

| | |
|---|---|
| Production rate | 6,600 food bars per hour |
| Allowance for breakage | 6% |
| Weight of formula mix | 1,140#/hr maximum<br>710#/hr minimum |
| Volume of total formula mix per hour | 117 cu ft |

| | |
|---|---|
| Volume of formula mix per unit | 2" x 4" x 4-½" = 34 cu in |
| Volume of compressed food bar per unit | 2" x 4" x ½" = 4 cu in |
| Number of scale batches | 6 per hour |
| Scaling & mixing cycle time | 10 minutes |
| Mix time | 6 minutes |

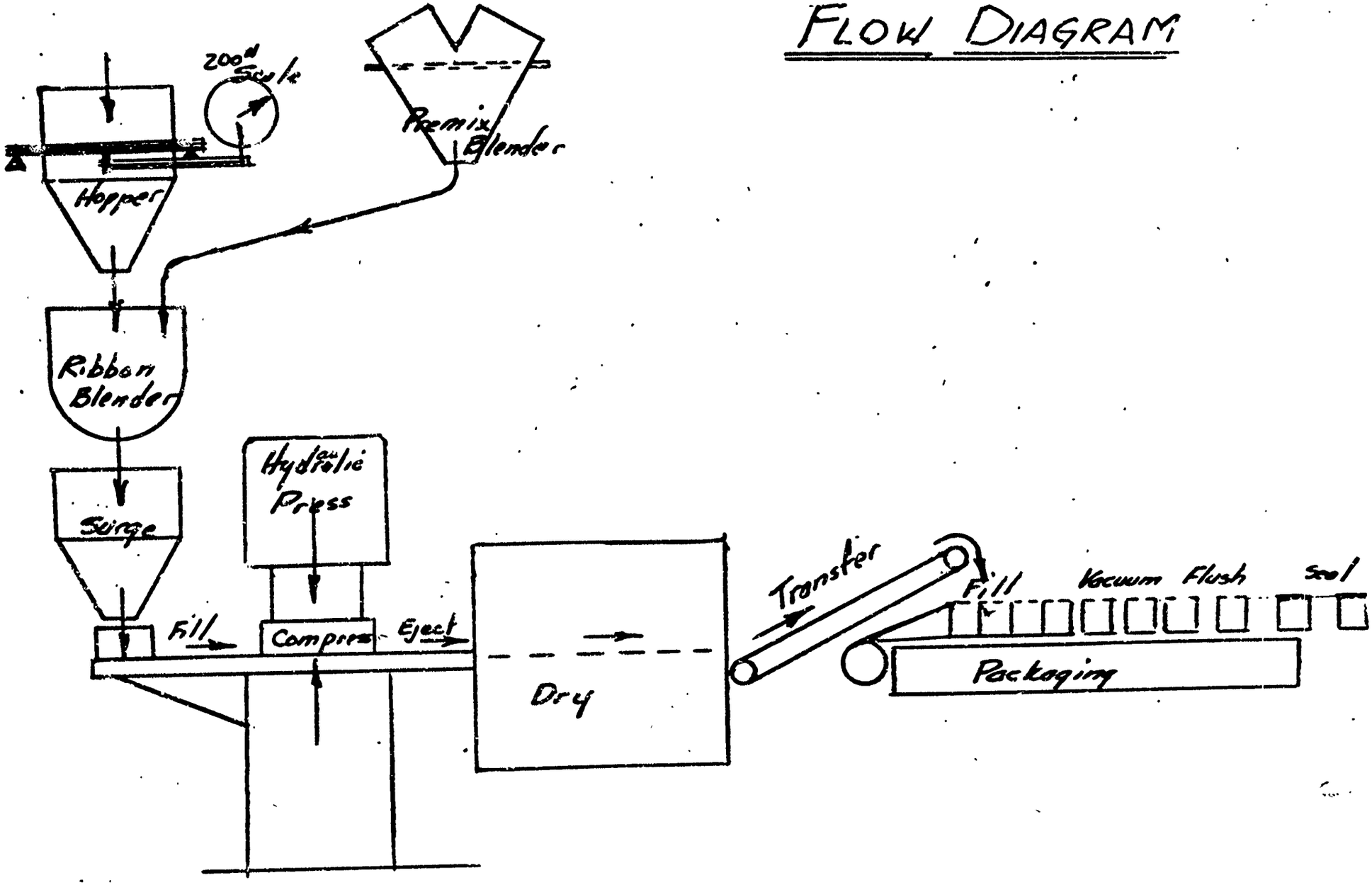
DESCRIPTION OF PROCESS

Ingredients will be scaled into weigh hopper and cycled into batch ribbon blender. P.K. blender will be used to premix small volume ingredients prior to adding to ribbon blender.

Ribbon blender is discharged into surge hopper feeding the filler unit of the hydraulic press. The filler unit fills the cavities of the hydraulic press; pressure is then applied to compress the mix into 1/2" thick bars. Pressure required to form bars varies from 375 psi minimum to 900 psi maximum.

The compressed bar is ejected into a continuous drying oven, heated to a temperature of 140°, and retained for 20 minutes. The dried bars are then conveyed to the packaging area where they are placed in a pouch, nitrogen flushed when required, and vacuum sealed.

# FLOW DIAGRAM



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1 ORIGINATING ACTIVITY (Corporate author)

The Pillsbury Co., Minneapolis, Minn.

2a REPORT SECURITY CLASSIFICATION

Unclassified

2b GROUP

3 REPORT TITLE

ALL PURPOSE MATRICES FOR COMPRESSED FOOD BARS

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Final (29 August 1962 - 8 November 1964)

5 AUTHOR(S) (Last name, first name, initial)

Durst, Jack R.

| 6. REPORT DATE | 7a TOTAL NO OF PAGES | 7b NO OF REFS |
|---|---|---|
| January 1966 | 127 | 0 |

8a. CONTRACT OR GRANT NO.

DA 19-129-AMC-2103

b. PROJECT NO.

7X84-06-031

c.

d.

9a ORIGINATOR'S REPORT NUMBER(S)

9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)

66-1-FD; FD-37

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11. SUPPLEMENTARY NOTES

12 SPONSORING MILITARY ACTIVITY

Animal Products Branch, Food Division
U. S. Army Natick Laboratories, Natick, Massachusetts, 01762

13. ABSTRACT

Edible binders have been developed which impart favorable physical properties including cohesiveness to compressed dry foods representing a broad range of chemical compositions. Further experimental effort yielded binders for compressed foods which are acceptable for consumption from the compressed state and which can also be rehydrated to yield a familiar meal item, such as casseroles, creamed soups, puddings, thin soups and beverages. These binders do not significantly alter the storage stability of the basic food components.

DD FORM 1473 JAN 64

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Security Classification

| 14. KEY WORDS | LINK A | | LINK B | | LINK C | |
|---|---|---|---|---|---|---|
| | ROLE | WT | ROLE | WT | ROLE | WT |
| Development | 8 | | | | | |
| Preparation (formulation) | 8 | | | | | |
| Matrices (food) | 9 | | 9 | | | |
| Food bars | 4 | | 9 | | | |
| Military rations | 4 | | 4 | | | |
| Storage stability | | | 8 | | | |

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