AD

TECHNICAL REPORT
FD-29

FOOD ADJUNCTS STABILIZED AS THIN SHEETS OR LAMINATES

by

JACK R. DURST

THE PILLSBURY COMPANY
Minneapolis, Minnesota

Contract No. DA 19-129-AMC-1 (N) (019000)

September 1965

U. S. Army Materiel Command
U. S. ARMY NATICK LABORATORIES
Natick, Massachusetts

AD

TECHNICAL REPORT
FD-29

FOOD ADJUNCTS STABILIZED AS THIN SHEETS OR LAMINATES

by

Jack R. Durst

THE PILLSBURY COMPANY
Minneapolis, Minnesota

Contract No. DA19-129-AMC-1 (N) (019000)

Project Reference:
PR63-724NR-RDT&E-327-K

September 1965

U. S. Army Materiel Command

U. S. ARMY NATICK LABORATORIES
Natick, Massachusetts

FOREWORD

In the design of individual food packets for various operational situations there is an inevitable compromise between physical attributes, such as weight and volume, and human factors, such as acceptability and nutritional characteristics. The named considerations become increasingly significant in the design of packets for soldiers who must carry on their person their entire supply for prolonged periods. As projected, such packets would be based on dry food compressed into dense bars of prescribed nutritional quality. This project seeks to mitigate the monotony and to improve the acceptability of these austere packets by providing a variety of common food adjuncts such as catsup, barbecue sauce, onion gravy, fruit preserves, peanut butter, soya sauce, maple syrup and pickle relish. These adjuncts would be stabilized in the form of thin sheets to be eaten along with the compressed food bar. It is hoped that such sheets when eaten with a bland food bar will produce the illusion of a familiar food such as normally with the adjunct used.

All work described in this report was performed at the Research and Development Laboratories of The Pillsbury Company, 311 Second Street S. E., Minneapolis 14, Minnesota, under contract number DA19-129-AMC-1. Dr. Jack R. Durst served as Official Investigator. His collaborators were Merlin Sletten, Francis M. Y. Cheng, John Moriarty, Larry Brandberg, John Ringstrom, Ronald Gauthier and Dean Wick. Edward Fritzberg collaborated on the engineering studies.

The Project Officer for the U. S. Army Natick Laboratories was Dr. Maxwell C. Brockmann of the Animal Products Branch, Food Division. Alternate Project Officer was Dr. Edward E. Anderson, 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, Continued

TABLE OF CONTENTS, Continued

TABLE OF CONTENTS, Continued

TABLE OF CONTENTS, Continued

TABLE OF CONTENTS, Continued

TABLE OF CONTENTS, Continued

TABLE OF CONTENTS, Continued

TABLE OF CONTENTS, Continued

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

This report consists of two phases, each covering a period of 12 months. Phase I involves the development of 30 different prototype food sheets, either homogenous or laminates, incorporating common food products. When consumed in an appropriate food context, each sheet shall closely simulate the flavor of its respective adjunct in standard form, and shall not possess properties which will add significantly to the difficulty of mastication or swallowing. Phase II reports on storage stability tests of the above food sheets. A mixed sample phase of the storage study was also conducted to determine if different types of food sheets could be packaged together successfully. Representative samples from three different types of food sheets were packaged in a foil pouch. The three types were: (1) those incorporated into a stable dispersion; (2) those using a hydrocolloid as the structural matrix; and (3) those using a dry mixing technique incorporating a high melting fat as the structural matrix. Samples were placed in 40°F, 73°F, 100°F and cycling storage (40°F to 0°). They remained in storage for two, four, eight and thirteen weeks. Results seemed to indicate that different kinds of sheets could be successfully packaged together and stored if discretion were used in selection of flavors.

SCOPE OF CONTRACT

A. Phase I (1st 12 months)

1. The object of this investigation shall be the development of a number of prototype sheets, either homogenous or laminates, incorporating common food adjuncts. When consumed in an appropriate food context, each sheet shall closely simulate the flavor contribution of its respective adjunct in standard form and shall not possess physical properties which add significantly to the difficulty of mastication, swallowing, or other functions connected with its consumption as a food adjunct. In addition, sheets shall have sufficient stability to withstand handling and storage incident to projected military use. Flavor stability may be attained by any means consistent with requirements herein imposed.

2. Prototype sheets fulfilling the requirements identified under paragraphs 3, 4, and 5 shall be prepared from the first ten (10) and from ten (10) additional items (selected by the contractor) included in the following list:

(1) Barbecue sauce

(2) Catsup

(3) Honey

(4) Mayonnaise

(5) Onion Gravy

(6) Peanut Butter

(7) Pickle Relish

(8) Preserves (Strawberry or Raspberry)

(9) Soya Sauce

(10) Vinegar

(11) Apple Sauce or Butter

(12) Chocolate Sauce or Frosting

(13) Chutney

(14) Coffee

(15) Pieces of Prefried Bacon, or Dried Beef, or Country Ham in White Sauce

(16) Chopped Dates or Figs

(17) Fish Paste or Powder

(18) Garlic or Onion

(19) Grape or Mint Jelly

(20) Horseradish

(21) Maple Syrup

(22) Margarine (simulating butter)

(23) Meat Extract

(24) Molasses

(25) Mustard

(26) Nuts, Almonds or Pecans (chopped)

(27) Olive Butter

(28) Olive Oil

(29) Orange or Lemon Sauce

(30) Parmesan Cheese or equivalent

(31) Shredded Coconut

(32) Protein Hydrolyzate

(33) Sour Cream

(34) Vitamin-Amino Acid Mixture (to compensate diet high in polished rice)

3. All components shall conform to current food requirements of the Food and Drug Administration.

4. At the time of preparation each sheet shall conform to the following requirements.

(a) Have a smooth surface, a uniform thickness not in excess of 1/4 inch, and a minimum length and width of 4 inches each.

(b) Be easily sheared by incisors at temperatures between 40 and 100°F. and subsequently chewed and swallowed without difficulty.

(c) Not stick to the fingers at temperatures up to 100°F. or to other sheets of the same type when stacked together and held two (2) hours at 100°F. under a pressure of one (1) pound per square inch.

(d) Have a pronounced flavor normal to the specific adjunct without significant foreign odors or flavors.

(e) Not break or fracture at temperatures between 30° and 100°F. when the edge of a 3-inch strip is displaced upward 1/2-inch.

5. When stacked in units of six (6) similar sheets and packaged in plastic foil bags, prototype sheets will fulfill requirements of paragraph 4 after three (3) months storage under the following temperature conditions:

(a) 100°F.

(b) 70°F.

(c) 40°F.

(d) Cycling, 2 cycles per week, maximum 40°F., minimum 0°F.

6. Information based on on controlled experiments conducted under storage conditions indicated in paragraph 5, shall be developed to define the effect of oxygen within the package. Any tests may be run under atmosphere of oxygen, air, and nitrogen that may give valuable information. Similar information shall be developed for the effects of low and high external humidities (20% and 75% relative humdities). The sheets will be stacked in random and in similar stacks and the results recorded.

7. Qualitative and rough quantitative observations (panel observations) shall be performed on flavor transfer when combinations of prototype sheets representing six (6) different adjuncts are packaged and subjected to the storage conditions described in paragraph 5.

8. All components, procedures, and equipment used for fabrication of each sheet shall be described in a manner adequate to permit reproduction of the sheet by a competent food technologist.

B. Phase II (2nd 12 months)

1. Prototype sheets fulfilling the requirements identified under Paragraphs 3, 4, and 5 of Phase I shall be prepared from the following ten (10) items.

(35) Tartar Sauce

(36) Thousand Island Dressing

(37) Cheddar Cheese

(38) Shrimp Cocktail Sauce

(39) Vanilla Cream Filling or Frosting

(40) Coffee Cream and Sugar

Margarine (simulating butter)

Maple Syrup

Coffee

Pieces of Prefried Bacon in White Sauce

2. Contractor shall minimize the number of different compositions and processing procedures used for the preparation of the 30 sheets required hereunder. (20 sheets, Phase I - 10 sheets, Phase II). Additives shall be restricted to five (5) standard compositions and a limit of four (4) different processing procedures shall be employed.

3. Contractor and Project Officer shall identify all major deficiencies in the thirty (30) prototype sheets prepared under this contract which may jeopardize the performance of the sheets under the concept of Food Packet, Individual, Combat. Contractor shall correct or compensate recognized deficiencies.

4. Contractor shall submit to the Project Officer, Armed Forces Food and Container Institute not less than fifty (50) prototype sheets representing each of the thirty (30) items developed under this contract for a total of fifteen hundred (1500) sheets.

5. Contractor shall submit engineering design for production facilities capable of efficient production of twelve hundred (1200) square feet of food adjunct sheets per hour. Recognition shall be given to engineering modifications through different pretreatment of

of adjuncts, preparation of standard compositions, and processing operations identified under Paragraph 2 of this phase.

6. Paragraph B, Reports, Phase I, Subparagraph a, progress, is amended to require four (4) quarterly progress reports; and subparagraph b, Final, is deleted.

INTRODUCTION:

This final report is written combining the work of Phase I and Phase II into one composite report since Phase II is a direct extension of the same type of work as Phase I and that the storage tests originally designated for Phase I were all done in Phase II.

Due to the diverse nature of the food products required to be made into flexible sheets we assumed from the beginning of our work that no one technique or substance would be adequate for making sheets from all the required items. We grouped the possible sheeting materials and processes into the following categories.

A. Use of Hydrocolloids as Structure Matrixes

1. Starches

a. Pregelatinized Tapioca

b. Corn Starch

c. Dextrins

d. Amylose

e. Amylopectin

2. Gelatins

3. Gums

a. Gum Arabic

b. Gum Tragacanth

c. Gum Guar

d. Pectins

e. Carboxymethyl cellulose

f. Methocel

B. Use of Spray Dried Encapsulated Fat Binders as the Structure Matrix

C. Incorporation in Stable Dispersions

D. Dry Mixing Technique Using High Melting Fat as the Structure Matrix

Trial and error methods were used until a pattern was found which determined which food adjuncts were compatible with a given sheeting component or combination of components and subsequent techniques for their use.

This report was organized by taking the food adjuncts in the order listed in the Scope of the Contract and giving the experimental work performed for each of these food adjuncts covering the six categories previously listed. The Storage Test results are then given for what was judged the best method for making each of the food sheets.

EXPERIMENTAL:

I. Barbecue Sauce Food Sheets

A. Use of Spray Dried Encapsulated Fat Binders as the Structure Matrix

Some of the food adjuncts could be obtained in a dry form. The idea was to use a binder material developed under Quartermaster Contract No. DA19-129-AMC-2103(X) (0.7007) by The Pillsbury Company. This binder contained fat, protein, and sugar in which the fat was encapsulated by the hydrated protein and then spray dried.

(a) Preparation of Spray Dried Encapsulated Fat

Binder B

Formula: 47.1% Lard Flakes
19.2% Sodium Caseinate (Land O'Lakes)
33.7% Sucrose

A pilot plant run was made using the following quantities:

47.1 lb. Lard Flakes
19.2 lb. Sodium Caseinate
33.7 lb. Sucrose
78 lb. Water

(b) Procedure: The lard flakes were heated in a steam jacketed kettle to 160°F so that they were completely melted. The sodium caseinate and sucrose were then added and mixed with the melted

lard flakes until completely coated. 75 lbs. of hot (160°F) water was added with rapid agitation with a lightening mixer. This material was then pumped through an Oakes mixer and recirculated until a smooth stable dispersion resulted (45 minutes). An additional 10 lbs. of hot (160°F) water was added to the stable dispersion to reduce the viscosity for spray drying. The material was then pumped through a Manton Gaulin pump set at 1000-1200 p.s.i. and then pumped through a spray nozzle containing a No. 67 Orifice with a No. 17 Insert into a Blaw-Knox Horizontal Spray Drier. The inlet air temperature was 230 - 240°F and the outlet air temperature was 170 - 175°F. A white free flowing powder resulted.

(1) Use of Spray Dried Encapsulated Fat Binder B to Make Barbecue Food Adjunct Sheets

(a) Formula: 5% Glycerin
45% Spice of Life Barbecue Powder
45% Binder "B"
5% Water

(b) Procedure: Using a Hobart mixer, the barbecue powder and binder were mixed and the water and glycerin added with continued mixing. It was difficult to distribute the liquids evenly throughout the product. The wetted product was put into a 4" x 4" mold in a Carver Press and pressed into 4" x 4" sheets using 250 p.s.i. pressure.

(c) Results: A flexible sheet was formed but tended to be a little grainy to taste.

B. Use of Hydrocolloids as the Structure Matrix

(1) CMC and Starch as the Structure Matrix

(a) Formula: 2% CMC
2% Pregel Tapioca Starch
96% Barbecue Sauce (Kraft hot)

(b) Procedure: Using a wire whip attached to a lightning mixer, the barbecue sauce was stirred and the CMC slowly added. The

starch was added in the same manner, and the resulting material was spread on release paper in thin sheets for drying. These sheets were air dried in thin sheets for drying. These sheets were air dried at room temperature (72°F). This product had lumps presumed to be starch or CMC not dissolved in the limited water.

(c) Results: After drying 4 days, the sheets could be removed from the release paper and were non-sticky. The starch was added to make a more flexible sheet than the sheet made with CMC and barbecue sauce. This product did not become brittle. However, it was rather tough and the lumps were very objectionable; Therefore, it was discarded.

(2) CMC and Corn Syrup Solids as the Structure Matrix

(a) Formula: 2% CMC
3% Corn Syrup Solids
95% Barbecue Sauce

(b) Procedure: The same procedure was used in this experiment as in the previous experiment A(1). The product was dried on release paper for three days in air at room temperature (72°F), then stored in a polyethylene plastic bag.

(c) Results: The resulting sheets were flexible, tasted like barbecue sauce, but were slightly sticky and were tough to chew.

(3) Gelatin and CMC as the Structure Matrix

(a) Formula: 1.67% Gelatin
0.50% CMC
31.16% Water
66.67% Barbecue Sauce (Kraft)

(b) Procedure: The gelatin and CMC were dissolved in the water previously heated to 170°F using a Waring Blendor. The barbecue sauce was added and the whole blended until uniform. This product

was placed into paper cartons and frozen solid in a blast freezer. When frozen, this material was easily sliced into thin sheets using a Hobart meat slicer which were then placed on a release paper obtained from the Daubert Chemical Company. These sheets were air dried at room temperature (72°F) for 24 hours.

(c) Results: The sheets were hard to get off the release paper so were dried an additional six hours. These sheets tasted like barbecue sauce, were a little tough to chew and were somewhat sticky on the surface.

(4) Treatment of Barbecue Sheets with Pectin Coatings to Eliminate Stickiness

Some of the barbecue sheets would have passed the necessary requirements listed in the scope of the contract if they did not have a sticky surface. In light of this, we attempted to coat these sheets with a thin layer of pectin followed by a hardening bath of $CaCl_2$.

(a) Formula: Pectin Solution

1% Sodium polypectate
3% Sucrose
96% Water

1% $CaCl_2$ Solution

(b) Procedure: The pectin solution was made by dissolving the sodium polypectate and sucrose in the water using a Waring Blendor and then removing any entrapped air by vacuum. The sheets to be coated were dipped into the pectin solution (room temperature) until covered. This coating was then fixed by placing the coated sheets into a 1% $CaCl_2$ solution. The resulting sheets were air dried at room temperature for 12 hours.

(c) Results: The resulting sheets were non-sticky, flexible, had a barbecue taste, did not stick together when packaged in groups

of sixes, but were a little tough to chew and had some calcium chloride taste.

(5) 1% CMC as the Structure Matrix

(a) Formula: 1% CMC
99% Barbecue Sauce (Kraft)

(b) Procedure: The barbecue sauce was placed in a Waring Blendor, and the CMC added and mixed until thoroughly dispersed (approximately 5 minutes). The mixture was frozen and sliced at a #10 setting on a Hobart slicer into approximately 3/32" thick sheets. These sheets were placed on release paper and dried in an air circulating oven set at 70°C for 3 hours, turned over and dried and additional 1/2 hour.

(c) Results: The sheets were flexible, fairly easy to bite and chew, tasted like barbecue sauce but were slightly sticky. It was found that this stickiness could be alleviated by dusting the sheets with rice flour.

C. Incorporation of Food Adjuncts into Stable Dispersions

It was thought that one way of making food sheets was to incorporate the food adjuncts into stable dispersions and then dry the dispersions into thin sheets. This work was based upon a Stable Dispersion Process patented by The Pillsbury Company. 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.

It has been found that other materials can be carried in the stable dispersions without breaking the dispersions and thus when the dispersions are dried into sheets, the materials are also incorporated into the sheets.

(1) Dispersion Technique for Making Barbecue Sauce Food Sheets

(a) Formula:
10 parts Barbecue Flavoring (Spice of Life)
30 parts Durkex Oil (Durkee Co.)
44 parts Non-fat Milk Solids
2 parts Gelatin (Knox)
14 parts Sucrose
75 parts Water

(b) Procedure: The oil was placed in a Waring Blendor and the non-fat milk solids, sucrose, and barbecue flavor added. These materials were mixed until coated with oil. The water in which the gelatin had previously been hydrated was then added with high speed mixing to form a stable dispersion. The resulting product was frozen, sliced, and dried for 24 hours at 55°C in an air circulating oven.

(c) Results: The 24 hour drying period proved to be too long in that the resulting sheets were a little too stiff. When these sheets were left open to room temperature and humidity overnight, they became flexible, were easy to bite and chew, and were not sticky. The sheets had a milky barbecue flavor that needed some improvement.

D. Best Method for Making Barbecue Sauce Food Sheets

The best method for making Barbecue Sauce Food Sheets was that given under I B(5) "1% CMC as the Structure Matrix." Therefore, a 30 pound batch was made using the procedure given under section I B(5) substituting a Schnellkutter for the Waring Blendor mixer. The resulting sheets were used for the subsequent storage tests.

II. Catsup Food Sheets

A. Incorporation Into Stable Dispersions

(1) Incorporation of Tomato Catsup Into a Stable Dispersion Using Sodium Caseinate and Gelatin as the Film Formers

(a) Formula: 22.7% Lard Flakes
9.1% Sodium Caseinate
1.8% Knox Gelatin
66.4% Tomato Catsup
42 ml. Water to 100 grams of ingredients

(b) Procedure: A stable dispersion was made by placing melted lard heated to 160°F in a Waring Blendor and adding the sodium caseinate with mixing until it was completely coated with the melted lard. The gelatin previously dissolved in the hot water (160°F) was added to the other ingredients with rapid mixing. A stable dispersion was formed and then the catsup heated to 130°F was added with continued mixing. Two groups of sheets were made. One group was air dried overnight at room temperature (74°F) and the other group dried at 65°C for one hour in an air circulating oven.

(c) Results

Both sheets were smooth, non-sticky and flexible but tasted more like cream of tomato soup than tomato catsup

(2) Incorporation of Tomato Catsup Into a Stable Dispersion Using Sodium Caseinate and Carboxy Methyl Cellulose as the Film Formers

(a) Formula: 22.7% Lard Flakes
8.2% Sodium Caseinate
2.7% CMC
66.4% Tomato Catsup
20 ml. Water per 100 gm. of ingredients

(b) Procedure: The procedure was the same as for (1) except the stable dispersion was made by initially combining the water and tomato catsup and heating the mixture to 130°F before addition to the other ingredients. The resulting stable dispersion was made into two groups of sheets by spreading on cookie pans. One group was air dried overnight at room temperature (74°F) and the other group dried at 65°C for 1 hour in an air circulating oven.

(c) Results: The resulting sheets when cut off the cookie pans were

non-sticky and flexible but tasted like cream of tomato soup.

B. Use of Hydrocolloids as the Structure Matrix

(1) CMC as the Structure Matrix and Glycerine as a Texturing Agent

(a) Formula: 2% CMC
3% Glycerine U.S.P.
95% Catsup (Red Owl Regular)

(b) Procedure: The glycerine was put into a beaker and the catsup added. The catsup and glycerine mixture was stirred with a wire whip and then the CMC was slowly added with continued mixing. The resulting product was spread in thin sheets on release paper and air dried at room temperature (72°F).

(c) Results: It took 36 hours until the sheet would release and thus could be turned over. The product became quite crisp and extruded a liquid with further drying. It was not determined if there is an optimum point of flexibility where the glycerine could be held in the product to make this product acceptable. More work will be needed with this formulation to make an acceptable product.

(2) CMC as the Structure Matrix and Sorbitol as a Texturing Agent

(a) Formula: 2% CMC
3% Sorbitol Solution Merck U.S.P.
95% Catsup (Red Owl Regular)

(b) Procedure: The same procedure was used with sorbitol as was used with the glycerine Section II B (1).

(c) Results: After a 4 day drying period in the air at room temperature (72°F), the glycerine product was crisp and the sorbitol product was pliable. The sheet was rather bland and tough to chew. Sorbitol appears to be an improvement over glycerine in this type of procedure. The product would be improved if the toughness could be reduced.

(3) Gelatin and CMC as the Structure Matrix

(a) Formula: 2.0% Gelatin
0.6% CMC
37.4% Water
60.0% Catsup

(b) Procedure: The procedure was the same as for the barbecue sauce sheet given in Section I B(3).

(c) Results: The resulting product tasted like catsup, was quite elastic, slightly sticky and somewhat hard to chew. When the product was stacked together in sixes, there was some sticking but the sheets could be pulled apart. It was thought that the product might be easier to chew if lesser amounts of the CMC and gelatin were added. Product was made using the following formulation:

1.6% Gelatin
0.4% CMC
38.0% Water
60.0% Catsup

The procedure was the same as before.

The resulting product was slightly improved in chewability but not materially so.

(4) Gelatin, CMC, and Sugars as the Structure Matrix

Sugars were added to the Gelatin-CMC Catsup Sheets in hopes of improving their chewability.

(a) Formula: 0.4% CMC
1.67 Gelatin
34.0% Water
4.0% Dextrose or Sucrose or Lactose
60.0% Catsup

(b) Procedure: The procedure was the same as in (3) except the sugars were dissolved in the gelatin-CMC solutions

(c) Results: The sheets made with dextrose were very sticky and not improved in chewability. The sheets made with sucrose and lactose were more sticky than those made with no added sugars

and were not improved in chewability. It is obvious that the addition of sugars are deleterious to the food sheets using the Gelatin-CMC structure matrix.

(5) Gelatin, CMC, and Starches as the Structure Matrix

A. Use of Col-Flo Starch

(a) Formula:
4.0% Col-Flo Starch (National)
0.4% CMC
1.6% Gelatin
34.0% Water
60.0% Catsup

(b) Procedure: The procedure was the same as in (3) except the starch was added to the Gelatin-CMC solution and mixed well before addition to the catsup and the product was air dried for seven days.

(c) Results: The sheets remained sticky and could not easily be removed from the release paper. The taste was good, and the product was easily chewed. Possibly this product would be okay if dried at elevated temperatures to remove stickiness.

B. Use of Pregelatinized Tapioca Starch

(a) Formula:
0.2% CMC
0.4% Pregelatinized Tapioca Starch
2.0% Gelatin
37.4% Water
60.0% Catsup

(b) Procedure: The procedure was the same as (5) A above except the product was air dried for two days.

(c) Results: The product was flexible, non-sticky, had good flavor but was very tough to chew.

(6) Gelatin and Guar Gum as the Structure Matrix

(a) Formula:
0.6% Guar Gum (Super Col General Mills Type S-2)
2.0% Gelatin
37.4% Water (distilled)
60.0% Catsup (Ballcrest Brand)

(b) Procedure: The product was made the same as given for the gelatin and CMC under (3) except the Super Col replaced the CMC.

(c) Results: The resulting product tasted like catsup but was sticky after drying, stuck together upon stacking in sixes and was difficult to chew. Apparently the guar gum was no improvement over the CMC as far as toughness of product and was less efficient in regard to stickiness.

(7) Gelatin and Starch as the Structure Matrix

(a) Formula:
1.6% Gelatin
4.0% Starch (Col Flo - National)
34.4% Water
60.0% Catsup

(b) Procedure: The procedure was the same as given under (5)A except the CMC was removed and drying time was eight days at room temperature (72°F).

(c) Results: The product was very sticky and wet. Could not be removed from the release paper.

(8) Gelatin as the Structure Matrix

(a) Formula:
2% Gelatin
98% Catsup

(b) Procedure: The catsup was heated to approximately 160°F. The gelatin was added to the catsup in a Waring Blendor and mixed until the gelatin was hydrolyzed. A vacuum was pulled on the mixture to remove any entrapped air. This product was frozen in a blast freezer and sliced into 1/8" sheets which were placed on release paper and air dried at room temperature (72°F) for four days.

(c) Results: The product was hard to remove from the release paper and was sticky but had very good taste and was quite flexible.

When this product was dried overnight in an air circulating oven at 50°C, it became quite brittle but still remained sticky to touch.

(9) Comparison of CMC and Guar Gum as the Structure Matrix

(a) Formula: 1% CMC or Guar Gum
99% Catsup

(b) Procedure: The procedure was the same as in (8) except the gelatin was replaced by CMC or Guar Gum, and the sheets were dried only three hours in the 50°C air circulating oven.

(c) Results: The CMC gave a deeper red color to the finished sheets, had a better catsup taste and was easier to chew. The flexibility was the same, and both were slightly sticky, the guar sheet being more sticky than the CMC sheet.

(10) 0.25% CMC as the Structure Matrix

Since catsup is approximately 70% water, it was felt that possibly sheets could be made that were more chewable if less CMC were used.

(a) Formula: 0.25% CMC
99.75% Catsup

(b) Procedure: Catsup was placed in a Waring Blendor, and the CMC added and mixed until thoroughly dispersed (approximately 5 min.). The mixture was frozen and sliced into 1/8" thick sheets which were placed on release paper. The sheets were dried in an air circulating oven set at 55°C for 3 hours.

(c) Results: The sheets were pliable, had good catsup taste, were less tough to chew than those made with higher levels of CMC but were a bit sticky on the surface. Some of these sheets were coated with pectin as given in Section I B(4). The resulting sheets were non-sticky and could be stacked in sizes without sticking together.

(11) 1% CMC as the Structure Matrix

(a) Formula: 1% CMC
99% Catsup

(b) Procedure: Procedure was the same as that given for Barbecue Sauce, Section I B(5).

This product was very similar in mixing characteristics to the barbecue sauce. Care must be taken to achieve a good CMC mixture. Freezing and handling techniques remain the same except on removal from the oven after drying, the catsup sheets must be allowed to cool before removal from the release paper.

(c) Results: The sheets were flexible, fairly easy to bite and chew, tasted like tomato catsup but were slightly sticky. It was found that this stickiness could be alleviated by dusting the sheets with rice flour.

C. Best Method for Making Catsup Food Sheets

The best method for making Catsup Food Sheets was given under II B(11) "1% CMC as the Structure Matrix." Therefore, a 30 pound batch was made using the procedure given under Section II B (11)substituting a Schnellkutter for the Waring Blendor mixer. The resulting sheets were used for the subsequent storage tests.

III. Honey Food Sheets

A. Incorporation Into Stable Dispersions

(1) Incorporation of Honey Into a Stable Dispersion Using Sodium Caseinate as the only Film Former

(a) Formula: 25% Lard Flakes
12% Sodium Caseinate
43% Honey (Neimans)
20% Sucrose
33 ml. water per 100 grams of ingredients

(b) Procedure: The stable dispersion was made by placing melted lard heated to 160°F in a Waring Blendor and adding the sodium

caseinate and sucrose with mixing until they were completely coated with the melted lard. The honey and water were mixed together and heated to 160°F and added to the other ingredients with rapid mixing. A stable dispersion formed after 1 minute. (A convenient method for testing this is to add one drop of the dispersion to 250 ml. of hot water. If a stable dispersion is formed, a cloudy milky solution results with no free fat evident. If a stable dispersion is not formed, free fat globules are readily seen on the surface of the water.) The stable dispersion was spread on a cookie sheet and air dried at room temperature (74°F) for 48 hours. The top of the dispersion was somewhat sticky so the sheet was dried an additional 18 hours at 55-60°C in the air circulating oven.

(c) Results: The top of the sheet was still sticky but when cut off the cookie sheet, the resulting food sheet was quite flexible. The resulting product tasted somewhat like honey, but the flavor level would have to be greatly increased to be an acceptable product.

When this formulation was tried using a milder flavored honey, the resulting product did not taste like honey at all.

(2) Incorporation of Honey Into a Stable Dispersion Using Sodium Caseinate and Gelatin as the Film Formers

(a) Formula:
22.6% Lard Flakes
9.0% Sodium Caseinate
2.0% Knox Gelatin
66.4% Honey (Neimans)
42 ml. water per 100 grams of ingredients

(b) Procedure: The procedure was the same as given in (1) before except the Knox gelatin was dissolved in the water before its addition. The product was dried at 65°C for 1 hour on cookie pans in an air circulating oven.

(c) Results: The resulting sheets when cut off the cookie pans were not sticky on the pan side and only very slightly sticky on the exposed surface. These sheets had much more honey flavor than the previous examples.

B. Use of Hydrocolloids as the Structure Matrix

(1) Carboxy Methyl Cellulose with Honey

(a) Formula: 3% CMC (high viscosity - Hercules)
97% Honey

(b) Procedure: The CMC was added to heated honey (140°F) with agitation by a wire whip attachment on a lightening mixer. The material was spread as a thin sheet on an aluminum cookie pan and air dried at room temperature.

(c) Results: The sheet would not dry even after a week's time so was discarded.

(2) Pectin with Honey

(a) Formula: 10.6% Pectin 150 grade Exchange brand
88.0% Honey
1.4% Citric Acid
20 ml. water per 100 gms. of ingredients

(b) Procedure: The pectin, citric acid, and honey were added to the water with stirring and heated to 180°F. The resulting product was spread on aluminum cookie pans in thin sheets and air dried at room temperature (72°F) overnight.

(c) Results: The sheets were easily removed from the pans, were flexible and non-sticky but did not taste like honey.

(3) CMC and Guar Gum as the Structure Matrix

(a) Formula: 49% Honey (Red Owl), white
1% CMC
2% Avicel (micro-crystalline cellulose)
3% Corn Syrup Solids
45% 1% Guar Gum Solution

(b) Procedure: The Avicel and corn syrup solids were added to the honey and stirred with the wire whip attachment until smooth. The guar solution made previously was added and then the CMC was added slowly as the wire whip agitated the mixtures. The product was spread in thin sheets on release paper and air dried at room temperature (72°F).

(c) Results: After 9 days of drying in air at room temperature, the sheet came off release paper and was not sticky to the fingers. The dried sheet did not taste very much like honey, was tough to chew, and was lumpy.

(4) CMC, Pectin, and Pregelatinized Tapioca Starch as the Structure Matrix and Tween 80 as a Texturing Agent

(a) Formula:

.5% Tween 80
2.0% Pectin Exchange (150)
1.0% CMC
2.0% Pregel. Tapioca Starch 19110
94.5% Honey

(b) Procedure: 94.5 grams of honey were put into a beaker and stirred with a wire whip. To this was added 2 gm. pectin and 0.5 gm. Tween 80 which had previously been dispersed in 30 ml. water. One gm. of CMC was then added slowly with continued mixing. The resulting product was spread on release paper to air dry at room temperature (72°F).

(c) Results: After 10 days of air drying, the product was still sticky and was therefore discarded.

(5) CMC and Egg Albumin as the Structure Matrix

(a) Formula:

98 parts Honey - CMC Solution Mixture
2 parts Dried Egg Albumin

CMC Solution
97.5 parts Water
2.5 parts CMC

Honey-CMC Solution Mixture
100 parts CMC Solution
50 parts Honey

(b) Procedure: The procedure for making a CMC solution using the Waring Blendor was as follows: Agitate the water by running the blendor slowly, add the CMC slowly and concurrently speed up the blendor by turning up the power stat and continue mixing until all the CMC is dissolved. The honey was added running the blendor at top speed.

Two grams of dried egg albumin were added to 98 gms. of honey - CMC solution mixture using a wire whip to mix the product.

(c) Results: Approximately three days of air drying at room temperature (72°F) were required to free the sheet from the release paper. It was only slightly sticky when touched but stuck together and to other sheets tenaciously. These sheets tasted like honey. Stickiness must be controlled to make this a desirable product.

(6) CMC and Gelatin as the Structure Matrix

(a) Formula: 2.50% Gelatin (Knox)
0.75% CMC
46.75% Water
50.00% Red Owl Honey (white)

(b) Procedure: The gelatin was put into solution by addition to the water previously warmed enough to dissolve it easily. This gelatin solution was put into a Waring Blendor bowl and the CMC was added as usual, IIIB(5), to the moving solution. The honey was then added and the resulting product was spread on release paper in a thin sheet to dry in air at room temperature (72°F.)

(c) Results: The next day the sheet could be removed from the release paper, although it did stretch some when being removed.

Part of the product, before sheeting, was frozen in a blast freezer and sliced in sheets with a meat slicer. The slices stuck

together immediately after slicing but were easily removed from release paper after drying in air overnight. The resulting sheets were slightly sticky to the touch.

(7) 10% Gelatin as the Structure Matrix

(a) Formula: 90% Honey
10% Gelatin
25 ml. Water per 100 gm. ingredients

(b) Procedure: The honey was heated to 160°F and placed in a Schnell-kutter and the gelatin added with mixing. The honey and gelatin were mixed for three minutes and then the water was added and mixing continued for an additional four minutes with vacuum being drawn at the time of the mixing. The product was very easy to handle in the liquid state. After pouring into a paper lined box and freezing, a depression formed on the top surface of the material. On trying to remove the paper from the frozen honey bar, much resistance was encountered. To solve this problem, the paper liner was sliced off with a Hobart meat slicer. When slicing of the sheets began, it was found that the honey was very sticky and tough. To combat this, continuous wetting of the slicer blade and carriage was necessary. The sheets were then sliced at a #10 setting and placed on release paper and then air dried at room temperature (72°F) for 48 hours.

(c) Results: After drying there was a considerable amount of sticking together of the honey sheets when one was placed upon the other so that some of the sheets were dusted with rice flour while others were laminated with sheets of rice paper. These were placed in air and moisture-tight polyethylene bags and stored under refrigeration until they were needed for the storage tests.

C. Dry Mixing Technique Using High Melting Fat as the Structure Matrix

(a) Formula:

9.17% Aratex
1.84% Gum Acacia
36.70% Powdered Sugar
18.35% Corn Syrup Solids
1.83% Glycerin
9.17% Water
18.35% Coconut Flour
4.59% Honey Flavor

(b) Procedure: The Aratex was heated in a N-200 Hobart bowl to approximately 150°F at which state it liquifies. The heating may be done by any convenient method such as a heat-air gun, or jacketed kettle. After the Aratex was thoroughly melted, the gum acacia was added with continued mixing in the Hobart until a smooth slurry was obtained. The powdered sugar and the water were mixed separately and added to the Aratex-gum acacia slurry with continued mixing. The glycerin was then added followed by the coconut flour, corn syrup solids, and honey flavor which had been previously mixed and sifted together to prevent lumping. The resulting mixture was mixed at high speed for 3 minutes. About a 1 pound lump of this product was formed into about a 12" cylinder, and this was placed on top of the intersection of the rollers of a machine (Figure 1 and 2) designed to roll out the sheets. The machine, a converted mill was first tried out with stainless steel rollers; however the material stuck to the rollers and was not able to be rolled out satisfactorily. To solve this problem the stainless steel rollers were removed from the machine and coated with 3 mil of teflon. After this modification the rolling of the product was very satisfactory.

The direction of the rollers (A) is shown in Figure 1. The product as mentioned before is inserted on the top of the two rollers and fed into the two roller stand by hand. After being rolled to the desired thickness the product drops to the teflon sheet (B) which has

been previously positioned as shown in Figure 1. After sliding down the teflon ramp, the sheet of product comes to (c) which is the end of a roll of waxed paper positioned at the rear of the machine. As the sheet moves down onto the wax paper, the paper is pulled out to accommodate the product size. When sufficient paper had been pulled out to accommodate the product, the waxed paper is cut along line X-Z (dotted) and the product on wax paper is removed from the machine. Figure 2 shows the cross-sectional view of the scraper assembly on the two rollers. The scrapers are necessary to insure that no particles of product adhere to the rollers. These large sheets are then cut into 4" x 4" x 1/16" sheets with the aid of a teflon pattern and spatula. The resulting food sheets were then air dried over night at room temperature (72°F.).

ROLLERS FOR SHEET MACHINE

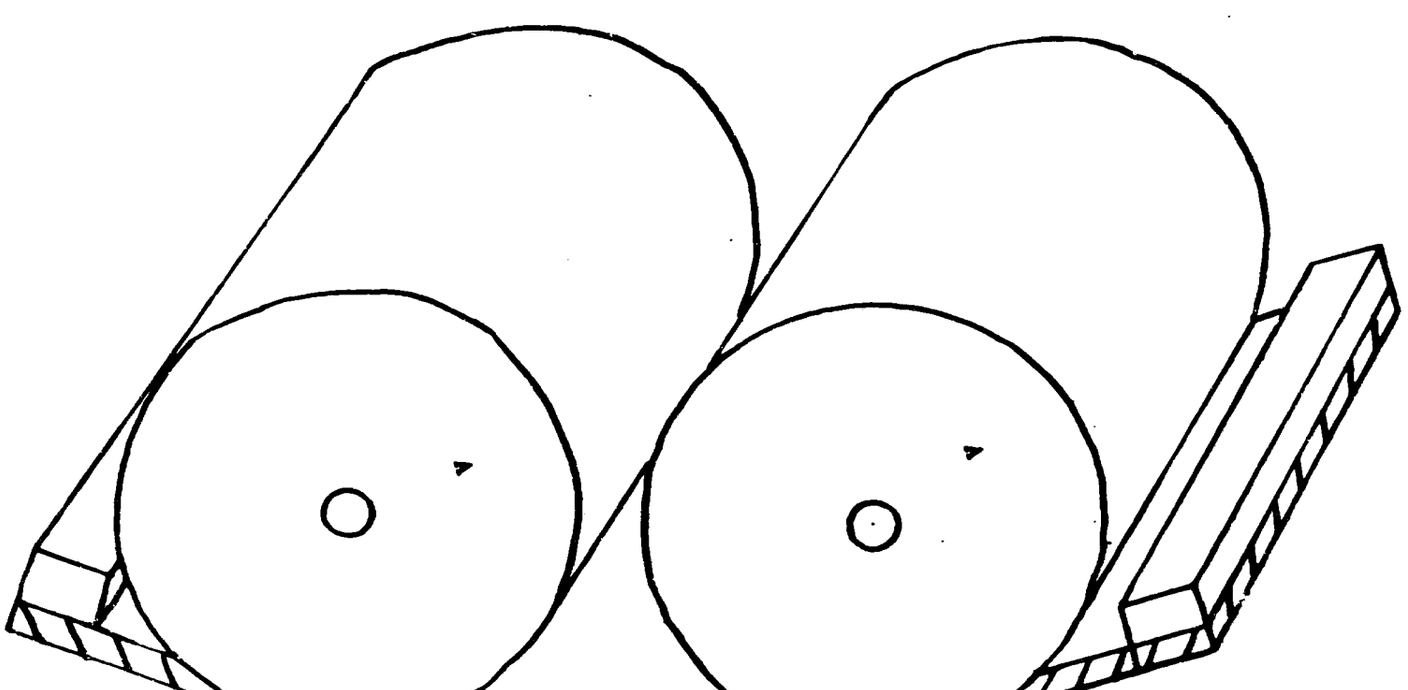

Figure 2

MACHINE FOR ROLLING
OUT SHEETS

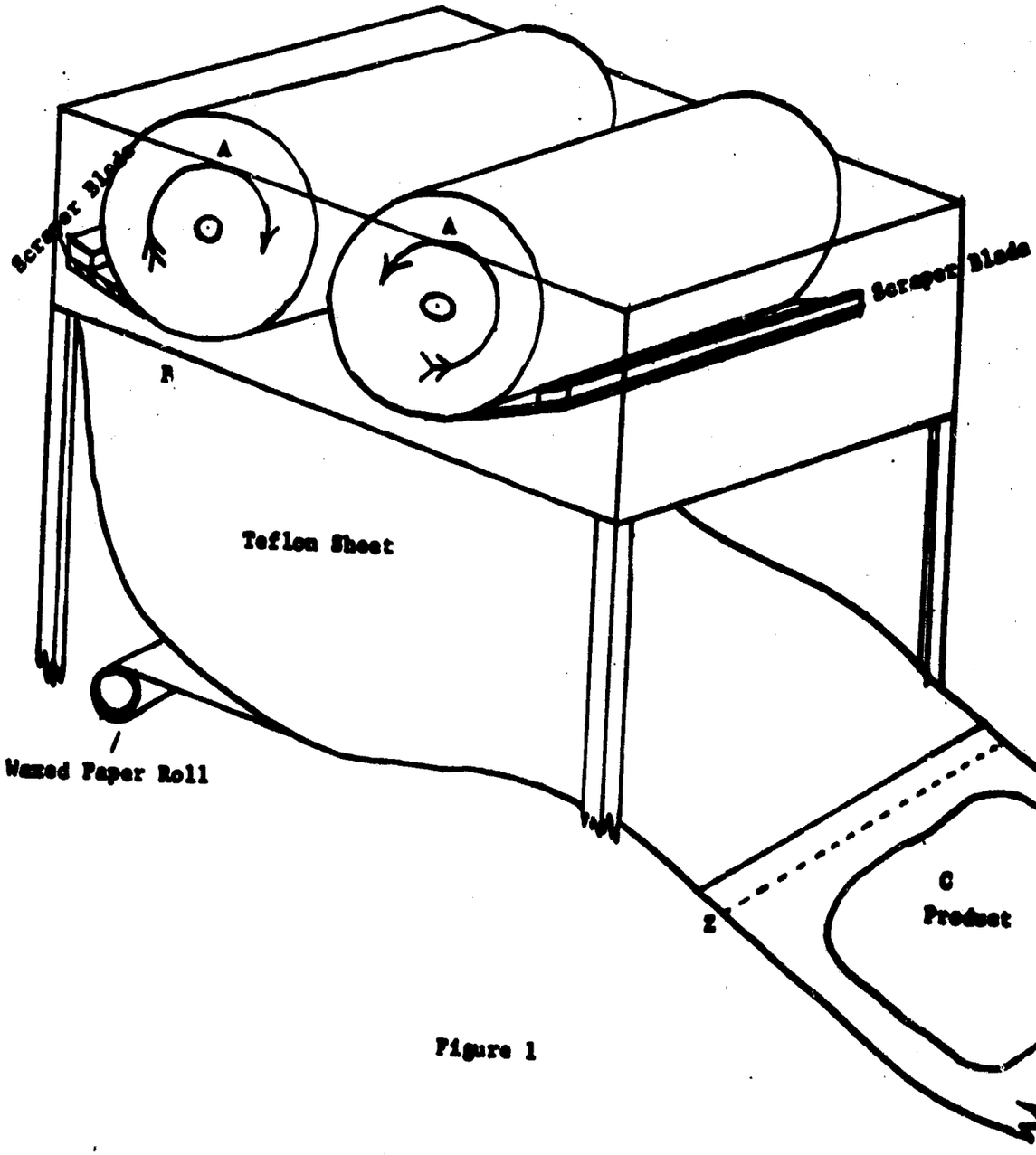

Figure 1

(c) Results: The sheets had good honey flavor, acceptable flexibility, were non-sticky, and had good color. These sheets were checked for stability by storing them six per foil pouch at 100°F for one week. The product held up well; a 10 pound batch was made for the storage tests.

D. Best Method for Making Honey Food Sheets

The best method for making honey food sheets is given in Section III C(1), "Dry Mixing Technique Using High Melting Fat as the Structure Matrix." A 10 pound batch was made for storage tests.

IV. Mayonnaise Food Sheets

A. Incorporation Into Stable Dispersions

(a) Formula:

30.00%	Durkex 500 (Durkee Co.)
5.00%	Gelatin
7.50%	Sodium Caseinate
1.60%	Salt
1.00%	Dry Mustard (Coleman's)
0.20%	White Pepper
4.70%	Sucrose
40.00%	Water
10.00%	Vinegar

(b) Procedure: Heat the oil to 150°F, place in a Waring Blendor, and mix in the sodium caseinate, sucrose, salt, pepper, and mustard powder. Add the water (heated to 150°F) in which the gelatin had previously been dissolved and mix until a stable dispersion forms. To this stable dispersion add the vinegar with continued mixing. Freeze and slice the product into 1/8" thick sheets using a Hobart slicer set at #7 and dry on release paper overnight at room temperature.

(c) Results: The sheets were flexible, non-sticky, easy to bite and chew, and tasted similar to mayonnaise.

B. Best Method for Making Mayonnaise Food Sheets

The best method for making mayonnaise food sheets is given in Section IV A, "Dispersion Technique for Making Mayonnaise Food Sheets." A 30 pound batch was made replacing the Waring Blendor with a Schnellkutter for the larger batch. The resulting sheets were used for the subsequent storage tests.

V. Onion Gravy Food Sheets

A. Use of Hydrocolloids as the Structure Matrix

(1) CMC and Starch as the Structure Matrix

(a) Formula:
2% Onion Powder (Toasted)
9% Col Flo Starch (National)
30% Spray Dried Encapsulated Lard
40% Pillsbury Gravy Mix
10% Agglomerated Beef Boullion
10% Corn Syrup Solids
100 gms. of water solution of 2% CMC

(b) Procedure: A CMC solution was made as written previously using a Waring Blendor III B (5). The dry ingredients were mixed together by hand and added to the CMC solution. After blending, the product was spread on release paper to dry in the air at room temperature (72°F).

(c) Results: This product after drying over the week-end was tasty, [illegible]able, and non-sticky, but tended to be a little brittle.

B. Incorporation Into Stable Dispersions

(1) Dispersion Technique for Making Onion Gravy Food Sheets

(a) Formula:
45.0% Durkex 500 (Durkee Co.)
22.0% Non-fat Milk Solids
3.0% Gelatin
18.5% Dextrin
10.0% Onion Flakes
0.5% Paprika
1.0% Salt
83 ml. water/100 gm. solids

(b) Procedure: A stable dispersion was formed using a standard procedure as given in Section IV (A) (1). Onions and gelatin were prehydrated prior to addition. The stable dispersion was frozen, sliced at a #7 setting on a Hobart slicer and dried on release paper in an air circulating oven set at 70°C for 40 minutes and then at room temperature (72°F) overnight.

(c) Results: The sheets were flexible, non-sticky, easy to bite and chew, and had a taste similar to onion gravy.

C. Best Method For Making Onion Gravy Food Sheets

The best method for making Onion Gravy Food Sheets is given in Section V B (1) "Dispersion Technique for Making Onion Gravy Food Sheets." A 30 pound batch was made replacing the Waring Blendor with a Schnell-kutter for the larger batch. The resulting sheets were used for the subsequent storage tests.

VI. Peanut Butter Food Sheets

A. Use of Hydrocolloids as the Structure Matrix

(1) CMC, Gelatin, and Starch as the Structure Matrix

(a) Formula: 80% Peanut Butter, Chunk Style (Red Owl)
12% Sucrose
8% Cornstarch
100 gms. of above ingredients added to 200 gms. of 2% CMC - 2% gelatin solution

(b) Procedure: After making a 200 gram batch of gum solution, the peanut butter, sucrose, and starch were added to the solution in a Waring Blendor with mixing. The product was spread into thin sheets on a release paper and air dried at room temperature (72°F).

(c) Results: After an 18 hour drying period, the product was removed from the release paper, turned over, and dried an additional six hours. The product was flexible, rather good tasting, and non-sticky. After a month's storage at room temperature in a polyethylene bag, a green mold formed on the surface. This technique and the resulting product appear to be adequate for making peanut butter food sheets if the mold problem can be eliminated.

B. Incorporation Into Stable Dispersions

(1) Dispersion Technique for Making Peanut Butter Food Sheets

(a) Formula: 70% Peanut Butter (hydrogenated)
8% Sodium Caseinate
7% Gelatin
15% Sucrose
125 ml. water/100 gm. solids

(b) Procedure: The peanut butter was heated to 150°F and placed in a Waring Blendor. The sodium caseinate and sucrose were added with mixing until thoroughly dispersed. The water heated to 150° F in which the gelatin had previously been dissolved was added and mixing continued at high speed until a stable dispersion formed (approximately 1 minute). This product was frozen, sliced at a #10 setting on a Hobart slicer and dried on release paper at room temperature for 48 hours.

(c) Results: The sheets were non-sticky, flexible, easy to bite and chew and had a mild peanut butter flavor. These sheets will be storage tested.

C. Best Method for Making Peanut Butter Food Sheets

The best method for making Peanut Butter Food Sheets is given in Section VI B(1) "Dispersion Technique for Making Peanut Butter Food Sheets." A 30 pound batch was made replacing the Waring Blendor with a Schnellkutter for the larger batch. The resulting sheets were used for the subsequent storage tests.

VII. Pickle Relish Food Sheets

A. Use of Hydrocolloids as the Structure Matrix

(1) Pectin, Locust Bean Gum and Pregelatinized Tapioca Starch with India Pickle Relish

(a) Formula: 1.5% Pectin 150 Exchange
1.5% Locust Bean Gum
5.0% Pregelatinized Tapioca Starch
5.0% Sucrose
37.0% Water
50.0% India Pickle Relish

(b) Procedure: Using a wire whip attachment to a lightening mixer, the dry ingredients were dispersed into the water and then the India pickle relish added. The resulting product was spread into thin sheets on aluminum cookie pans and air dried at room temperature (72°F) for 15 hours.

(c) Results: The dried sheets were easily sliced off the pans. They were flexible, non-sticky, and tasted like India pickle relish. These sheets were still good with no apparent deterioration after two months storage at room temperature wrapped in Saran plastic film.

(2) CMC as the Structure Matrix

(a) Formula: 94% Relish (India) - 6% Corn Syrup Solids
combined with
2% CMC - 98% Water

(b) Procedure: 50 grams of the relish-corn syrup solids mixture were hand mixed into 100 grams of a 2% CMC solution. The resulting product was spread in thin sheets on a release paper.

(c) Results: After 2 days of air drying at room temperature (72°F) on the release paper, the sheets could be peeled off. The sheets were very flexible and non-sticky but became quite tough and hard to chew after storage in a polyethylene bag. Even though the sheets were tough, they remained flexible after the storage period. The sheets did not become tough to chew until they were quite dried out. Proper packaging prevented this drying out.

(3) 2% CMC as the Structure Matrix

(a) Formula: 94% Pickle Relish
4% Corn Syrup Solids
2% CMC

(b) Procedure: The pickle relish was placed in a Waring Blendor and the corn syrup solids and CMC added with high speed mixing for

for approximately 5 minutes. This product was frozen, sliced at a #10 setting on a Hobart slicer and dried on release paper for three hours in an air circulating oven set at 70°C.

(c) Results: The sheets were flexible, non-sticky, tasted like pickle relish but were slightly tough. These sheets will be storage tested.

B. Best Method for Making Pickle Relish Food Sheets

The best method for making pickle relish food sheets is given in Section VII A(3) "2% CMC as the Structure Matrix." This was done in a 30 pound batch as follows:

(1) 2% CMC as the Structure Matrix

(a) Formula: 94% Pickle Relish
4% Corn Syrup Solids
2% CMC

(b) Procedure: Pickle relish was placed in the Schnellkutter, and the corn syrup solids and CMC added with high speed mixing. This product needs careful attention to the mixing to insure that the CMC gets thoroughly broken up and dispersed through the pickle relish. After mixing, this product was very sticky but was able to be packed into boxes and put into the freezer. After freezing it was difficult to remove the paper liner from the frozen block, so that it was necessary to slice it off with a Hobart slicer. Also during slicing it was necessary to wet the blades of the slicer to keep it from sticking to the product. These sheets were dried on release paper in an air circulating oven set at 70°C. for four hours and then at room temperature for 48 hours.

(c) Results: Sheets were flexible, tasted like pickle relish but were slightly sticky. Therefore, they were dusted with rice flour to prevent them from sticking to each other when stacked

together. These sheets were used for the subsequent storage tests.

VIII. Strawberry Preserve Food Sheets

A. Use of Hydrocolloids as the Structure Matrix

(1) CMC as the Structure Matrix

(a) Formula: 2% CMC
98% Strawberry Preserves (Red Owl)

(b) Procedure: A wire whip on a lightning mixer was used to disperse the CMC in the preserves. The resulting smooth product was spread out on release paper to dry in thin sheets.

(c) Results: Even after a week's drying in air at room temperature (72°F), the sheets remained sticky to the touch. It appears that the CMC alone was not adequate to make non-sticky strawberry preserve food sheets.

(2) Larger Quantity Preparation of Strawberry Preserve Sheets Using CMC as the Structure Matrix

(a) Formula: 98% Strawberry Preserves
2% CMC

(b) Procedure: The product was mixed as shown in VIII A (1) only mixed in larger quantities. Great difficulty was encountered in mixing the product in the Schnellkutter. After mixing the product increased greatly in viscosity and was very difficult to handle. The product was packed in boxes and frozen. After several days in the blast freezer, the preserves were very gelatin like and not solid enough to slice very well. No amount of wetting of the slicer blade of the Hobart slicer would facilitate getting off any slices that would not stick to the slicer. The product was placed on a plate freezer in hopes that a lower temperature would facilitate slicing, but this did not work. Because of this difficulty, it was decided

to reformulate this product using a dry method of manufacture.

B. Dry Mixing Technique Using High Melting Fat as the Structure Matrix

(1) Dry Mixing Technique Using High Melting Fat as the Structure Matrix

(a) Formula:
19.57% Strawberry Jam Solids (Le Grout)
2.17% Imitation Strawberry Flavor (Fries & Fries F-602)
8.53% Aratex
8.53% Water
1.67% Gum Acacia
1.67% Glycerin
24.42% Powdered Sugar
16.72% Coconut Flour
16.72% Corn Syrup Solids

(b) Procedure: The same procedure as given for the Honey Food Sheets, Section III C (1) was used substituting the Strawberry Jam Solids and Imitation Strawberry Flavor for the Honey.

(c) Results: The sheets had good strawberry jam flavor, acceptable flexibility, were non-sticky and had good color. These sheets were checked for stability by storing them six per foil pouch at 100°F. for one week. The product held up well; therefore a 10 pound batch was made for future storage tests.

C. Best Method For Making Strawberry Preserve Food Sheets

The best method for making Strawberry Preserve Food Sheets is given in Section VIII B (1) "Dry Mixing Technique Using High Melting Fat as the Structure Matrix."

IX. Soya Sauce Food Sheets

A. Use of Hydrocolloids as the Structure Matrix

(1) CMC as the Structure Matrix

(a) Formula:
4% CMC
96% Soya Sauce (Chun King)

(b) Procedure: The CMC was stirred into the soya sauce with a wire whip attachment on a lightning mixer to disperse and to dissolve the CMC. The resulting product was spread on release

paper in thin sheets and air dried at room temperature (72°F).

(c) Results: Drying was very slow, at least a week was necessary before the product could be handled readily. The taste of the product was very typical of soya sauce, but the sheets were more fragile than desired.

(2) CMC and Starch as the Structure Matrix

(a) Formula:
3% Sorbitol Solution (Merck)
3% Corn Syrup Solids
2% CMC
90% Soya Sauce
2% Pre-gelatinized Tapioca Starch

(b) Procedure: The sorbitol solution was weighed out into a beaker with the corn syrup solids and the soya sauce added to them. The soya sauce was stirred by hand to blend the ingredients together. The CMC and starch were dry mixed and slowly added to the other ingredients using a wire whip for mixing. The resulting product was spread on release paper in thin sheets and air dried at room temperature (72°F).

(c) Results: After 4 days of air drying, the product was non-sticky, rather plastic, and had a typical flavor of soya sauce. The product sheets seemed to fulfill the requirements set up by the contract.

(3) Larger Quantity Preparation of Soya Sauce Food Sheets Using CMC and Starch as the Structure Matrix

(a) Formula:
3% Sorbitol Solution
3% Corn Syrup Solids
2% CMC
2% Pregelatinized Tapioca Starch
90% Soya Sauce

(b) Procedure: The product was mixed in a Schnellkutter with the following mixing times - Soya sauce and CMC for three minutes, sorbitol and corn syrup solids were added and then

mixing continued for an additional five minutes. Vacuum was placed on this mixture through all the mixing steps. The product was placed in wax paper-lined boxes and frozen.

(c) Results: After a period of time, the product was checked and found not to have frozen. Only portions of it had frozen so that additional freezing was necessary, but again, it was found that the product would not completely freeze. What had happened due to the high concentration of the salt in the soya sauce was that the product had fractionally frozen. The part that had not set up under the initial freezing conditions had its salt concentration greatly increased and would not freeze. Due to this difficulty of freezing, no slices were made from this product. It was decided to try to reformulate this product.

B. Incorporation Into Stable Dispersion

(1) Incorporation of Soya Sauce Into a Dispersion Using CMC, Dextrinized Starch and Pregelatinized Tapioca Starch as Film Formers

(a) Formula:
2% CMC
40% Lard
8% Dextrin Starch (National)
8% Dextrose
40% Soya Sauce (Chun King)
2% Pregelatinized Tapioca Starch (Morningstar Brand)
50 ml. Water per 100 gm. of ingredients

(b) Procedure: The dry ingredients were added to the melted lard as in all the other examples and the soya sauce and water added with blending. It was hoped that the protein in the soya sauce would at least partially replace the protein film former, sodium caseinate used in previous examples thus giving a more true flavor of soya sauce.

(c) Results: The resulting product was spread on cookie pans and air dried overnight (72°F). The resulting sheet had to be cut off the cookie pan and was somewhat sticky. It remained sticky to touch even after storing for a long period. The flavor of this food sheet was not representative of soya sauce.

(2) Use of Hydrolyzed Vegetable Protein in a Stable Dispersion For the Soya Sauce Sheets

(a) Formula:

20% Durkex 500
4% Gelatin
6% Sodium Caseinate
19% Dextrin
10% Hydrolyzed Vegetable Protein
41% Water

(b) Procedure: The oil was heated to 150°F., placed in a mixer such as a Waring Blendor or Schnellkutter and mixed with the sodium caseinate, dextrin and hydrolyzed vegetable protein. The water, heated to 150°F. in which the gelatin had been previously dissolved, was added with continued mixing until a stable dispersion was formed. (Approximately 2 minutes). This stable dispersion was placed in 4" x 4" approximately 12" wax paper lined boxes and frozen. The frozen blocks were then sliced on a Hobart Slicer at a No. 7 setting and placed on release paper and dried for 24 hours at room temperature (72°F).

(c) Results: The soya sauce sheets were good looking, were flexible, non-sticky, and tasted like soya sauce, but had some holes. These holes were not deemed serious enough to prevent future use of the sheets; therefore, a 30 pound batch of these sheets was made and the resulting sheets pouched in the foil pouches for future storage tests.

C. Best Method for Making Soya Sauce Food Sheets

The best method for making soya sauce food sheets is given in Section

IX B(2), "Use of Hydrolyzed Vegetable Protein in a Stable Dispersion for Soya Sauce."

X. Vinegar Food Sheets

A. Use of Hydrocolloids as the Structure Matrix

(1) CMC, Guar Gum, Starch, and Avicel as the Structure Matrix

(a) Formula:

11% Dry Vinegar (Vinstant) (Delaware Food Products)
3% CMC
3% Guar Gum (Super Col) (General Mills)
8% Col-Flo Starch (National)
30% Spray Dried Encapsulated Fat
20% Corn Syrup Solids
25% Avicel (American Viscose)
200 gm. water per 100 gram of dry ingredients

(b) Procedure: A gum solution was made as usual on a Waring Blendor adding the guar gum to the water first and then the CMC (III B(5)). The dry ingredients were added and blended into a homogenous mixture. The product was spread on a cookie pan in thin sheets and air dried at room temperature (72° F.).

(c) Results: This sheet became quite brittle after three days drying, but it tasted like it had retained at least the vinegar flavor. Further work will be done to eliminate the brittleness.

(2) CMC as the Structure Matrix and Defatted Coconut Flour as a Filler

A great deal of difficulty was encountered in making a vinegar food sheet. Many formulations and processing techniques were tried with poor results. The following formulation and procedure are the best to date.

(a) Formula:

12.00% Defatted coconut flour
66.50% Vinegar (5%)
1.00% CMC
2.50% Citric acid
3.00% Sorbitol (70%)
15.00% Corn syrup solids

(b) Procedure: The CMC was dissolved by mixing in a blendor with the water. Then all of the other ingredients were mixed in thoroughly. Instead of freezing and slicing as was used for the other sheets, this product was poured directly on large sheets of polyethylene

and air dried overnight at room temperature (72°F.). (The product cracked badly when the freeze-slice technique was used.) These large sheets were then cut into 4" x 4" x 1/8" sheets.

(c) Results: Flexible, non-sticky sheets that tasted like vinegar resulted. These sheets tended to be a little tough if made too thick. A 30 pound batch was made and these sheets pouched for future storage tests.

B. Best Method for Making Vinegar Food Sheets

The best method for making vinegar food sheets is given in Section X A(2), "CMC as the Structure Matrix and Defatted Coconut Flour as a Filler."

XI. Apple Butter Food Sheets

A. Use of Hydrocolloids as the Structure Matrix

(1) Pectin with Apple Butter

(a) Formula:
1% Pectin(150 Exchange)
99% Apple Butter

(b) Procedure: The pectin was hand mixed into the apple butter, and the resulting product spread on aluminum cookie pans in thin sheets. These sheets were dried open to the air at room temperature for 22 hours.

(c) Results: The resulting product was flexible, slightly sticky with a flavor of apple butter. These sheets were stored in plastic bags and were still slightly sticky after several weeks storage at room temperature.

(2) CMC and Pectin as the Structure Matrix

(a) Formula:
1% Pectin (Exchange 150)
1% CMC
1% Myverol 1806
97% Apple Butter (Red Owl)

(b) Procedure: While stirring the apple butter with a wire whip attached to a lightning mixer, the pectin was added slowly and then

the CMC added in a like manner. The Myverol was then added and the whole product whipped rapidly. The product was spread on release paper in thin sheets and air dried at room temperature (72°F.).

(c) Results: After two days drying in air at room temperature, the sheets came off the release paper. They were non-sticky and plastic but rather hard to chew. A month's storage in a polyethylene bag did not seem to change them except to make them tougher to chew. Possibly better packaging; i.e. better moisture barrier, would prevent some of this toughness on storage.

(3) 0.25% CMC and 1% Gelatin as the Structure Matrix

(a) Formula:

0.25% CMC
1.00% Gelatin (Knox)
98.75% Apple Butter

(b) Procedure: The apple butter was warmed to 130°F and placed in a Waring Blendor. The gelatin was added with mixing followed by the addition of the CMC with continued mixing (approximately 5 minutes). The resulting product was frozen, sliced at a #10 setting on a Hobart slicer and dried on release paper for 4 hours in an air circulating oven set at 70° C and then at room temperature (72°F) for 8 hours.

(c) Results: The sheets were non-sticky, flexible, easy to bite and chew, had a good apple butter taste, and they did not stick together.

B. Best Method for Making Apple Butter Food Sheets

The best method for making apple butter food sheets is given in Section XI A(3), "0.25% CMC and 1% Gelatin as the Structure Matrix." A 30 pound batch was made as follows:

(a) Procedure: Apple Butter was warmed to 130°F and placed in a Schnellkutter. The gelatin was added with high speed mixing for

two minutes followed by the addition of the CMC with continued mixing for approximately three more minutes. After freezing, the product was sliced with no difficulty and placed upon release paper. Handling of this item is very critical as it has a weaker structure than the other products using the gums as the structural matrix. These sheets were dried four hours in an air circulating oven set at 70°C, then at room temperature for eight hours.

(c) Results: The sheets were flexible, easy to bite and chew but were slightly sticky; therefore, they were dusted with rice flour. It was also noted that a slight bubbling occurred on these sheets.

XII. Chocolate Sauce Food Sheets

A. Use of Hydrocolloids as the Structure Matrix

1. CMC as the Structure Matrix

(a) Formula:

2% CMC
2% Buttermilk Solids
96% Chocolate Syrup (Hershey's)

(b) Procedure: The chocolate syrup was stirred with a wire whip attachment, as before in other experiments, and the CMC added slowly and the mixture whipped rapidly. The resulting product was spread on release paper in thin sheets and air dried at room temperature (72° F).

(c) Results: After 3 days the chocolate sheet came off the release paper and was only slightly sticky on the bottom side. These sheets were tough and hard to chew but did have a good chocolate taste.

2. Gelatin and CMC as the Structure Matrix

(a) Formula:

0.75% CMC
2.50% Gelatin
46.75% Water
50.00% Chocolate Syrup (Hershey)

(b) Procedure: The procedure for making the sheets was the same as that given for Barbecue Sauce Food Sheets, Section I B(3) replacing the Barbecue Sauce with the chocolate syrup. The sheets were air dried

at room temperature (72°F) for 24 hours. turned over, and dried an an additional 12 hours.

(c) Results: The sheets were flexible, non-sticky, had a good chocolate taste but were very tough to bite and chew.

B. Incorporation Into Stable Dispersions

1. Dispersion Technique For Making Chocolate Sauce Food Sheets

(a) Formula:

20.0% Durkex 500 (Durkee Co.)
15.0% Non-fat Milk Solids
5.0% Gelatin
6.0% Cocoa
0.5% Vanilla Concentrate
53.5% Sucrose
47 ml water per 100 gm solids

(b) Procedure: A slurry was formed by adding the non-fat milk solids and cocoa to the oil in a Waring Blendor and mixing until they were thoroughly coated. The sucrose was then added with mixing and then the water with the gelatin dissolved therein was added with high speed mixing until a stable dispersion was formed. This product was frozen and cut into thin slices using a #7 setting on a Hobart slicer. The sheets were air dried on release paper at room temperature overnight, turned over, and then dried one hour in an air circulating oven set at 45° C.

(c) Results: The sheets were flexible, non-sticky, fairly easy to bite and chew and had an excellent chocolate sauce taste. These sheets were storage tested and did not hold up being brittle and sticking together when stored at the higher temperatures.

2. Dispersion Technique for Making Chocolate Sauce Food Sheets Using Sodium Caseinate as the Principle Film Former

(a) Formula:

19.00% Durkex 500
7.00% Sodium caseinate
2.00% Gelatin
5.00% Gelatinized cocoa
0.50% Vanilla concentrate
32.00% Sucrose
34.35% Water
0.15% Citric acid

(b) Procedure: To help keep the bacteria count down and to make the product smoother and more palatable, the cocoa was gelatinized before addition to the product.

Procedure for Gelatinized Cocoa:

Mix cocoa and water (approximately 20% solids) into a slurry and place into a Groen vacuum or pressure mixer. Set temperature of the outside steam jacket to 170°F. Set mixing speed at No. 10 and mix for 10 minutes. Next cut temperature to 150°F and mix for an additional 1½ hours. Make sure that the lid is fastened tightly while the gelatinizing is being carried on. This gelatinized cocoa is then used in the formula allowing for the moisture in the cocoa. The stable dispersion was made as follows: The Durkex 500 was heated to 150°F and the sodium caseinate added and mixed until coated with oil. The sucrose was added and mixing continued until all the ingredients were well dispersed. The water, heated to 150° F in which the gelatin had previously been dissolved, was added with continued mixing until a stable dispersion was formed. (Approximately 2 minutes.) To this stable dispersion was added the pregelatinized cocoa, vanilla concentrate, citric acid and mixing was continued until all ingredients were thoroughly distributed. This product was then poured into poly-lined boxes and placed in the freezer. The frozen blocks were then sliced at a No. 10 setting on a Hobart Slicer and dried on release paper for 24 hours.

(c) Results: The resulting sheets had good odor, color, and general appearance, were flexible and did not stick together. There was no appreciable shrinkage during the drying period. These sheets were pouched six to a pouch in the metalized pouches and stored for one week at 100°F. The sheets held up well; therefore, were made in a 30 pound batch by the procedure outlined. These sheets were then placed in foil pouches for future storage tests.

C. Best Method for Making Chocolate Sauce Food Sheets

The best method for making chocolate sauce food sheets is given in Section XII B(2), "Dispersion Technique for Making Chocolate Sauce Food Sheets Using Sodium Caseinate as The Principle Film Former."

XIII. Coffee Food Sheets

A. Incorporation Into Stable Dispersions

1. Dispersion Technique for Making Coffee Food Sheets

(a) Formula:

20.9% Durkex 500
20.9% Non-fat Milk Solids
20.9% Sucrose
6.2% Instant Coffee
31.1% Water

(b) Procedure: The standard dispersion techniques and subsequent forming of the sheets as given for the chocolate sauce sheets, Section XII B(1) were used. The sheets were dried overnight at room temperature (72°F).

(c) Results: The sheets tasted like instant coffee, were flexible and easy to chew but were slightly sticky; therefore, the sheets were dusted with rice flour to prevent any sticking together. These sheets were storage tested and did not hold up, being brittle and sticking together when stored at the higher temperature.

2. Dispersion Technique for Making Coffee Food Sheets Using Sodium Caseinate as The Principle Film Former

(a) Formula:

20.0% Durkex 500
3.0% Gelatin
5.0% Sodium caseinate
5.3% Instant coffee
20.7% Sucrose
5.0% Non-fat dried milk solids
41.0% Water

(b) Procedure: The general dispersion technique procedure, as given in the Chocolate Food Sheets as given in Section XII B(2) was used.

(c) Results: The sheets were flexible, non-sticky and had the taste and smell of coffee with cream and sugar. These sheets were then placed in the metalized pouches and stored at 100°F for one week. They held

up well and were therefore made in a 30 pound batch and pouched for for future storage tests.

B. Best Method for Making Coffee Food Sheets

The best method for making coffee food sheets is given in Section XIII A(2), "Dispersion Technique for Making Coffee Food Sheets Using Sodium Caseinate as the Principle Film Former."

XIV. White Sauce with Bacon Food Sheets

A. Incorporation Into Stable Dispersions

1. Dispersion Technique for Making White Sauce with Bacon Food Sheets

(a) Formula:

10.7% Durkex Oil (Durkee Co.)
20.1% Non-fat Milk Solids
10.3% Dextrin
1.5% Gelatin (Knox)
0.2% Paprika
42.9% Water
14.3% Bacon Bits (Wilson)

(b) Procedure: A stable dispersion was formed using standard procedures as given for the Chocolate Sauce Sheets, Section XII B(2). After the dispersion was formed, the bacon bits were added and the product was frozen and sliced into sheets at a #7 setting on a Hobart Slicer. These sheets were dried on release paper in an air circulating oven set at 70°C for 40 minutes and then dried at room temperature (72°F) overnight.

(c) Results: The sheets were flexible, non-sticky, easy to bite and chew and tasted similar to bacon and white sauce. These sheets were storage tested.

B. Best Method for Making White Sauce with Bacon Food Sheets

The best method for making white sauce with bacon food sheets is given in Section XIV A(1), "Dispersion Technique for Making White Sauce with Bacon Food Sheets."

XV. Chopped Date Food Sheets

A. Use of Hydrocolloids as The Structure Matrix

1. CMC as The Structure Matrix

(a) Formula: 2% CMC
98% Water) - CMC Solution
150 grams dried dates added to 100 grams of CMC solution

(b) Procedure: CMC Solution made as usual in a Waring Blendor and the dates added to the solution and blended. The resulting product was spread in thin sheets on release paper and air dried at room temperature (72F).

(c) Results: The dried sheets were rather flexible even after a week's drying in air and were good tasting. It is believed that this product will fulfill contract specifications.

2. 0.5% CMC as the Structure Matrix

Date sheets were made to see if a lower concentration of CMC could be used than that shown in the second Progress Report and to see if this material could be processed by the freezing and slicing technique.

(a) Formula: 53.0% Dried dates
0.5% CMC
46.5% Water

(b) Procedure: The CMC was put into solution by dissolving in the water while mixing in a Waring Blendor. The dried dates were added, and mixing was continued until the product was smooth. The mixture was frozen and sliced into 1/8" thick sheets using a Hobart meat slicer. The resulting sheets were placed on release paper and dried in an air circulating oven set at 55°C for five hours. The sheets were then turned over and dried an additional 1½ hours.

(c) Results: Good sheets were formed. They were flexible, non-sticky, easy to bite and chew and tasted like dates. This was a very acceptable product.

B. Best Method for Making Chopped Date Food Sheets

The best method for making chopped date food sheets is given in Section XV A(2), "0.5% CMC as the Structure Matrix." A 30 pound batch was made replacing the Waring Blendor with a Schnellkutter and the resulting product used for subsequent storage tests.

XVI. Onion Food Sheets

A. Use of Hydrocolloids as The Structure Matrix

1. CMC and Gelatin as the Structure Matrix

(a) Formula:

10.00% Onion Flakes (Dry)
0.25% CMC
5.00% Gelatin
84.75% Water

(b) Procedure: The onion flakes were hydrated in the water and the gelatin was added and the mixture heated to 140°F to dissolve the gelatin. This material was placed in a Waring Blendor, and the CMC was added with mixing. The product was frozen, sliced at a #10 setting on a Hobart slicer, placed on release paper, dried in an air circulating oven set at 70°C for 6 hours and then dried at room temperature over the week-end.

(c) Results: The sheets were non-sticky and tasted like onion but were too dry and brittle.

2. CMC as the Structure Matrix and Defatted Coconut Flour as a Filler

(a) Formula:

10.00% Dried Onion Flakes
15.00% Corn Syrup Solids
10.00% Defatted Coconut Flour
4.00% Sorbitol
1.00% CMC
60.00% Water

(b) Procedure: Same as for the Vinegar Food Sheets X A(2).

(c) Results: The resulting sheets were flexible, non-sticky and tasted like onions. Therefore, a 30 pound batch was made and these sheets pouched for future storage tests.

B. Best Method for Making Onion Food Sheets

The best method for making Onion Food Sheets is given in Section XVI A(2).

XVII. Horseradish Food Sheets

A. Use of Hydrocolloids as the Structure Matrix

(1) CMC and Knox Gelatin as the Structure Matrix

(a) Formula: 11 gms. Vinegar (Vinstant) Delaware Food Products)
30 gms. Spray Dried Encapsulated Lard
25 gms. Dry Horseradish (French's)
20 gms. Corn Syrup Solids
86 gms. of this material was added to
200 gms. of a 5% Gelatin - 1.5% CMC solution

(b) Procedure: The water was warmed slightly to help dissolve the Knox gelatin. The gelatin solution was added to a Waring Blendor bowl and the CMC added as usual, followed by the dry ingredients.

After blending until smooth, the product was sheeted out on release paper and air dried at room temperature (72° F).

(c) Results: Only one day drying was required to produce a non-sticky and flexible product. The vinegar sour taste was present, but the horseradish taste was mild. After storing a month in a polyethylene plastic bag, the sheets were still flexible and looked like they were just a little drier. The taste of the sheets after storage was very bland, and they became difficult to chew because of toughness. This probably can be alleviated by proper packaging.

(2) CMC as the Structure Matrix

(a) Formula: 25% Horseradish Powder
10% Dry Vinegar (Vinstant Delaware Food Products)
1% CMC
64% Corn Syrup Solids
100 ml. Water/100 gm. Solids

(b) Procedure: The CMC was added to the water using a Schnellkutter. The horseradish powder, Vinstant, and corn syrup solids were then added respectively with continued mixing until all were well blended. The resulting product was frozen, sliced into thin sheets, using a Hobart slicer, placed on release paper, and dried overnight at room temperature and then dried an additional 45 minutes at 70° C in an

air circulating oven. It should be noted that when mixing a large batch as a 30 lb. batch, noxious odor was encountered and was very irritating to the lungs, throat, and eyes. During the mixing operation, the operator of any mixer should have some type of gas mask to aid his breathing while mixing. After the slicing of the product and during the drying or actually during the thawing after slicing, bubbles appeared on the surface of the sheet. These bubbles produced holes through the sheet resembling swiss cheese. It is thought that air trapped under the sheet was the cause of these bubbles.

(c) Results: The sheets tasted like horseradish, were flexible and slightly tough and did have some holes as noted before. Possibly thinner sheets would be better under these circumstances. These sheets were storage tested and did not hold up. They tended to become very sticky and could not be separated.

B. Incorporation Into Stable Dispersions

(1) Dispersion Technique for Making Horseradish Cream Sauce Sheets

(a) Formula:

28.00% Durkex 500
7.00% Sodium Caseinate
4.00% Gelatin
9.70% Horseradish Powder
0.10% Cayenne Pepper
1.20% Salt
40.00% Water
10.00% of a 5% Vinegar

(b) Procedure: The standard dispersion techniques, as given in Section XII B(2) for the Chocolate Sauce Food Sheets, were used. The vinegar was added after the stable dispersion was made.

(c) Results: A flexible, non-sticky product resulted that tasted and smelled like horseradish cream sauce. It should be noted that during mixing a quite noxious odor from the horseradish evolved. This did not cause any difficulty in the final product. The stability of this product was checked by placing six sheets per foil pouch and storing the

pouches at 100° F. for one week. These sheets held up very well; therefore a 30 pound batch was made and the resulting sheets placed in foil pouches for future storage tests.

C. Best Method for Making Horseradish Food Sheets

The best method for making horseradish food sheets is given in Section XVII B(1) "Dispersion Technique For Making Horseradish Cream Sauce Sheets."

XVIII. Maple Syrup Food Sheets

A. Dry Mixing Technique Using High Melting Fat as the Structure Matrix

(1) Use of Aratex as the Structure Matrix

(a) Formula:

9.26%	Aratex (Durkee Co.)
1.85%	Gum Acacia
1.85%	Glycerin
37.04%	Powdered Sugar
18.52%	Corn Syrup Solids
9.26%	Water
18.52%	Coconut Flour
3.70%	Maple Flavor

(b) Procedure: A Hobart stainless steel bowl was warmed to about 200° F with an electric heating mantle controlled by a variac. The Aratex was melted in the Hobart bowl and the gum acacia added with mixing. The powdered sugar and corn syrup solids were added with mixing, and to this mixture was added the water and glycerin with continued mixing and heating. The coconut flour and maple flavor were mixed together and sifted into the mixing bowl and the blending and heating continued until a soft plastic mass was obtained. This mass was immediately placed on a teflon sheet and rolled into a 1/8" thick sheet using a teflon coated rolling pin.

(c) Results: The sheets had an excellent appearance, were elastic, and bent easily without cracking. The product broke up well in the mouth when chewed and had a good maple syrup flavor. These sheets were packaged in foil pouches, 6 sheets per pouch, and storage tested for two weeks at 40° F and 100° F. The sheets held up well; therefore were used for the

large storage test.

B. Best Method For Making Maple Syrup Food Sheets

The best method for making maple syrup food sheets is given in Section XVIII A(1) "Use of Aratex as The Structure Matrix." A 10 pound batch was made using the procedure given for Honey Food Sheets Section III C(1). The resulting sheets were packed in foil pouches and storage tested.

Margarine Food Sheets

A. Incorporation Into Stable Dispersions

(1) Dispersion Technique for Making Margarine Food Sheets Using Gelatin and Non-fat Milk Solids as the Film Formers

(a) Formula:
65% Butter Flavored and Colored Margarine (Durkee D-2-251)
5% Gelatin
30% Non-fat Milk Solids
50 ml. Water/100 gm. Solids
1 drop 4% Yellow Color/100 gm. Solids

(b) Procedure: The margarine was heated to 150° F and melted. Melted margarine was placed in the Schnellkutter and mixed with non-fat milk solids. The water, heated to 150° F in which the gelatin had previously been dissolved, was added and the whole mixed until a stable dispersion formed. The yellow color was mixed in, and the resultant product was frozen and sliced at a #7 setting on a Hobart slicer and placed on release paper and dried in an air circulating oven set at 70° C for 45 minutes and then dried overnight at room temperature. It should be noted that to get good slices of this product, it was necessary to bring the frozen block of margarine to refrigerator temperature to prevent cracking of the slices.

(c) Results: The sheets were non-sticky, easy to bite and chew and fairly pliable, and tasted similar to margarine. These sheets were slightly moist in appearance on the top although at that time not thought enough to be objectionable. These sheets were storage tested and did not hold

up well being too high in moisture and also oiling off.

(2) Dispersion Technique for Making Margarine Food Sheets Using Sodium Caseinate and Gelatin as the Film Formers

(a) Formula:

35.00% Durkex 500
8.75% Sodium Caseinate
5.83% Gelatin
1.00% Salt
3.00% Sorbitol - 70% solution
46.41% Water
0.01% Butter Flavor - Polak brand
0.7 gm. 4% yellow coloring per 1000 gms. of other ingredients.

(b) Procedure: The standard dispersion technique, as given in Section XII B(2) for Chocolate Food Sheets, was used.

(c) Results: Flexible, non-sticky food sheets that tasted and smelled like margarine resulted. The stability of these sheets was checked by placing six of the sheets per foil pouch and storing the pouches at 100° F. for one week. These sheets held up quite well; therefore a 30 pound batch was made and the resulting sheets packaged in foil pouches and storage tested.

B. Best Method for Making Margarine Food Sheets

The best method for making Margarine Food Sheets is given in Section XIX A(2) "Dispersion Technique for Making Margarine Food Sheets Using Sodium Caseinate and Gelatin as the Structure Matrix."

XX. Meat Extract Food Sheets

A. Incorporation Into Stable Dispersions

(1). Dispersion Technique for Making Meat Extract Food Sheets

(a) Formula:

27.00% Durkex 500
6.80% Sodium Caseinate
4.50% Gelatin
10.90% Beef Extract
0.90% Monosodium Glutamate
4.40% Dextrin
45.50% Water

(b) Procedure: The standard dispersion techniques, as given in Section XII B(2) for Chocolate Food Sheets, were used.

(c) Results: Flexible, non-sticky food sheets that tasted and smelled like meat extract resulted. The stability of these sheets was checked by placing six sheets per foil pouch and storing the pouches at 100°F. for one week. The resulting product held up well; therefore a 30 pound batch was made. These sheets were placed in foil pouches and were used for the larger storage tests.

B. Best Method for Making Meat Extract Food Sheets

The best method for making Meat Extract Food Sheets is given in Section XX A(1), "Dispersion Technique for Making Meat Extract Food Sheets."

XXI. Mustard Food Sheets

A. Use of Hydrocolloids as the Structure Matrix

(1) 2% CMC as the Structure Matrix

(a) Formula:
3% Corn Syrup Solids
3% Sorbitol
2% CMC
92% Prepared Mustard (Red Owl)

(b) Procedure: The mustard was added to the sorbitol and corn syrup solids and then the CMC was added with continued stirring using a wire whip. The mixture was stirred until it was homogenous. This product was spread on release paper and was air dried at room temperature (72°F).

(c) Results: The resulting sheets were flexible and non-sticky but somewhat tough to bite and chew.

(2) 0.25% CMC as the Structure Matrix

(a) Formula:
94.75% Prepared Mustard
0.25% CMC
5.00% Glycerin

(b) Procedure: The CMC and mustard were mixed together until smooth and then the glycerin was mixed in. The product was frozen, sliced at a #10 setting on a Hobart slicer, placed on release paper and dried overnight at room temperature (72°F).

(c) Results: The sheets were flexible, non-sticky, easy to bite and chew,

tasted like mustard but had small holes in the form of slits.

(3) Comparison of 0.25% CMC and 0.25% Guar Gum as the Structure Matrix

(a) Formula: 0.25% CMC or Guar Gum
99.75% Prepared Mustard (Gedney)

(b) Procedure: The procedures were the same as those given for comparison of CMC and Guar Gum in tomato catsup as shown in Section II B(9).

(c) Results: Groups of both the CMC mustard sheets and the Guar Gum mustard sheets were air dried overnight at room temperature and other groups of sheets air dried for three hours at 55°C in an air circulating oven. Those dried in the oven became very dry and brittle. The others were flexible, non-sticky, easy to bite and chew, and had a strong mustard taste. This test showed no real difference between guar gum and CMC as a structure matrix for mustard sheets.

(4) Reduced Viscosity Mix Using 0.23% CMC as the Structure Matrix

When we attempted to make 30 pound batch runs using the formula and procedure given in Section XXI A(2) we again got cracking of the mustard sheets. Further experiments showed that our difficulty arose from the high viscosity of the mustard mix prior to freezing which caused stratification of the mustard when frozen and thus cracking when dried. It was found that diluting with water and adding corn syrup solids helped prevent this by reducing the viscosity. Therefore, the following formula was used.

(a) Formula: 78.40% Prepared mustard (Aslesens)
11.80% Corn Syrup Solids
1.87% Glycerin
0.23% CMC
7.70% Water

(b) Procedure: The ingredients were mixed in a Waring Blendor until smooth and then heated to 145°F. and mixed 2 minutes under vacuum to remove entrapped air. The resulting product was then poured into 4" x 4" x 10" poly-lined boxes and frozen. These sheets were sliced at #10 setting on a Hobart slicer. Slicing must be done while the product

is quite cold. These sheets were placed on polyethylene sheets and air dried for 24 hours at room temperature (72°F.).

(c) Results: The resulting sheets were flexible, non-sticky and tasted and smelled like mustard. There were some holes in the product but not enough to make it unsatisfactory. Therefore, a 30 pound batch was made and the sheets pouched for the larger storage test.

B. Best Method for Making Mustard Food Sheets

The best method for making Mustard Food Sheets is given in Section XXI A(4) "Reduced Viscosity Mix Using 0.23% CMC as the Structure Matrix."

XXII. Lemon Sauce Sheets

A. Incorporation Into Stable Dispersions

(1) Dispersion Technique for Making Lemon Sauce Sheets

(a) Formula:

13.30% Durkex 500
12.70% Non-fat Milk Solids
3.30% Gelatin
0.35% Lemon Flavor
0.45% Citric Acid
36.60% Sucrose
33.30% Water
.70 ml/100 gm. solids - 4% solution of yellow color

(b) Procedure: The oil was heated to 150°F and placed in a Waring Blendor. The non-fat milk solids were added and mixing continued until they were coated with the oil. The sucrose and lemon flavor were added with continued mixing. To this slurry the water, heated to 150° and in which the gelatin and citric acid had previously been dissolved, was added and mixing continued until a stable dispersion formed. The coloring was added, and the resulting product was frozen and sliced on a Hobart slicer and dried at room temperature on release paper over the week-end.

(c) Results: The resulting sheets were very satisfactory in all aspects. They were flexible, non-sticky, easily chewed, and tasted like lemon.

These sheets then were placed as before, six to a foil pouch, and stored under air atmosphere at 100° F and 40° F for one week. On examining after this week, it was found that these sheets tended to stick together at the 100° F temperature. Therefore, this product will have to be reformulated.

(2) Dispersion Technique for Making Lemon Sauce Sheets - Removing The Citric Acid from the Formula

It was believed that the citric acid in the product made under XXII A(1) caused the stickiness because of lower pH; therefore a new formulation was made without the citric acid.

(2) Dispersion Technique for Making Lemon Sauce Sheets - Removing The Citric Acid from the Formula

(a) Formula:
13.30% Durkex 500
12.70% Non-fat Dried Milk Solids
3.30% Gelatin
0.35% Lemon Flavor
37.05% Sucrose
33.30% Water
0.70 ml. of Yellow Color FD&C No. 6 - 4% Water Solution per 100 grams of other ingredients

(b) Procedure: The general dispersion procedure, as given in Section XII B(2), Chocolate Sauce Sheets, was used. A stable dispersion was first made and then the lemon flavor and yellow coloring were added.

(c) Results: The resulting sheets were flexible, non-sticky, tasted and smelled like lemon sauce and did not shrink appreciably on drying. These sheets were then placed in the metalized pouches and stored at 100°F for one week. They held up well; therefore were made in a 30 pound batch and pouched in the metalized pouches and storage tested.

B. Best Method for Making Lemon Sauce Sheets

The best method for making Lemon Sauce Sheets is given in Section XXII A(2) "Dispersion Technique for Making Lemon Sauce Sheets - Removing the Citric Acid from the Formula."

XXIII. Shredded Coconut Food Sheets

A. Use of Hydrocolloids as the Structure Matrix

(1) Gelatin and CMC as the Structure Matrix

(a) Formula:
4.5 parts CMC
15.0 parts Gelatin
380.5 parts Water
270.0 parts Toasted Coconut (Red Owl)

(b) Procedure: The procedures were the same as those given for Barbecue Sauce Sheets in Section I B(3) replacing the Barbecue Sauce with Coconut.

(c) Results: The sheets were flexible, non-sticky, had a good coconut flavor but were somewhat difficulty to bite and chew.

B. Incorporation Into Stable Dispersions

(1) Dispersion Technique for Making Coconut Food Sheets

(a) Formula:
50% Shredded Coconut
50% Dispersion
10 parts water to 100 gm. of other ingredients

The Dispersion formula is as follows:

33% Durkex 500
33% Non-fat Milk Solids
34% Sucrose
50 ml. Water/100 gm. Solids

(b) Procedure: The dispersion was made by standard techniques as illustrated by the Chocolate Sauce XII B(2), 100 parts each of shredded coconut and dispersion were placed in a Hobart mixer and 20 parts of water were added to facilitate mixing. The resulting product was frozen and sliced at a #7 setting on a Hobart slicer, placed on release paper and dried at room temperature ($72^{\circ}F$) overnight. It also should be noted that these bars should be brought to refrigerated temperatures approximately 35° to 40° before slicing.

(c) Results: On slicing, some cracking was encountered and the resulting dry bars, though somewhat flexible, did not have a great deal of

strength. These bars were storage tested and were found to be too fragile to meet the requirement of thecontract.

(2) Dispersion Technique for Making Shredded Coconut Food Sheets - Incorporation into the Vanilla Cream Base

(a) Formula:

15.00%	Durkex 500
5.25%	Sodium Caseinate
2.25%	Gelatin
0.75%	Vanilla Concentrate
24.00%	Sucrose
27.75%	Water
25.00%	Shredded Coconut

(b) Procedure: The standard dispersion technique, as given under Section XII B(2) for making the Chocolate Food Sheets, was used. The stable dispersion was made and then the shredded coconut, which had previously been made smaller by grinding in a Waring Blendor, was added.

(c) Results: Food sheets that were non-sticky, flexible, and tasted and smelled like coconut resulted. To check the stability of these sheets, they were placed six sheets to a foil pouch, and these pouches were stored for one week at 100°F. The sheets held up very well; therefore this product was made up in a 30 pound batch, and the resulting sheets were placed in the foil pouches and used for the larger storage tests.

C. Best Method for Making Coconut Food Sheets

The best method for making Coconut Food Sheets is given in Section XXIII B(2) "Dispersion Technique for Making Shredded Coconut Food Sheets - Incorporation Into the Vanilla Cream Base."

XXIV. Sour Cream Food Sheets

A. Incorporation Into a Stable Dispersion

(1) Dispersion Technique for Making Imitation Sour Cream Food Sheets

(a) Formula:

45.0%	Durkex 500
45.0%	Non-fat Milk Solids
3.0%	CMC
4.8%	Corn Syrup Solids
2.2%	Phosphoric Acid (85%)
100 gm.	Water/100 gm. Solids

(b) Procedure: The Durkex 500 was heated to 150° F and placed in the Schnellkutter. Dry ingredients were mixed into the oil until the oil covered all the dry ingredients. Hot water was added to the dry ingredients, and the mixture was blended at high speed to form a stable dispersion. The phosphoric acid was then added slowly with continued high speed mixing. pH was lowered to 5. This product was frozen, sliced at #7 setting on a Hobart slicer, and placed on release paper and dried at room temperature (72°F) for 24 hours. Some difficulty was encountered on slicing of this product. When allowed to thaw sufficiently for slicing, cohesion of the product began to fail and it began to fall apart on handling.

(c) Results: The resulting sheets were flexible and easy to bite and chew but tended to oil or grease out. These sheets were storage tested and did not hold up.

(2) Dispersion Technique for Making Imitation Sour Cream Food Sheets Using Sodium Caseinate and Gelatin as Film Formers

(a) Formula:
30.00% Durkex 500
7.50% Sodium Caseinate
5.00% Gelatin
13.85% Corn Syrup Solids
43.00% Water
0.55% Phosphoric Acid - 85% Strength
0.10% Aromalok Flavor #29131 Triolean Cream Flavor

(b) Procedure: The standard dispersion technique, as given in Section XII B(2) for making the Chocolate Food Sheets, was used. The phosphoric acid, dissolved in 4% of the water, was added after the stable dispersion was formed.

(c) Results: Flexible, non-sticky food sheets that tasted and smelled like sour cream resulted. The stability of these products was checked by placing six of the food sheets per foil pouch and storing these pouches for one week at 100°F. The product held up well; therefore a 30 pound batch was made, and these resulting sheets were placed in foil pouches and storage tested.

B. Best Method for Making Sour Cream Food Sheets

The best method for making sour cream food sheets is given in Section XXIV A(2), "Dispersion Technique for Making Imitation Sour Cream Sheets Using Sodium Caseinate and Gelatin as Film Formers."

XXV. Tartar Sauce Food Sheets

A. Incorporation Into Stable Dispersions

(1) Dispersion Technique for Making Tartar Sauce Sheets

(a) Formula:

26.40% Durkex 500
4.40% Gelatin
6.60% Sodium Caseinate
1.40% Salt
0.88% Dry Mustard
0.18% White Pepper
4.14% Sucrose
1.70% Chopped Onion
2.30% Chopped Pickles
0.50% Chopped Parsley
35.20% Water
16.30% Vinegar

(b) Procedure: The oil was heated to 150° F and placed in a Waring Blendor. The sodium caseinate, sucrose, salt, pepper, mustard powder, and chopped parsley were mixed in and mixing continued until they were coated with oil. Water, heated to 150° F and in which the gelatin had previously been dissolved, was added and mixing continued until a stable dispersion formed. To this stable dispersion the chopped onion, chopped pickles, and vinegar were added with slight mixing. This product then was placed in the wax paper lined 4" x 4" boxes and frozen in the blast freezer, sliced on #7 on a Hobart slicer and dried on release paper at room temperature over the weekend.

(c) Results: The resulting sheets were flexible, easy to chew, and tasted like tartar sauce. These sheets were then placed in foil pouches, as the other sheets were in the storage test, in groups of sixes and stored at 100° and at 40° F in air atmosphere. These sheets proved

to be satisfactory after a period of one week; therefore, were made in quantity for the larger storage test.

B. Best Method for Making Tartar Sauce Food Sheets

The best method for making tartar sauce food sheets is given in Section XXV A(1), "Dispersion Technique for Making Tartar Sauce Sheets." A 30 pound batch was made by the above method except that a Schnellkutter was used for mixing the stable dispersion in place of a Waring Blendor.

XXVI. Thousand Island Dressing Food Sheets

A. Incorporation Into Stable Dispersions

(1) Dispersion Technique for Making Thousand Island Dressing Sheets

(a) Formula:

17.2% Durkex 500
2.9% Gelatin
4.3% Sodium Caseinate
0.9% Salt
0.6% Dry Mustard
0.1% White Pepper
5.6% Sucrose
22.9% Water
5.7% Vinegar
22.4% Chili Sauce
17.4% India Relish Drained Solids

(b) Procedure: The oil was heated to 150° F and placed in a Waring Blendor and the sodium caseinate, sucrose, salt and pepper and mustard added with mixing. The water, heated to 150° F and in which the gelatin had previously been dissolved, was added and mixing was continued until a stable dispersion formed. To this stable dispersion the vinegar, chili sauce, and India relish solids were added with continued mixing. The resulting product was processed as was the tartar sauce XXV(A(1)).

(c) Results: Flexible non-sticky sheets that tasted like Thousand Island Dressing resulted. These sheets were then further tested to see if they would stand under storage by placing them in sixes in foil pouches and storing them under 100° F and 40° F conditions. These products were then checked after one week and found to be satisfactory.

B. Best Method For Making Thousand Island Dressing Food Sheets

The best method for making Thousand Island Dressing Food Sheets is given in Section XXVI A(1) "Dispersion Technique for Making Thousand Island Dressing Sheets." A 30 pound batch was made by the above method except that a Schnellkutter was used for mixing the stable dispersion in place of a Waring Blendor.

XXVII. Imitation Cheddar Cheese Food Sheets

A. Incorporation Into Stable Dispersions

(1) Dispersion Technique for Making Imitation Cheddar Cheese Food Sheets

(a) Formula:

30.00% Durkex 500
7.50% Sodium Caseinate
5.00% Gelatin
12.77% Dextrin
2.00% Salt
2.70% Monosodium Glutamate
0.03% Imitation Cheddar Cheese Flavor - Fries & Fries J84
40.00% Water
0.70 ml. per 100 gm. solids of a 4% in water of F.D&C No. 6 Coloring

(b) Procedure: The standard dispersion technique, as given in Section XII B(2) for the Chocolate Food Sheets, was used.

(c) Results: Flexible, non-sticky food sheets that tasted and smelled like cheddar cheese resulted. The stability of this product was checked by placing six sheets per foil pouch and storing the pouches for one week at 100°F. These sheets held up very well; therefore a 30 pound batch was made and the resulting sheets placed in foil pouches and storage tested.

B. Best Method for Making Imitation Cheddar Cheese Food Sheets

The best method for making Imitation Cheddar Cheese Food Sheets is given in Section XXVII A(1) "Dispersion Technique for Making Imitation Cheddar Cheese Food Sheets."

XXVIII. Shrimp Cocktail Sauce Food Sheets

A. Incorporation Into Stable Dispersions

(1) Dispersion Technique for Making Shrimp Sauce Food Sheets

(a) Formula:

20.00% Durkex 500
5.00% Sodium Caseinate
1.00% Sucrose
2.90% Gelatin
32.00% Water
12.00% Seafood Cocktail Mix (Dry) (Griffith 904-1196)
10.00% Tomato Puree (Hunt's)
17.00% Vinegar (5%)

(b) Procedure: The standard dispersion techniques, as given in Section XII B(2) for Chocolate Sauce Sheets, were used. The seafood cocktail mix, tomato puree, and vinegar were added with mixing after the stable dispersion was formed.

(c) Results: The resulting sheets were flexible, non-sticky and tasted and smelled like shrimp sauce. These sheets did shrink in size about 10% on drying.

The stability of the product was checked by placing six sheets to a foil pouch and storing the pouches for one week at 100°F. The sheets held up well; therefore, a 30 pound batch was made and these sheets packaged in foil pouches and storage tested.

B. Best Method for Making Shrimp Cocktail Sauce Food Sheets

The best method for making Shrimp Cocktail Sauce Food Sheets is given in Section XXVIII A(1) "Dispersion Technique for Making Shrimp Sauce Food Sheets."

XXIX. Vanilla Cream Filling Sheets

A. Incorporation Into Stable Dispersions

(1) Dispersion Technique for Making Vanilla Cream Filling Sheets

(a) Formula:

13.3% Durkex 500
12.7% Non-fat Milk Solids
3.3% Gelatin
1.0% Vanilla Concentrate
36.4% Sucrose
33.3% Water

(b) Procedure: Procedure was the same as for the Lemon Sauce Sheets Section.

(c) Results: The resulting product was equally good as the Lemon Sauce Sheets as far as taste, flexibility, and non-stickiness. Again these sheets were placed six in a pouch and stored under 40° and 100° F storage conditions, and again these sheets tended to stick together under the 100° F temperature. Therefore, this product was reformulated.

(2) Dispersion Technique for Making Vanilla Cream Filling Sheets Using Sodium Caseinate and Gelatin as the Film Formers

(a) Formula:

20.00%	Durkex 500
7.00%	Sodium Caseinate
3.00%	Gelatin
1.00%	Vanilla Concentrate
32.00%	Sucrose
37.00%	Water

(b) Procedure: The general dispersion technique, as was given in Section XII B(2) for preparation of the Chocolate Food Sheets, was used. The vanilla concentrate was added to the preformed stable dispersion.

(c) Results: Non-sticky, flexible food sheets that tasted and smelled like vanilla cream filling resulted. The stability of these sheets was checked by placing them six to a metalized pouch and storing them at 100°F. for one week. These sheets held up quite well; therefore were made in a 30 pound batch, placed in foil pouches and storage tested.

B. Best Method for Making Vanilla Cream Filling Sheets

The best method for making Vanilla Cream Filling Sheets is given in Section XXIX A(2) "Dispersion Technique for Making Vanilla Cream Filling Sheets Using Sodium Caseinate and Gelatin as the Film Formers."

XXX. Coffee Cream and Sugar Food Sheets

A. Incorporation Into Stable Dispersions

(1) Dispersion Technique for Making Coffee Cream and Sugar Food Sheets

(a) Formula:

30.00% Durkex 500
7.50% Sodium Caseinate
5.00% Gelatin
17.50% Sucrose
39.99% Water
0.01% Imitation Butter Flavor - Polak Brand

(b) Procedure: The standard dispersion technique, as given in Section XII B(2) for the Chocolate Food Sheets, was used.

(c) Results: Flexible, non-sticky food sheets that resembled sweetened coffee cream resulted. The stability of these products was checked by placing six sheets in foil pouches and storing these pouches at 100°F. for one week. The sheets held up well; therefore a 30 pound batch was made. The resulting sheets were packaged in foil pouches and storage tested.

B. Best Method for Making Coffee Cream and Sugar Food Sheets

The best method for making Coffee Cream and Sugar Food Sheets is given in Section XXX A(1) "Dispersion Technique for Making Coffee Cream and Sugar Food Sheets."

Engineering Design For Production of Twelve Hundred Square Feet of Food Adjunct Sheets Per Hour

Flow diagram

Operation -	Equipment Required
Weighing	Ingredient storage bins, scales, and batch containers
Conveying	
Mixing	Model SKV60E Schnellkutter manufactured by Koch Equipment Co., Kansas City, Missouri.
Transferring	Moyno or Waukesha pump. Variable drive - 1.0 to 3.0 gpm.
Pre-cooling	Votator (Girdler Corp.) or Thermutator (Cherry-Burrell)
Molding and gelling	Continuous horizontal mold - flexible sides for quick release of gelled product. 20' estimated length. Mounted in a refrigerated area.
Slicing	Double-bladed slicer - vertical rotary cutter - 200 RPM. This will also be located in refrigerated area to prevent distortion of molded product. Water spray will be used to lubricate and clean cutting blade.
Spreading	Spreading will be the manual or mechanical orientation of the slices on the drying trays or belt.
Drying	Continuous forced circulation double apron drier - 8' wide x 90' long. Air velocity 700 ft/min. Proctor & Schwartz or equivalent.
Packaging	
Refrigeration:	Estimated at a total of 5 tons for pre-cooling and final gelation.

PRODUCTION UNIT

The basis for the design of this unit is as follows:

Production rate - 1200 sq. ft. of 1/8" thick food sheets per hour

Allowance for trim and losses - 10%

Weight of formula mix per hour - 1434 lbs.

Weight of final product per hour - 860 lbs.

Volume of formula mix per hour - 23 cu. ft.

Number of mix batches per hour - 12

Over-all mixing time - 5 minutes

Water to be evaporated per hour in drying - 574 lbs.

Mixes to be gelled to a continuous block 2" x 4" in cross-section, firm enough to be easily sliced without break-down. This will be done by a two stage system.

Drying conditions are assumed to be 150°F. dry bulb inlet air temperature, 20% relative humidity, and air velocity of 700 ft./min. Under these conditions, drying time is estimated to be 1 hour.

Description of process flow:

The ingredients will be measured out into complete mixes weighing 125 lbs. each and these will be conveyed as a unit for rapid transfer to the mixer.

The mixer of choice is the Schnellkutter, a product of Koch Equipment Co., Kansas City, Missouri, Model SKV60E. The largest unit available will be used because it has a capacity of 125 lbs. making it possible to produce the amount required in 12 batches.

At the end of 5 minutes over-all mixing time, the batch will be dumped into a 4 cu. ft. hopper. This will be connected to the inlet of a Moyno or Waukesha variable speed pump (or any other pump capable of positively impelling a viscous mixture).

This pump will feed the mixture at controlled rates to a Votator or Thermutator unit operating with refrigerant in the jacket. Continuous agitation within this unit will cause the temperature of the mix to drop rapidly and prevent gelation of the cold product. Sufficient latent heat will be removed so that on being extruded and coming to rest, the mix will gel immediately. The rate of gelation will be accelerated by contact with the cold mold.

The discharge from the Votator will be piped to the refrigerated mold and be extruded continuously into the mold. A means will be provided to level the product to a depth of 2".

The continuous mold will consist of a conveyor belt of suitable material. This belt will have vertical flexible sides (flanges) spread 4" apart. The entire molding equipment will be enclosed in a refrigerated atmosphere. The conveyor will act as a feeder for the molded material and force it until the rotary slicer. Adjustment of the conveyor speed will be necessary to match the fixed slicer speed of 200 RPM. The pump feeding the Votator will, in a similar way, have to be adjusted in speed to deliver the correct volume of mix to fill the mold to the proper depth.

The rotary slicer will be double-bladed and rotate in a vertical plane. The rate of slice production will be 396 per minute.

The slices will be oriented on the drier apron either by hand or by a mechanical device yet to be developed.

The drier will be a standard continuous forced circulation apron drier having 2 aprons 8' wide operating independently. The length will approximate 90 feet. Because the air velocity will be extremely high and, further, because the slices will be easily blown about, an over-riding wire mesh belt will have to be employed on both aprons. These belts will rest on the food sheets on the apron and act as temporary hold-downs.

TABLE I

MOISTURE AND pH RESULTS FOR FOOD SHEETS STORED 0, 2, AND 4 WEEKS

Sample & Reference	0 Weeks		2 Week Air Storage				4 Week Air Storage			
	Moisture	pH	Moisture		pH		Moisture		pH	
			40°F	73°F	40°F	73°F	40°F	73°F	40°F	73°F
Barbecue Sauce IB(5)	10.44	4.05	9.29	12.94	4.2	4.15	10.07	10.50	4.10	4.10
Catsup IIB(11)	11.16	4.00	11.97	7.37	4.3	4.2	11.63	9.36	3.90	4.10
Honey IIIC(1)	10.05	6.00	-	-	-	-	-	9.75	-	6.15
Mayonnaise IV A	10.61	5.00	13.26	12.61	4.7	4.7	11.82	13.88	4.75	4.85
Onion Gravy VB(1)	7.03	6.10	8.74	8.28	6.4	6.6	9.76	9.82	5.2	6.30
Peanut Butter VIB(1)	8.80	6.2	7.75	8.73	6.2	6.2	8.88	8.57	6.3	6.25
Pickle Relish VIIA(3)	16.25	3.80	14.82	15.58	3.9	4.0	15.26	15.16	3.60	3.65
Strawberry Preserves VIII B(1)	9.78	4.40	-	-	-	-	-	9.84	-	4.40
Soya Sauce IX B(2)	11.12	5.40	-	-	-	-	-	11.85	-	5.40
Vinegar XA(2)	10.52	4.00	-	-	-	-	-	7.69	-	4.00
Apple Butter XI A(3)	-	-	9.37	9.38	4.0	4.15	9.15	10.09	3.55	3.30
Chocolate Sauce XII B(2)	8.09	5.90	-	"	-	-		d i s c a r d e d		
Coffee XIII A(2)	8.93	5.80	-	-	-	-	-	8.09	-	5.75
Bacon with White Sauce XIV A(1)	9.81	6.25	9.46	9.51	6.4	6.4	10.78	10.38	6.3	6.25
Dates XV A(2)	8.27	5.10	9.57	8.65	4.7	4.7	9.56	9.24	4.90	4.80
Onion XVI A(2)	8.32	6.10	-	-	"	-	-	8.08		6.10
Horseradish XVII B(1)	10.47	5.10	-	"	-	-	-	11.21	-	5.10
Maple Syrup XVIII A(1)	8.79	6.05	-	-	-	"	"	8.21	-	6.00
Margarine XIX A(2)	6.95	6.30	-	"	"	"	"	7.11	-	5.75
Meat Extract XX A(1)	8.45	5.65	-	"	"	-	"	8.24		5.65

STORAGE STUDY FOR THE FOOD SHEETS

The following variables were used for the storage study.

1. Temperature at 100°F, 73°F, 40°F, and cycling twice a week alternating between 40°F and 0°F.
2. Atmospheres - One nitrogen, the other regular atmospheric air.
3. Time periods of 0, 2 weeks, 4 weeks, 8 weeks, and 13 weeks.
4. Tests to be run on the items coming out of the various storage conditions were:
   a. Chemical

      Moisture and pH on initial and air packs at 40°F and 73°F at 2, 4, 8, and 13 weeks. (This was modified for economy sake for some of the food sheets to moisture and pH on initial and air packs at 73°F at 4 and 13 weeks.

   b. Bacteriological

      Total count, coliforms, molds and yeast on initial and on air and nitrogen packs at 100°F at 4, 8 and 13 weeks. (This was modified for economy sake for some food sheets to initial and on air packs at 100°F at 4 and 13 weeks.

   c. Organoleptic

      Taste and smell on all samples.

   d. Physical

      Cohesion, hardness and general appearance on all samples.

The sheets were placed six sheets per pouch into metalized pouches (0.5 mil mylar - 0.5 mil aluminum foil - 3.0 mil polyolefin) (C-7% - Continental Can Co.)

For the samples packed under nitrogen, pouches were sealed on a Flex-vac automatic pouch sealer at 500°F with nitrogen set at 50 pounds/square inch. For the air pack variables, the pouches were packed on a robot bar sealer at 275°F holding for two seconds.

TABLE II

MOISTURE AND pH RESULTS FOR FOOD SHEETS STORED 8 AND 13 WEEKS

Sample & Reference	8 Week Air Storage				13 Week Air Storage			
	Moisture		pH		Moisture		pH	
	40°F.	73°F.	40°F.	73°F.	40°F.	73°F.	40°F.	73°F.
Barbecue Sauce IB(5)	10,85	11,28	4,20	4,20	12,01	13,68	4,25	4,25
Catsup IIB(11)	13,63	7,15	4,10	4,10	8,74	10,80	4,25	4,30
Honey III C(1)	-	-	-	-	-	8,54	-	6,20
Mayonnaise IV A	13,45	13,51	4,85	4,75	13,70	11,74	4,85	4,95
Onion Gravy V B(1)	9,86	9,09	6,15	6,10	9,69	9,61	6,40	6,30
Peanut Butter VI B(1)	-	-	-	-	-		-	
Pickle Relish VII A(3)	14,26	14,91	3,90	3,90	16,17	15,82	4,00	4,00
Strawberry Preserves VIII B(1)	-	-	-	-	-	9,60	-	4,60
Soya Sauce IX B(2)	-	-	-	-	-	11,70	-	5,60
Vinegar X A(2)	-	-	-	-	-	9,61	-	4,00
Apple Butter XI A(3)	8,76	8,57	3,55	3,80	-	9,56	-	4,10
Chocolate Sauce XII B(2)		D	I S	C A	R D	E D		
Coffee XIII A(2)	-	-	-	-	-	8,37	-	5,90
Bacon with White Sauce XIV A(1)	10,80	9,91	6,45	6,45	10,99	11,40	6,50	6,40
Dates XV A(2)	9,54	9,86	4,70	4,65	9,90	9,41	4,90	4,85
Onion XVI A(2)	-	-	-	-	-	7,83	-	6,10
Horseradish XVII B(1)	-	-	-	-	-	11,39	-	5,40
Maple Syrup XVIII A(1)	-	-	-	-	-	9,90	-	6,20
Margarine XIX A(2)	-	-	-	-	-	7,22	-	6,10
Meat Extract XX A(1)	-	-	-	-	-	8,40	-	5,90
Mustard XXI A(4)	-	-	-	-	-	7,88	-	4,60
Lemon Sauce XXII A(2)		D	I S	C A	R D	E D		
Coconut XXIII B(2)	-	-	-	-	-	8,74	-	6,30

TABLE 1 (Continued)

MOISTURE AND pH RESULTS FOR FOOD SHEETS STORED 0, 2, AND 4 WEEKS

Sample Reference	0 Weeks		2 Week Air Storage				4 Week Air Storage			
	Moisture	pH	Moisture		pH		Moisture		pH	
			40°F	73°F	40°F	73°F	40°F	73°F	40°F	73°F
Mustard XXI A(4)	8.33	4.25	---	---	---	---	---	8.02	---	4.35
Lemon Sauce XXII A(2)	9.20	6.30	---	---	---	---	---	discarded		
Coconut XXIII B(2)	8.94	6.30	---	---	---	---	---	8.12	---	6.35
Tartar Sauce XXV A(1)	10.01	4.75	9.86	9.74	4.70	4.70	9.39	10.29	4.80	4.75
Thousand Island Dressing XXVI A(1)	12.00	4.50	9.67	11.91	4.7	4.65	10.08	11.29	4.65	4.55
Cheese XXVII A(1)	9.56	5.80	---	---	---	---	---	9.69	---	5.90
Shrimp Sauce XXVIII A(1)	9.09	4.60	---	---	---	---	---	10.05	---	4.35
Vanilla Cream Sauce XXIX A(2)	6.30	6.30	---	---	---	---	---	6.06	---	6.45
Cream & Sugar XXX A(1)	6.98	6.15	---	---	---	---	---	6.31	---	6.35

TABLE III

INITIAL AND FOUR WEEK MICROBIOLOGICAL ANALYSIS OF FOOD SHEETS

	Initial			4 Weeks at 100° F					
				Air Pack			Nitrogen Pack		
Reference Sample	Total Bact. Count/Gm.	Presumptive Coliform Count/Gm.	Mold & Yeast Count/Gm.	Total Bact. Count/Gm.	Presumptive Coliform Count/Gm.	Mold & Yeast Count/Gm.	Total Bact. Count/Gm.	Presumptive Coliform Count Gm.	Mold & Yeast Coun m.
Barbecue Sauce IB(5)	400	<10	<10	420	<10	<10	170	<10	
Catsup II B(11)	50	<10	30	140	<10	<10	120	<10	
Honey III C(1)	70	<10	<10	410	<10	<10	---	---	
Mayonnaise IV A	140	<10	50	280	10	30	140	<10	
Onion Gravy V B (1)	>3000	<10	20	4500	<10	<10	3000	<100	
Peanut Butter VI B (1)	390	40	30	44	40	20	---	---	
Pickle Relish VII A (3)	1750	<10	40	1830	<10	<10	100	<10	
Strawberry Preserves VIII B(1)	40	<10	20	300	<10	<10	---	---	
Soya Sauce IX B(2)	2810	<10	15	690	<10	<10	---	---	
Vinegar X A(2)	40	<10	20	20	<10	<10	---	---	
Apple Butter XI A(3)	---	---	---	400	<10	<10	200	<10	< 0
Chocolate Sauce XII B (2)	440	<10	130	Discarded Sample					
Coffee XIII A(2)	340	<10	100	600	<10	<10	---	---	---
Bacon w/White Sauce XIV A (1)	2750	<10	320	1920	<10	10	1700	<10	10
Dates XV A92)	50	<10	20	20	<10	<10	40	<10	<10
Onion XVI A(2)	70	<10	40	420	<10	<10	---	---	---
Horseradish XVII B(1)	580	<10	80	2800	<10	<10	---	---	---
Maple Syrup XVIII A(1)	70	<10	40	19,200	<10	<10	---	---	---
Margarine XIX A (2)	>3,000	<10	>3,000	20	<10	<10	---	---	---
Meat Extract XX A(1)	60	<10	15	300	<10	<10	---	---	---
Mustard XXI A(4)	>3,000	<10	<3000	720	<10	<10	---	---	---

TABLE II (Continued)

MOISTURE AND pH RESULTS FOR FOOD SHEETS STORED 8 AND 13 WEEKS

Sample & Reference	8 Week Air Storage				13 Week Air Storage			
	Moisture		pH		Moisture		pH	
	40°F.	73°F.	40°F.	73°F	40°F.	73°F.	40°F	73°F.
Tartar Sauce XXV A(1)	9.92	10.06	4.80	4.80	-	10.05	-	4.75
Thousand Island Dressing XXVI A(1)	9.41	9.41	4.60	4.60	-	9.17	-	4.55
Cheese XXVII A(1)	-	-	-	-	-	10.26	-	6.10
Shrimp Sauce XXVIII A (1)	-	-	-	-	-	9.18	-	4.80
Vanilla Cream Sauce XXIX A(2)	-	-	-	-	-	6.43	-	6.40
Cream & Sugar XXX A(1)	-	-	-	-	-	7.22	-	6.30

TABLE IV

EIGHT WEEK AND THIRTEEN WEEK MICROBIOLOGICAL ANALYSIS OF FOOD SHEETS

Sample Reference	8 weeks at 100° F						13 weeks at 100° F					
	Air Pak			Nitrogen Pak			Air Pak			Nitrogen Pak		
	Total Bact. Count /Gm.	Presumptive Coliform Count /Gm	Mold & Yeast Count /Gm.	Total Bact. Count /Gm.	Presumptive Coliform Count /Gm.	Mold & Yeast Count /Gm	Total Bact. Count /Gm	Presumptive Coliform Count /Gm	Mold & Yeast Count /Gm	Total Bact. Count /Gm.	Presumptive Coliform Count /Gm	Mold & Yeast Count /Gm
Barbecue Sauce I B(5)	280	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Catsup II B(11)	10	<10	<10	<10	<10	<10	60	<10	<10	30	<10	<10
Honey III A(1)	---	---	---	---	---		230	<10	<10	-	---	---
Mayonnaise IV A	360	<10	<10	250	<10	<10	200	<10	30	50	<10	20
Onion Gravy V B(1)	1180	<10	5	1260	<10	<10	2400	<10	<10	1000	<10	<10
Peanut Butter VI B(1)	---	---	---	---	---	---	SAMPLE INADVERTENTLY NOT RUN					---
Pickle Relish VII A(3)	300	<10	<10	20	<10	<10	10	<10	<10	<10	<10	<10
Strawberry Preserves VIII B(1)	---	---	---		---	---	170	<10	<10		---	---
Soya Sauce IX B(2)	---	---	---	---	---	---	3480	<10	<10	---	---	---
Vinegar X A(2)	---	---	---	-	---	-	<10	<10	<10	---	---	---
Apple Butter XI A(3)	30	<10	70	20	<10	<10	<10	<10	<10	<10	<10	<10
Chocolate Sauce XII B(2)							SAMPLE DISCARDED					
Coffee XIII A(2)	---	---	---	---	---	---	70	<10	<10	---	-	---
Bacon with White Sauce XIV A(1)	370	<10	30	980	<10	10	1000	<10	30	1080	<10	30
Dates XV A(2)	20	<10	<10	80	<10	<10	30	<10	<10	20	<10	<10
Onion XVI A(2)	---	---	---	---	---	---	400	<10	<10	---	---	---
Horseradish XVII B(1)	---	---	---	---	---	---	2880	<10	150	---	---	---
Maple Syrup XVIII A(1)	---	---	---	---	---	---	270	<10	<10	---	---	---
Margarine XIX A(2)	---	---	---	---	---	---	80	<10	<10	---	---	---
Meat Extract XX A(1)	---	---	---	---	---	---	140	<10	<10	---	-	---
Mustard XXI A(4)	---	-	---	---	---	-	150	<10	<10	---	-	---
Lemon Sauce XXII A(2)	SAMPLE DISCARDED						SAMPLE DISCARDED					

TABLE III (Continued)

INITIAL AND FOUR WEEK MICROBIOLOGICAL ANALYSIS OF FOOD SHEETS

	Initial			4 Week at 100 F					
				Air Pack			Nitrogen Pack		
Reference Sample	Total Bact. Count/Gm.	Presumptive Coliform Count/Gm.	Mold & Yeast Count/Gm.	Total Bact. Count/Gm.	Presumptive Coliform Count/Gm.	Mold & Yeast Count/Gm.	Total Bact. Count/Gm.	Presumptive Coliform Count/Gm	Mold & Yeast Count/Gm.
Lemon Sauce XXII A(2)	5340	<10	140	SAMPLE DISCARDED					
Coconut XXIII B(2)	350	<10	10	380	<10	<10	--	--	--
Tartar Sauce XXV A(1)	920	40	40	SAMPLE INADVERTENTLY NOT RUN					
Thousand Island Dressing XXVI A(1)	670	<10	70	760	<10	40	--	--	--
Cheese XXVII A(1)	160	<10	55	1000	<10	<10	--	--	--
Shrimp Sauce XXVIII A(1)	2570	<10	10	50	<10	<10	--	--	--
Vanilla Cream Sauce XXIX A(2)	1580	<10	5	40	<10	<10	--	--	--
Cream & Sugar XXX A(1)	260	<10	75	2920	<10	<10	--	--	--

TABLE V

INITIAL ORGANOLEPTIC AND PHYSICAL STORAGE STUDY RESULTS FOR THE FOOD SHEETS

	Initial				
Sample Reference	Appearance	Taste	Smell	Stickiness	Flexibility
Barbecue Sauce I B(5)	Good	Typical	Typical	None	Good
Catsup II B(11)	Good	Typical	Typical	None	Good
Honey III C(1)	Good	Typical	Typical	None	Adequate
Mayonnaise IV A	Good	Typical	Typical	None	Good
Onion Gravy V B(1)	Good	Typical	Typical	None	Good
Peanut Butter VI B(1)	Good	Typical	Typical	None	Good
Pickle Relish VII A(3)	Good	Typical	Typical	None	Good
Strawberry Preserves VIII B (1)	Good	Typical	Typical	None	Adequate
Soya Sauce IX B(2)	Good	Typical	Typical	None	Good
Vinegar X A(2)	Good	Typical	Typical	None	Good
Apple Butter XI A(3)	Good	Typical	Typical	Slightly sticky/dusted with rice flour	Good
Chocolate Sauce XII B(2)	Good	Typical	Typical	None	Good
Coffee XIII A(2)	Good	Typical	Typical	None	Good
Bacon With White Sauce XIV A(1)	Good	Typical	Typical	None	Good
Dates XV A(2)	Good	Typical	Typical	None	Good
Onion XVI A(2)	Good	Typical	Typical	None	Good
Horseradish XVII B( )	Good	Typical	Typical	None	Good
Maple Syrup XVIII A(1)	Good	Typical	Typical	None	Adequate

TABLE IV (Continued)

EIGHT WEEK AND THIRTEEN WEEK MICROBIOLOGICAL ANALYSIS OF FOOD SHEETS

Sample Reference	8 weeks at 100°F						13 weeks at 100°F					
	Air Pak			Nitrogen Pak			Air Pak			Nitrogen Pak		
	Total Bact. Count /Gm.	Presumptive Coliform Count /Gm.	Mold & Yeast Count /Gm.	Total Bact. Count /Gm.	Presumptive Coliform Count /Gm.	Mold & Yeast Count /Gm.	Total Bact. Count /Gm.	Presumptive Coliform Count /Gm.	Mold & Yeast Count /Gm.	Total Bact. Count /Gm.	Presumptive Coliform Count /Gm.	Mold & Yeast Count /Gm.
Coconut XXIII B(2)	---	---	---	---	---	---	170	<10	<10	---	---	---
Tartar Sauce XXV A(1)	---	---	---	---	---	---	820	<10	40	---	---	---
Thousand Island Dressing XXVI A(1)	---	---	---	---	---	---	760	40	20	---	---	---
Cheese XXVII A(1)	---	---	---	---	---	---	40	<10	<10	---	---	---
Shrimp Sauce XXVIII A(1)	---	---	---	---	---	---	710	<10	<10	---	---	---
Vanilla Cream Sauce XXIX A(2)	---	---	---	---	---	---	250	<10	<10	---	---	---
Cream & Sugar XXX A(1)	---	---	---	---	---	---	120	<10	<10	---	---	---

TABLE VI

TWO WEEK ORGANOLEPTIC AND PHYSICAL STORAGE STUDY RESULTS FOR THE FOOD SHEETS

Sample Reference	Atmosphere	40°F	73°F	100°F	Cycling 0°F to 40°F
Barbecue Sauce I B(5)	Air	Typical odor & taste, non-sticky & flexible	Typical odor & taste, non-sticky & flexible	Darker color, slight sticking together but separable & flexible	Same as 40°F.
	N_2	Same as air	Same as air	Same as air	Same as air
Catsup II B(11)	Air	Typical odor & taste, non-sticky & flexible	Typical odor & taste, non-sticky & flexible	Darker color, typical odor, non-sticky and flexible	Same as 40°F
	N_2	Same as air	Same as air	Slight stickiness, typical odor & color, flexible	Softer than air
Honey III C(1)	Air	Typical odor & taste, non-sticky & flexible	Same as 40°F	Same as 40°F	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Mayonnaise IV A	Air	Typical odor & taste, non-sticky & flexible, slightly darker	Same as 40°F except very slight oil spots	Same as 73°F	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air

TABLE V (Continued)

INITIAL ORGANOLEPTIC AND PHYSICAL STORAGE STUDY RESULTS FOR THE FOOD SHEETS

	Initial				
Sample Reference	Appearance	Taste	Smell	Stickiness	Flexibility
Margarine XIX A(2)	Good	Typical	Typical	None	Good
Meat Extract XX A(1)	Good	Typical	Typical	None	Good
Mustard XXI A(4)	Good	Typical	Typical	None	Good
Lemon Sauce XXII A(2)	Good	Typical	Typical	None	Good
Coconut XXIII B(2)	Good	Typical	Typical	None	Good
Tartar Sauce XXV A(1)	Good	Typical	Typical	None	Good
Thousand Island Dressing XXVI A(1)	Good	Typical	Typical	None	Good
Cheese XXVII A(1)	Good	Typical	Typical	None	Good
Shrimp Sauce XXVIII A(1)	Good	Typical	Typical	None	Good
Vanilla Cream Sauce XXIX A(2)	Good	Typical	Typical	None	Good
Cream and Sugar XXX A(1)	Good	Typical	Typical	None	Good

TABLE VI (Continued)

TWO WEEK ORGANOLEPTIC AND PHYSICAL STORAGE STUDY RESULTS FOR THE FOOD SHEETS

Sample Reference	Atmosphere	40°F	73°F	100°F	Cycling 0°F to 40°F
Vinegar X A(2)	Air	Good flexibility, odor & color but tough	Same as 40°F	Same as 40°F except darker	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Apple Butter XI A(3)	Air	Typical odor & taste, non-sticky & flexible	Same as 40°F	Darker; otherwise same as 40°F	Same as 40°F
	N_2	Same as air except slightly darker	Same as air	Same as air	Darker & more moist looking than air
Chocolate Sauce XII B(2)	Air	Slightly greasy but otherwise good	Same as 40°F	Slight spotting & & greasing	Slightly fragile but otherwise good
	N_2	Good	Same as air	Same a air	Good
Coffee XIII A(2)	Air	Non-sticky & flexible, odor not as strong as 100°F	Typical odor & taste, non-sticky, & flexible	Same as 73°F except slightly darker	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Bacon with White Sauce XIV A(1)	Air	Typical odor & taste, non-sticky, & flexible	Slight oiliness on surface; otherwise same as 40°F	Same as 73°F	Same as 40 F except slight oiliness
	N_2	Same as air	More oily; otherwise same as air	Same as air	Same as air

TABLE VI (Continued)

TWO WEEK ORGANOLEPTIC AND PHYSICAL STORAGE STUDY RESULTS FOR THE FOOD SHEETS

Sample Reference	Atmos-phere	40°F	73°F	100°F	Cycling 0°F to 40°F
Onion Gravy V B(1)	Air	Typical odor & taste, non-sticky & flexible	Same as 40°F except very slight oil spots	Same as 73°F	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air except for very slight oil spots
Peanut Butter VI B(1)	Air	Typical odor & taste, non-sticky & flexible	Same as 40°F.	Same as 40°F	Same as 40°F
	N_2	Same as air	Same as air	Very slight greasing, other-wise same as air	Same as air
Pickle Relish VII A(3)	Air	Typical odor & taste, non-sticky & flexible	Same as 40°F	Same as 40°F	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Strawberry Preserves VIII B(1)	Air	Odor & color good, non-sticky & flexible	Same as 40°F	Slightly darker than 73°F. slight sticking (can be separated), odor less at 100°F	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Soya Sauce IX B(2)	Air	Very good flexi-bility, odor & color	Same as 40°F	Very slight sticking, other-wise same as 40°F	Same as 40°F
	N_2	Same as air	Same as air	Sticky, good color, darker color, may have had a leak	Same as air

TABLE VI (Continued)

TWO WEEK ORGANOLEPTIC AND PHYSICAL STORAGE STUDY RESULTS FOR THE FOOD SHEETS

Sample Reference	Atmos-phere	40°F	73°F	100°F	Cycling 0°F to 40°F
Meat Extract XX A(1)	Air	Very good odor, flexibility & color. Typical taste	Same as 40°F	Same as 40°F	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Mustard XXI A(4)	Air	Very good odor, taste, color & flexibility	Same as 40°F	Same as 40°F except less odor & darker color	Same as 40°F
	N_2	Same as air	Same as air	Same as air except lighter color	Same as air
Lemon Sauce XXII A(2)	Air	Good odor, taste, color & flexibil-ity, very slight greasing	Same as 40°F	Same as 40°F except appearance of spots and some greasing	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Coconut XXIII B(2)	Air	Very good odor, taste, color & flexibility	Same as 40°F	Same as 40°F except very slight greasing	Same as 40°F
	N_2	Same as air	Same as air	Same as air except slightly darker	Same as air
Tartar Sauce XXV A(1)	Air	Good odor, taste, color & flexibility	Same as 40°F	Same as 40°F	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air

TABLE VI (Continued)

TWO WEEK ORGANOLEPTIC AND PHYSICAL STORAGE STUDY RESULTS FOR THE FOOD SHEETS

Sample Reference	Atmosphere	40°F	73°F	100°F	Cycling 0°F to 40°F
Dates XV A(2)	Air	Good odor & taste, non-sticky & flexible	Same as 40°F	Same as 40°F	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Onion XVI A(2)	Air	Good odor, taste, flexibility & color	Same as 40°F	Same as 40°F except somewhat darker color	Same as 40°F
	N_2	Same as air	Same as air	Less intense odor, otherwise same as air	Same as air
Horseradish XVII B(1)	Air	Typical odor, taste & color. Good flexibility	Same as 40°F	Same as 40°F except somewhat darker color	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Maple Syrup XVIII A(1)	Air	Good odor, taste, flexibility & color	Same as 40°F	Darker color, less strength, some sticking	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Margarine XIX A(2)	Air	Good taste, flexibility & color, not much odor	Sheen on one side, otherwise same as 40°F	Color, odor & flexibility good, some slight greasing	Same as 40°F except very slight greasing
	N_2	Same as air	Same as air	Same as air	Same as air

TABLE VII

FOUR WEEK ORGANOLEPTIC AND PHYSICAL STORAGE STUDY RESULTS FOR THE FOOD SHEETS

Sample Reference	Atmosphere	40°F	73°F	100°F	Cycling 0°F to 40°F
Barbecue Sauce I B(5)	Air	Typical odor & taste, non-sticky & flexible	Same as 40°F except slightly sticky, can separate though	Sticky, needs rice flour	Same as 73°F
	N_2	Same as air	Same as air	Same as air	Same as air
Catsup II B(11)	Air	Typical odor & taste, non-sticky & flexible	Same as 40°F except slightly sticky, can separate though	Same as 73°F	Same as 40°F
	N_2	Same as air	Same as air	Same as air except slightly darker	Same as air
Honey III C(1)	Air	Typical odor & taste, non-sticky & flexible	Same as 40°F	Thinner sheets were slightly fragile; otherwise same as 40°F	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Mayonnaise IV A	Air	Typical odor & taste, non-sticky & flexible	Same as 40°F	Same as 40°F except for darker color	Same as 40°F
	N_2	Same as air	Same as air	Same as 40°F N_2	Same as air
Onion Gravy V B(1)	Air	Typical odor & taste, non-sticky & flexible	Some oil spots - same as 40°F	Same as 73°F	Same as 73°F
	N_2	Same as air except very slight oil spots	Same as air except darker color	Same as air except lighter color	Same as air
Peanut Butter VI B(1)	Air	Typical odor & taste, non-sticky & flexible	Same as 40°F	Same as 40°F	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air

TABLE VI (Continued)

TWO WEEK ORGANOLEPTIC AND PHYSICAL STORAGE STUDY RESULTS FOR THE FOOD SHEETS

Sample Reference	Atmosphere	40°F	73°F	100°F	Cycling 0°F to 40°F
Thousand Island Dressing XXVI A(1)	Air	Good odor, taste, color & flexibility	Same as 40°F	Same as 40°F	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Cheese XXVII A(1)	Air	Good odor, taste, color & flexibility	Same as 40°F	Same as 40°F except very slight greasing on edge	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Shrimp Sauce XXVIII A(1)	Air	Good odor, taste, color & flexibility	Same as 40°F except darker color	Same as 40°F except much darker color	Same as 40°F
	N_2	Same as air except darker color	Same as air	Same as air	Same as air except darker color
Vanilla Cream Sauce XXIX A(2)	Air	Very good odor, taste, color & flexibility	Same as 40°F	Same as 40°F except slightly less odor	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Cream & Sugar XXX A(1)	Air	Good odor, taste, color & flexibility	Same as 40°F	Same as 40°F except slightly darker	Same as 40°F
	N_2	Same as air	Same as air	Same as air except very slight greasing	Same as air

TABLE VII (Continued)

FOUR WEEK ORGANOLEPTIC AND PHYSICAL STORAGE STUDY RESULTS FOR THE FOOD SHEETS

Sample Reference	Atmosphere	40°F	73°F	100°F	Cycling 0°F to 40°F
Coffee XIII A(2)	Air	Typical odor & taste, non-sticky & flexible	Same as 40°F	Same as 40°F	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Bacon with White Sauce XIV A(1)	Air	Typical odor & taste, non-sticky & flexible	Same as 40°F except slight oil spots	Same as 73°F	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Dates XV A(2)	Air	Good odor & taste, non-sticky & flexible	Same as 40°F	Same as 40°F	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Onion XVI A(2)	Air	Good odor, taste, flexibility & color	Same as 40°F	Same as 40°F	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air except slightly more brittle
Horseradish XVII B(1)	Air	Typical odor, taste & color. Good flexibility	Same as 40°F	Same as 40°F except some darkening	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Maple Syrup XVIII A(1)	Air	Good odor, taste, flexibility & color	Same as 40°F except more fragile	Same as 73°F except more fragile	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Margarine XIX A(2)	Air	Good taste, flexibility & color. Not much odor	Same as 40°F except slight greasing	Same as 73°F	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air

TABLE VII (Continued)

FOUR WEEK ORGANOLEPTIC AND PHYSICAL STORAGE STUDY RESULTS FOR THE FOOD SHEETS

Sample Reference	Atmos-phere	40°F	73°F	100°F	Cycling 0° to 40°F
Pickle Relish VII A(3)	Air	Typical odor & taste, non-sticky & flexible	Same as 40°F	Same as 40°F	Same as 40°f
	N_2	Same as air	Same as air	Less odor & darker than in air	Same as air
Strawberry Preserves VIII B(1)	Air	Odor & color good, non-sticky & flexible	Same as 40°F	Slight sticking, more fragile than at 40°F	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Soya Sauce IX B(2)	Air	Good flexibility, odor & color	Same as 40°F except slight sticking	Same as 73°F	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Vinegar X A(2)	Air	Very tough, stuck together even though powdered	Some stuck together, others not sticky. Two different batches, some discoloring	Very flexible but tough	Same as 40°F
	N_2	Same as air	Stuck together	Same as air	Same as air
Apple Butter XI A(3)	Air	Typical odor & taste, non-sticky & flexible	Same as 40°F except slightly sticky, can separate	Same as 73°F	Same as 40° F
	N_2	Same as air	Darker & less sticky than air	Same as 40°F N_2	Same as air
Chocolate Sauce XII B(2)	Air	Slightly greasy but otherwise good	Spotted, brittle, some mold	Badly spotted, brittle, moldy	Same as 40°F
	N_2	Same as air	Same as air	Badly spotted, spots are greasy	Same as air

TABLE VII (Continued)

FOUR WEEK ORGANOLEPTIC AND PHYSICAL STORAGE STUDY RESULTS FOR THE FOOD SHEETS

Sample Reference	Atmos-phere	40°F	73°F	100°F	Cycling 0°F to 40°F
Cheese XXVII A(1)	Air	Good odor, taste, color & flexibility	Same as 40°F	Same as 40°F except slight sticking & slight oiling	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Shrimp Sauce XXVIII A(1)	Air	Good odor, taste, color & flexibility	Same as 40°F except darker color	Same as 73°F except much darker color	Same as 40°F
	N_2	Same as air	Same as air except not as dark in color	Same as air	Same as air
Vanilla Cream Sauce XXIX A(2)	Air	Good odor, taste, color & flexibility	Same as 40°F	Same as 40°F except slightly sticky	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Cream & Sugar XXX A(1)	Air	Good odor, taste, color & flexibility	Same as 40°F	Same as 40°F except slight greasing	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air

TABLE VII (Continued)

FOUR WEEK ORGANOLEPTIC AND PHYSICAL STORAGE STUDY RESULTS FOR THE FOOD SHEETS

Sample Reference	Atmosphere	40°F	73°F	100°F	Cycling 0°F to 40°F
Meat Extract XX A(1)	Air	Very good odor, flexibility & color. Typical taste	Same as 40°F	Same as 40°F	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Mustard XXI A(4)	Air	Good odor, taste & color, but brittle when cold	Good odor, taste color & flexibility	Same as 73°F except slight sticking	Same as 73°F
	N_2	Same as air	Same as air	Same as air	Same as air
Lemon Sauce XXII A(2)	Air	Good odor but some spots & oily surface	Good odor - more spots than 40°F	Badly spotted; brittle between spots	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Coconut XXIII B(2)	Air	Good odor, taste, color & flexibility	Same as 40°F except slight greasing	Same as 73°F	Same as 73°F
	N_2	Same as air	Same as air	Same as air	Same as air
Tartar Sauce XXV A(1)	Air	Good odor, taste, color & flexibility	Same as 40°F except slightly darker color	Same as 40°F	Same as 40°F
	N_2	Same as air	Same as air	Same as air except slight oiliness	Same as air
Thousand Island Dressing XXVI A(1)	Air	Good odor, taste, color & flexibility	Same as 40°F	Same as 40°F except darker color	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air

TABLE VIII (Continued)

EIGHT WEEK ORGANOLEPTIC AND PHYSICAL STORAGE STUDY RESULTS FOR THE FOOD SHEETS

Sample Reference	Atmosphere	40°F	73°F	100°F	Cycling 0°F to 40°F
Peanut Butter VI B(1)	Air	Typical odor & taste, non-sticky & flexible	Same as 40°F	Same as 40°F	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Pickle Relish VII A(3)	Air	Good odor, taste, color, flexibility & not sticky	Same as 40°F	Same as 40°F except strange odor	Same as 40°F
	N_2	Rice paper laminated; better with rice flour	Same as air except stronger odor	Same as air	Same as air
Strawberry Preserves VIII B(1)	Air	Odor & color good, non-sticky & flexible	Same as 40°F	Darker color, some shredding on bending	Same as 40°F except crumbling
	N_2	Same as air	Same as air	Same as air	Same as air
Soya Sauce IX B(2)	Air	Good flexibility, odor & color	Same as 40°F	Badly stuck together, need rice flour	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Vinegar X A(2)	Air	Very tough; otherwise good odor, taste, flexibility & not sticky	Same as 40°F	Same as 40°F except slightly darker	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air

TABLE VIII

EIGHT WEEK ORGANOLEPTIC AND PHYSICAL STORAGE STUDY RESULTS FOR THE FOOD SHEETS

Sample Reference	Atmosphere	40°F	73°F	100°F	Cycling 0°F to 40°F
Barbecue Sauce I B(5)	Air	Very good	Good odor	Good, not sticky, not dusted	Good; not dusted with rice flour, good color
	N_2	Not sticky; good	Slightly sticky, not sticky to the touch; some adherence	Dusted but same as air	Very good have been powdered
Catsup II B(11)	Air	Good, not sticky; odor not too good	Good not powdered; no odor	Sticky not treated with rice flour	Odor poor; otherwise good
	N_2	Very good not powdered; odor poor	Powdered odor good	Good, darker odor good	Good; odor not too strong
Honey III C(1)	Air	Typical odor & taste, non-sticky & flexible	Same as 40°F	Darker color & more crumbly than 40°F	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air except some crumbling
Mayonnaise IV A	Air	Good odor; no sticking; good flexibility	Good, very very slight oil on one sheet, good odor	Darker than original; lacking in odor	Generally good; good odor
	N_2	Good; lighter than air; good odor	Good odor; slightly lighter than air	Darker than original; lacking in odor	Lighter than air; otherwise good
Onion Gravy V B(1)	Air	Color same as N_2; otherwise good	Small amounts of oil	Better than N_2; no oil; good odor, appeared much less moist than N_2	More oil than N_2; otherwise good
	N_2	Good; ligher color; no oil	Not as dark as cycling; quite a bit of oil	Some oil; darker than 70°; good odor	Good odor; very slight oil

TABLE VIII (Continued)

EIGHT WEEK ORGANOLEPTIC AND PHYSICAL STORAGE STUDY RESULTS FOR THE FOOD PRODUCTS

Sample Reference	Atmosphere	40°F	73°F	100°F	Cycling 0°F to 40°F
Horseradish XVII B91)	Air	Typical odor, taste & color, good flexibility	Same as 40°F	Same as 40°F except darker color	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Maple Syrup XVIII A(1)	Air	Good odor, taste, flexibility & color	Same as 40°F	Darker color & slightly crumbly	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Margarine XIX A(2)	Air	Good taste, flexibility & color, not much odor	Same as 40°F	Same as 40°F except slight greasing	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Meat Extract XX A(1)	Air	Very good odor flexibility & color, typical taste	Same as 40°F	Same as 40°F except color darker	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Mustard XXI A(4)	Air	Good odor, taste, color & flexibility	Same as 40°F except some sticking together	Same as 40°F	Same as 40°F except slightly crisp
	N_2	Same as air	Same as air	Same as air	Same as air
Lemon Sauce XXII A(2)	Air	SAMPLES DISCARDED			
	N_2				

TABLE VIII (Continued)

EIGHT WEEK ORGANOLEPTIC AND PHYSICAL STORAGE STUDY RESULTS FOR THE FOOD SHEETS

Sample Reference	Atmosphere	40°F	73°F	100°F	Cycling 0°F to 40°F
Apple Butter XI A(3)	Air	Typical odor, taste & color. Flexible & not sticky	Same as 40°F	Same as 40°F except some sticking	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Chocolate Sauce XII B(2)	Air	S A M P L E D I S C A R D E D			
	N_2				
Coffee XIII A(2)	Air	Typical odor & taste, non-sticky & flexible	Same as 40°F	Same as 40°F	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Bacon with White Sauce XIV A(1)	Air	Good odor; lighter color than N_2	Same as N_2	Good odor; very spotty greasing; slightly darker than N_2	Same as N_2
	N_2	Good odor, flexibility, & color	Darker than 40°F; slight greasing	Same as air	Very good; much lighter than N_2 100°F
Dates XV A(2)	Air	Good odor; no sticking; good flexibility	Somewhat stiff; otherwise good	Darker than N_2; otherwise good	Same as 40°F
	N_2	Same as air	Same as air	Same as 40°F	Same as air
Onion XVI A(2)	Air	Good odor, taste, flexibility & color	Same as 40°F except slightly crisper	Same as 40°F	Same as 40°F
	N_2	Same as air	Same as air	Same as air except slightly darker color	Same as air

TABLE IX

THIRTEEN WEEK ORGANOLEPTIC AND PHYSICAL STORAGE STUDY RESULTS FOR THE FOOD SHEETS

Sample Reference	Atmosphere	40°F	73°F	100°F	Cycling 0°F to 40° F
Barbecue Sauce I B(5)	Air	Good; slight sticking	Was not powdered; more difficult to separate	Stuck together; darker color; otherwise good; could be separated with effort	Good odor; some slight sticking
	N_2	Same as air	Same as air	Same as air	Same as air
Catsup II B(11)	Air	Good but no odor	Not powdered; quite sticky	Stuck together; very dark color; otherwise good. Could be separated	Some sticking, otherwise good
	N_2	Not as dry as air but better product	Same as air	Same as air	Same as air
Honey III C(1)	Air	Typical odor & taste, non-sticky & flexible	Same as 40°F except color darker	Some sticking & slight darkening of color	Same as 40°F
	N_2	Same as air	Same as 40°F air	Same as air	Same as air
Mayonnaise IV A	Air	Typical odor & taste, non-sticky & flexible	Same as 40°F	Light brown color; odor not the same as original	Sample lost
	N_2	Same as air	Same as air	Better odor than air; and lighter color	Sample lost

TABLE VIII (Continued)

EIGHT WEEK ORGANOLEPTIC AND PHYSICAL STORAGE STUDY RESULTS FOR THE FOOD SHEETS

Sample Reference	Atmosphere	40°F	73°F	100°F	Cycling 0°F to 40°F
Coconut XXIII B(2)	Air	Good odor, taste, color, & flexibility	Same as 40°F	Same as 40°F except color darker	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Tartar Sauce XXV A(1)	Air	Good odor, taste, color & flexibility	Same as 40°F	Darker color & odor not of Tartar Sauce	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Thousand Island Dressing XXVI A(1)	Air	Good odor, taste, color & flexibility	Same as 40°F	Same as 40°F except darker color	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Cheese XXVIII A(1)	Air	Good odor, taste, color & flexibility	Same as 40°F	Same as 40°F except slight greasing	Same as 40°F except slight darkening of color
	N_2	Same as air	Same as air	Same as air	Same as air
Shrimp Sauce XXVIII A(1)	Air	Good odor, taste, color & flexibility	Same as 40°F except darker color	Same as 73°F except darker color	Same as 40°F except much darker color
	N_2	Same as air	Same as air	Same as air	Same as air
Vanilla Cream Sauce XXIX A(2)	Air	Good odor, taste, color & flexibility	Same as 40°F except slight sticking	Same as 40°F	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Cream & Sugar XXX A(1)	Air	Good odor, taste, color & flexibility	Same as 40°F except stuck together slightly	Stuck together with dark round spots	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air

TABLE IX (Continued)

THIRTEEN WEEK ORGANOLEPTIC AND PHYSICAL STORAGE STUDY RESULTS FOR THE FOOD SHELF

Sample Reference	Atmosphere	40°F	73°F	100°F	Cycling 0°F to 40°F
Vinegar X A(2)	Air	Stuck together & tough but separable	Same as 40°F	Stuck together even though powdered with rice flour, very tough	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Apple Butter XI A(3)	Air	Sample lost	Good odor, taste, color, flexibility	Stuck together good odor & flexibility	Same as 73°F
	N_2	Sample lost	Same as air	Good odor not as sticky as air	Same as air
Chocolate Sauce XII B(2)		S A M P L E D		S T A R D	E D
Coffee XIII A(2)	Air	Typical odor & taste, non-sticky & flexible	Same as 40°F	Same as 40°F	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Bacon with White Sauce XIV A(1)	Air	Good; some grease from bacon	Good	Some sticking together, otherwise good, could be separated	Good
	N_2	Good	Good	Darker than air; good color	Same as air
Dates XV A(2)	Air	Good odor, taste & color	Good odor, taste color & flexibility	Stuck together darker color, otherwise good could be separated	Sample lost
	N_2	Brittle at 40°F, broken when at this temperature	Same as air	Same as air	Sample lost

TABLE IX (Continued)

THIRTEEN WEEK ORGANOLEPTIC AND PHYSICAL STORAGE STUDY RESULTS FOR THE FOOD SHEETS

Sample Reference	Atmosphere	40°F	73°F	100°F	Cycling 0°F to 40°F
Onion Gravy V B(1)	Air	Very good odor, flexibility & color	Mold on outside of one sheet; otherwise okay	Somewhat fragile; good odor, some greasing	Good
	N_2	Very slight oiliness	Slight stickiness; looks drier; sticks at corners; very slight amount of greasing	Same as air	Good
Peanut Butter VI B(1)	Air	Typical odor & taste, non-sticky & flexible	Same as 40°F	Same as 40°F	Same as 40°F except very slight oiliness
	N_2	Same as air	Same as air	Same as air	Same as air
Picle Relish VII A(3)	Air	Good odor, taste, color, flexibility & not sticky	Same as 40°F	Same as 40 F except slight sticking	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Strawberry Preserves VIII B(1)	Air	Odor & color good, non-sticky & flexible	Slightly darker & more fragile than 40 F but acceptable	Darker color & more fragile than 40 F	Same as 40 F
	N_2	Same as air	Same as air except less color change	Same as air except not as fragile	Same as air
Soya Sauce IX B(2)	Air	Good flexibility, odor & color	Same as 40 F	Same as 40 F	Same as 40 F
	N_2	Same as air	Same as air	Same as air except slight sticking	Same as air

TABLE IX (Continued)

THIRTEEN WEEK ORGANOLEPTIC AND PHYSICAL STORAGE STUDY RESULTS FOR THE FOOD SHEET

Sample Reference	Atmosphere	40°F	73°F	100°F	Cycling 0°F to 40°F
Lemon Sauce XXII A(2)		S A M P L E D I S C A R D E D			
Coconut XXIII B(2)	Air	Good odor, taste, color & flexibility	Same as 40°F except slight oiling	Darker color some greasing, spotted	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Tartar Sauce XXV A(1)	Air	Good odor, taste, color & flexibility	Same as 40°F except more yellow color	Color turned brown some oiling & slight sticking	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Thousand Island Dressing XXVI A(1)	Air	Good odor, taste, color & flexibility	Same as 40°F	Same as 40°F except much darker	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Cheese XXVII A(1)	Air	Good odor, taste, color & flexibility	Same as 40°F	Darker color, some sticking, dark spots & mold	Same as 40°F
	N_2	Same as air	Same as air	Same as 40°F except slight oiling	Same as air
Shrimp Sauce XXVIII A(1)	Air	Good odor, taste, color & flexibility	Same as 40°F except darker color	Okay except color turned black	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air

THIRTEEN WEEK ORGANOLEPTIC AND PHYSICAL STORAGE STUDY RESULTS FOR THE FOOD SHEETS

Sample Reference	Atmosphere	40°F	73°F	100°F	Cycling 0°F to 40°F
Onion XVI A(2)	Air	Good odor, taste, flexibility & color	Same as 40°F	Same as 40°F except more fragile	Same as 40°F
	N_2	Same as air	Same as air	Some cracked & some sticking together	Same as air
Horseradish XVII B(1)	Air	Typical odor, taste & color, good flexibility	Same as 40°F	Same as 40°F except much darker color	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Maple Syrup XVIII A(1)	Air	Good taste, flexibility & color but slight coconut smell	Same as 40°F except slightly fragile	Darker color & more fragile than 40°F	Same as 40°F
	N_2	Same as air	Same as air	Same as air	Same as air
Margarine XIX A(2)	Air	Good taste, flexibility & color but slight greasing	Same as 40°F	Same as 40°F	Same as 40°F
	N_2	Same as air	Same as air	Badly oiled	Same as air
Meat Extract XX A(1)	Air	Good odor, flexibility & color Typical taste	Same as 40°F	Darker color & more fragile	Same as 40°F
	N_2	Same as air	Same as air	Same as 40°F	Same as air
Mustard XXI A(4)	Air	Good odor, taste, color & flexibility	Same as 40°F	Same as 40°F except darker color	Same as 40°F
	N_2	Same as air	Same as air	Same as air except slight sticking	Same as air

RESULTS OF THE MIXED SAMPLE PHASE OF THE STORAGE STUDY

The purpose of this experiment was to find if different types of food sheets could be packaged together successfully. Representative samples from each of three general kinds of sheets were packaged, three of two different kinds together in a foil pouch. The three types of sheets were as follows:

1. Those incorporated into a stable dispersion
2. Using a hydrocolloid as the structural matrix
3. Using a dry mixing technique incorporating a high melting fat as the structural matrix.

Samples were placed in 40°F, 73°F, 100°F and cycling storage (40°F to 0°F). They remained there for two, four, eight and thirteen weeks

The mixing of the samples had no effect on the storage stability of the individual sheets. In general there was no appreciable transfer of flavor even after thirteen weeks of storage. Some of the sheets tasted different from when they went in storage, but this could not be identified as anything definite. Even this was only on those sheets that were in direct physical contact with other sheets. It is reasonable to assume that if some type of disposable disc were used to separate the different kinds there would be no transfer.

Immediately after the pouches were opened there was some odor transfer noted, again where the faces of the sheets were in direct contact. In most cases this soon disappeared if the sheets were left exposed to the open air. However, in extreme cases such as horseradish, pickle relish, etc., the odor left on the other sheet lingered for quite some time.

The transfer of this odor varied with time, temperature and the types of sheets used. The transfer of odor became greater in direct proportion to the time the sheets were in contact. Also, it was greater at the higher temperatures. The dispersion types were the least absorptive, the hydrocolloids next and then dry mix type the most absorptive.

The results as noted seem to indicate that different kinds of sheets could successfully be stored together if discretion were used in the flavors stored.

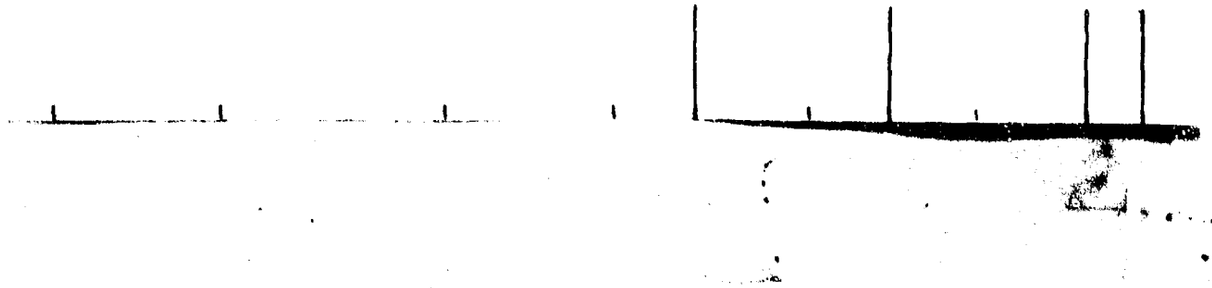

TABLE IX (Continued)

THIRTEEN WEEK ORGANOLEPTIC AND PHYSICAL STORAGE STUDY RESULTS FOR THE FOOD SHEETS

Sample Reference	Atmosphere	40°F	73°F	100°F	Cycling 0°F to 40°F
Vanilla Cream Sauce XXIX A(2)	Air	Good odor, taste, color & flexibility	Same as 40°F	Slightly sticky, brown spots on edges	Same as 40°F
	N_2	Same as air	Same as air	Blotchy appearance, otherwise good	Same as air
Cream & Sugar XXX A(1)	Air	Good odor, taste, color & flexibility	Same as 40°F except slight greasing	Same as 40°F except slight sticking	Same as 40°F
	N_2	Same as air	Same as air	Sticky, oily, brown spots	Same as air

Unclassified
Security Classification

DOCUMENT CONTROL DATA - R&D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1 ORIGINATING ACTIVITY (Corporate author)

The Pillsbury Company, Minneapolis, Minnesota

2a REPORT SECURITY CLASSIFICATION

Unclassified

2b GROUP

3 REPORT TITLE

FOOD ADJUNCTS STABILIZED AS THIN SHEETS OR LAMINATES

4 DESCRIPTIVE NOTES (Type of report and inclusive dates)

Final report 15 October 1962 - 15 October 1964

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

DURST, JACK R.

6 REPORT DATE	7a TOTAL NO OF PAGES	7b NO OF REFS
October 1965	103	0

8a CONTRACT OR GRANT NO

DA 19-129-AMC-1 (N) (OI9000)

b PROJECT NO

PR63-724NR-RDT&E-327-K

c

d

9a ORIGINATOR'S REPORT NUMBER(S)

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

FD-29

10 AVAILABILITY LIMITATION NOTICES

Qualified requesters may obtain copies of this report from DDC and CFSTI.

11 SUPPLEMENTARY NOTES

12 SPONSORING MILITARY ACTIVITY

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

13 ABSTRACT

This report consists of two phases, each covering a period of 12 months. Phase I involves the development of 30 different prototypes of food sheets, either homogenous or laminates, incorporating common food products. When consumed in an appropriate food context, each sheet shall closely simulate the flavor of its respective adjunct in standard form, and shall not possess properties which will add significantly to the difficulty of mastication or swallowing. Phase II reports on storage stability tests of the above food sheets. A mixed sample phase of the storage study was also conducted to determine if different types of food sheets could be packaged together successfully. Representative samples from three different types of food sheets were packaged in a foil pouch. The three types were: (1) those incorporated into a stable dispersion; (2) those using a hydrocolloid as the structural matrix; and (3) those using a dry mixing technique incorporating a high melting fat as the structural matrix. Samples were placed in 40°F, 73°F, 100°F, and cycling storage (40°F to 0°). They remained in storage for two, four, eight and thirteen weeks. Results seem to indicate that different kinds of sheets could be successfully packaged together and stored if discretion were used in the selection of flavors.

DD FORM 1473

Unclassified
Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Development	8					
Food adjuncts	1		2		2	
Matrix (Food)	1					
Military rations	4		4		4	
Food sheets	2		2		2	
Storage stability			8			
Packaging					8	
Mixed					0	
Homogenous	0					
Laminated	0					

INSTRUCTIONS

1. ORIGINATING ACTIVITY: Enter the name and address of the contractor, subcontractor, grantee, Department of Defense activity or other organization *(corporate author)* issuing the report.

2a. REPORT SECURITY CLASSIFICATION: Enter the overall security classification of the report. Indicate whether "Restricted Data" is included. Marking is to be in accordance with appropriate security regulations.

2b. GROUP: Automatic downgrading is specified in DoD Directive 5200.10 and Armed Forces Industrial Manual. Enter the group number. Also, when applicable, show that optional markings have been used for Group 3 and Group 4 as authorized.

3. REPORT TITLE: Enter the complete report title in all capital letters. Titles in all cases should be unclassified. If a meaningful title cannot be selected without classification, show title classification in all capitals in parenthesis immediately following the title.

4. DESCRIPTIVE NOTES: If appropriate, enter the type of report, e.g., interim, progress, summary, annual, or final. Give the inclusive dates when a specific reporting period is covered.

5. AUTHOR(S): Enter the name(s) of author(s) as shown on or in the report. Enter last name, first name, middle initial. If military, show rank and branch of service. The name of the principal author is an absolute minimum requirement.

6. REPORT DATE: Enter the date of the report as day, month, year; or month, year. If more than one date appears on the report, use date of publication.

7a. TOTAL NUMBER OF PAGES: The total page count should follow normal pagination procedures, i.e., enter the number of pages containing information.

7b. NUMBER OF REFERENCES: Enter the total number of references cited in the report.

8a. CONTRACT OR GRANT NUMBER: If appropriate, enter the applicable number of the contract or grant under which the report was written.

8b, 8c, & 8d. PROJECT NUMBER: Enter the appropriate military department identification, such as project number, subproject number, system numbers, task number, etc.

9a. ORIGINATOR'S REPORT NUMBER(S): Enter the official report number by which the document will be identified and controlled by the originating activity. This number must be unique to this report.

9b. OTHER REPORT NUMBER(S): If the report has been assigned any other report numbers *(either by the originator or by the sponsor)*, also enter this number(s).

10. AVAILABILITY/LIMITATION NOTICES: Enter any limitations on further dissemination of the report, other than those imposed by security classification, using standard statements such as:

(1) "Qualified requesters may obtain copies of this report from DDC."

(2) "Foreign announcement and dissemination of this report by DDC is not authorized."

(3) "U. S. Government agencies may obtain copies of this report directly from DDC. Other qualified DDC users shall request through _____."

(4) "U. S. military agencies may obtain copies of this report directly from DDC. Other qualified users shall request through _____."

(5) "All distribution of this report is controlled. Qualified DDC users shall request through _____."

If the report has been furnished to the Office of Technical Services, Department of Commerce, for sale to the public, indicate this fact and enter the price, if known.

11. SUPPLEMENTARY NOTES: Use for additional explanatory notes.

12. SPONSORING MILITARY ACTIVITY: Enter the name of the departmental project office or laboratory sponsoring *(paying for)* the research and development. Include address.

13. ABSTRACT: Enter an abstract giving a brief and factual summary of the document indicative of the report, even though it may also appear elsewhere in the body of the technical report. If additional space is required, a continuation sheet shall be attached.

It is highly desirable that the abstract of classified reports be unclassified. Each paragraph of the abstract shall end with an indication of the military security classification of the information in the paragraph, represented as *(TS)*, *(S)*, *(C)*, or *(U)*.

There is no limitation on the length of the abstract. However, the suggested length is from 150 to 225 words.

14. KEY WORDS: Key words are technically meaningful terms or short phrases that characterize a report and may be used as index entries for cataloging the report. Key words must be selected so that no security classification is required. Identifiers, such as equipment model designation, trade name, military project code name, geographic location, may be used as key words but will be followed by an indication of technical context. The assignment of links, rules, and weights is optional.