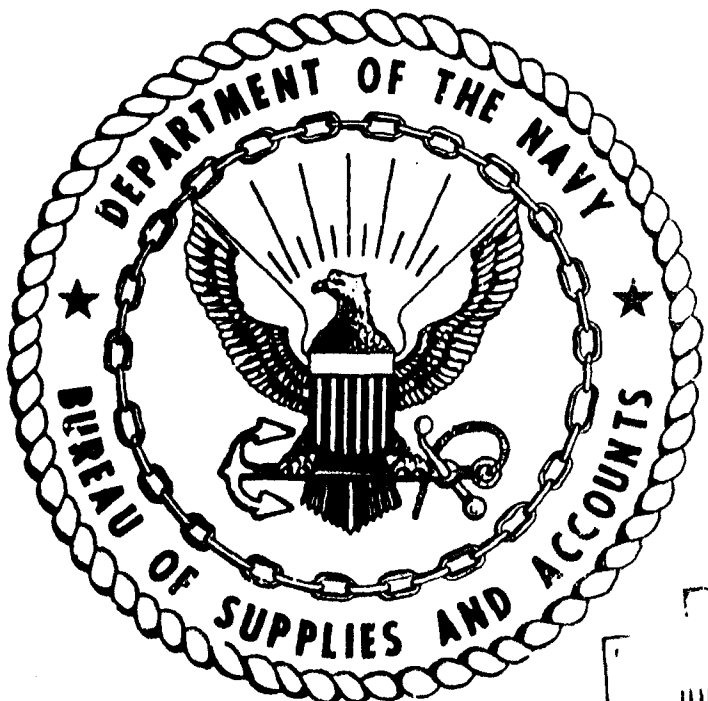
EVALUATION OF DEHYDRATED RAW CABBAGE FOR NAVY USE



U. S. NAVAL SUPPLY RESEARCH AND DEVELOPMENT FACILITY
BAYONNE, N. J.

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TECHNICAL REPORT REVIEW

EVALUATION OF DEHYDRATED RAW CABBAGE FOR NAVY USE

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/s/ F. C. Brehm
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By direction
Chief, Bureau of Supplies and Accounts
Department of the Navy
Washington 25, D. C.

Enclosure (1)

EVALUATION OF DEHYDRATED RAW CABBAGE

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U. S. NAVAL SUPPLY RESEARCH AND DEVELOPMENT FACILITY
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THE EVALUATION OF DEHYDRATED RAW CABBAGE FOR NAVY USE

by

B. S. MacNulty

Subtask No. NT FO15-13-002-69-45
System No. 2202-06945-2

October 1962

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TABLE OF CONTENTS

TABLE OF CONTENTS (CONTD)

LIST OF TABLES

ABSTRACT

A study was conducted to compare dehydrated raw cabbage with fresh cabbage and to determine the suitability of the dehydrate for Navy use. The dehydrate failed to comply with the Military Specification MIL-C-826A for rehydration ratio and textural and taste properties of the rehydrated product. The reconstituted cabbage lacked desirable "eye appeal", flavor and texture and was not comparable orgmoleptically with fresh cabbage. One pound of dehydrate was found to be equivalent to 9.3 pounds of fresh cabbage, (A.P.) and when substituted for the fresh it offered a substantial saving in weight and space. While there is a definite need in the Navy supply system for a dehydrated cabbage, the product evaluated was not considered satisfactory for the purpose. It was recommended that the dehydrated cabbage available at present continue to be utilized aboard those Navy vessels where ration-dense foods are required for extended cruises; and that the Facility continue to evaluate dehydrated cabbage products as they become commercially available.

SUMMARY

PROBLEM

To determine the suitability of a dehydrated raw cabbage for Navy use.

CONCLUSIONS

1. The dehydrated raw cabbage did not comply with the Military Specification MIL-C-826A.

2. The reconstituted raw cabbage was not comparable organoleptically to fresh cabbage.

3. For general mess breakout and issuing purposes, 1 case (6 lb net wt) of dehydrate equals approximately 55.8 pounds (A.P., as purchased) of fresh cabbage.

4. Dehydrated raw cabbage is almost four times more costly to serve than fresh cabbage.

5. The substitution of dehydrated raw cabbage for fresh cabbage does offer substantial savings in shipping weight, refrigerated space, and preparation manhours.

RECOMMENDATIONS:

It is recommended that:

1. The Navy continue to use dehydrated raw cabbage where ration-dense foods are required for extended cruises.

2. The Facility continue to evaluate dehydrated cabbage products, as they become commercially available to find a more suitable product.

THE EVALUATION OF DEHYDRATED RAW CABBAGE FOR NAVY USE

INTRODUCTION

Both freezer and chill space aboard the majority of the Navy ships is at a premium; whereas, dry storage space is not so scarce. The substitution of dehydrated foods for both fresh and frozen type foods is one way of eliminating some of the existing shipboard storage problems, since most dehydrates are generally considered as nonperishable and can be stored at ambient temperatures. Where vessels might convert chill storage space to freezing storage, the dehydrates do provide possible substitutes for the foods usually stored therein. In addition, dehydrates weigh less, generally occupy less space and have a relatively longer shelf life than both the fresh and frozen foods.

At the request of the Navy Subsistence Office, the Bureau of Supplies and Accounts authorized the Naval Supply Research and Development Facility to conduct an evaluation of dehydrated raw cabbage, a new ration-dense item in the Navy Supply System.* This report is concerned with studies conducted to compare Navy-issue dehydrated raw cabbage with fresh. The text is divided into the following sections:

1. Description of Test Product
2. Rehydration Ratio and Qualities of Rehydrated Product
3. Acceptability of Dehydrated Raw Cabbage vs Fresh Cabbage as used in Navy recipes
4. Equivalent Weight Ratio of Dehydrate to Fresh Cabbage
5. Storage, Weight, and Space Comparisons of Dehydrate to Fresh Cabbage
6. Cost Comparison of Dehydrate to Fresh Cabbage
7. Man-hour Savings Made Possible by Utilizing the Dehydrate

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*CHBUSANDA ltr W12 of 3 Jun 1960.

DESCRIPTION OF TEST PRODUCT

Dehydrated raw cabbage is made from diced fresh cabbage from which most of the natural moisture has been removed. The general manufacturing process consists of stripping and coring the fresh cabbage, washing with potable cold water to remove the soil and foreign materials, and dicing the prepared cabbage through a 3/8" dicer. Drying is generally accomplished by forcing warm dry air over the product as it rests on screens.

The dehydrated test product was ordered under Federal Stock Number 8915-656-1452. It was designated as Style A - Raw, and processed in accordance with Military Specification MIL-C-826A of 8 April 1960. The dehydrate was packed in No. 10 cans, with 6 cans per case, giving a net weight of 6 pounds per case. Each pound (1 can) of dehydrate was expected to yield 8 pounds of rehydrated raw cabbage. Fig. 1 shows the product before and after reconstitution.

Dehydrated raw cabbage is a nonperishable item with an estimated minimum storage life of 2 years at temperatures of 75°F. Although the dehydrated cabbage is packaged in sealed containers and not susceptible to bacterial spoilage, it is prone to deterioration during prolonged storage at relatively high temperatures.

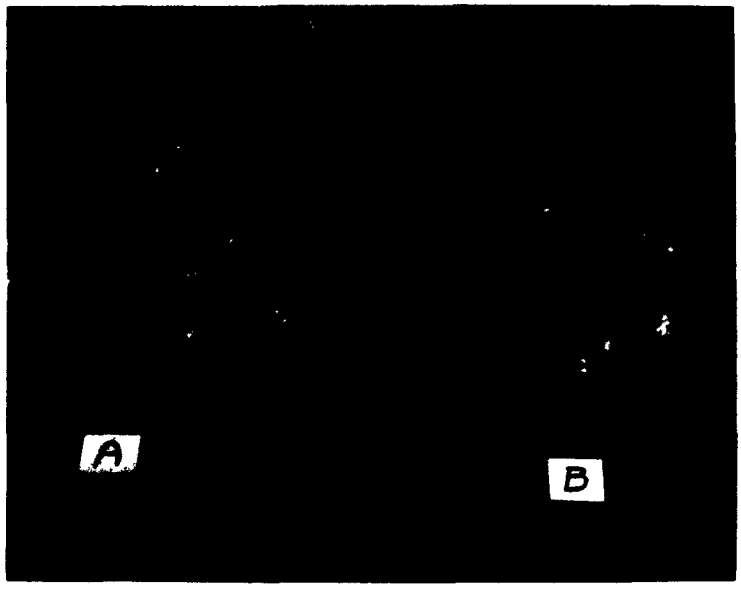

Fig. 1. - Navy issue dehydrated raw cabbage: (A) before reconstitution and (B) after reconstitution.
NAVSUPRANDFAC Photo No. 906-1.

REHYDRATION RATIO AND QUALITIES OF REHYDRATED PRODUCT

Procedure

Two separate series of rehydration tests were conducted. The first consisted of tests in which the temperature of the water of rehydration was constant and the period of rehydration was varied. Nine - 1 ounce samples of dehydrated raw cabbage were rehydrated in 16 ounces of "cold" (50°F.) water. Three of the 9 samples were reconstituted for 45 minutes,* three for 3 hours and 3 overnight (approximately 24 hours).**

The second series consisted of tests in which the temperature of the water of rehydration was varied and the period of rehydration was constant. The phrase "cold water" appeared in all of the recommended methods of rehydration. The term is ambiguous and necessitated establishing the proper temperature and the effects of various water temperatures on the cabbage during rehydration. Water temperatures of 40°, 50°, 60°, 70° and 80°F. were used. One ounce samples were reconstituted by soaking in water of the above temperatures for 45 minutes. The reported test results represent the average of three separate tests per temperature. The reconstituted cabbage samples were then evenly distributed on a "U. S. Standard No. 8 sieve (0.094" openings) 8" in diameter" as specified in the Military Specification. The sieve was placed in an inclined position to facilitate drainage and the product was allowed to drain for 1 minute.*** The drained cabbage was weighed, and selected members of the NAVSUPRANDFAC taste panel and food technologists examined it for typical cabbage color (and absence of discolored pieces), aroma, texture and flavor.

The rehydration ratio was considered as the weight of the dehydrated raw cabbage (in this case 1 ounce) to the weight of the rehydrated cabbage.ϕ

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*The subject item was rehydrated in accordance with Military Specification MIL-C-826A, dated 8 April 1960 as specified under paragraph 3.5.2.1. "Style A cabbage shall rehydrate to approximately its original texture and form, when 1 ounce of dehydrated product is added to 16 ounces of cold water and allowed to soak for 45 minutes ...." See Appendix A.

**Appendix 20 of the Military Specification and the packer's enclosed directions: "Soak dehydrated raw cabbage in cold water, preferably in the refrigerator. Soak at least 45 minutes. A 3 hour or overnight soak increases crispness and is recommended." See Appendix A, Appendix 20, Instructions and Recipes for Use of Dehydrated Cabbage, Raw.

***See Appendix A, paragraph 4.5.6.

ϕIn the case of dehydrated raw cabbage, the yield ratio and rehydration ratio are similar and can be used interchangeably.

Findings

1. The average rehydration ratio of dehydrated raw cabbage increased as the length of the rehydration period increased. The rehydration ratio for cabbage reconstituted in 50°F. water for 45 minutes was 1:6.3; for 3 hours - 1:7.0, and for 24 hours - 1:7.9. (See Table I.)

2. Cabbage reconstituted in 40°, 50°, 60°, 70° and 80°F. water for 45 minutes had the same approximate rehydration ratio 1:6.3.

3. Cabbage reconstituted as specified in the Military Specification MIL-C-826A (50°F. water for 45 minutes) had a rehydration ratio of 1:6.3 which was lower than the specified ratio of 1:8.0.

4. The rehydrated cabbage lacked flavor, aroma and was tough in texture.

5. The most satisfactory rehydrated raw cabbage, from the standpoint of flavor and texture, was obtained by soaking the dehydrate for 3 hours in 50°F. water. The rehydration ratio obtained by this method was 1:7.0.

Discussion of Findings

The dehydrated cabbage failed to comply with the Military Specification MIL-C-826A for product characteristics and the rehydration ratio of 1:8.0.* The NAVSUPRANDFAC taste panel members and the Food Technologists stated that the rehydrated cabbage was not typical of fresh cabbage. Instead of a crisp textured product, the rehydrated product was soggy, reminding one of "wilted cabbage". Also, it lacked flavor. Some of the food technologists stated that "It tastes like dried hay".

It should also be noted that the Military Specification suggests using "cold water". The term, "cold water", is ambiguous and could mean water from any cold water tap (introducing a wide range of water temperatures) or refrigerated water. The specification should be more specific regarding this requirement.

The subsequent test data included in this report was based on dehydrated raw cabbage being prepared in the following manner:

Soaking in 50°F. water for 3 hours.

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*See Appendix A, paragraphs 3.5.2 and 3.5.2.1.

TABLE I. REHYDRATION RATIOS AND QUALITIES OF DEHYDRATED RAW CABBAGE*

Method of Rehydration	Test No.	Rehydration Ratio** 1 Oz. of Wt of Dehydrate: Reconstituted Dehydrate	General Comments Concerning the Rehydrated Raw Cabbage
(A) 50°F. water, 45 minute soak (method specified in MIL-C-826A, under paragraph 3.5.2.1)	1	1:6.3	Color: Excellent Aroma: Weak Texture: Tough; not crisp like fresh cabbage Flavor: Weak, not typical
	2	1:6.2	
	3	1:6.3	
AVERAGE		1:6.3	
(B) 50°F. water 3 hr. soak (Packers and Military Specification Method for Rehydration for use)	1	1:6.9	Color: Excellent Aroma: Weak Texture: Tough; however, better than sample (A) above Flavor: Weak, not typical
	2	1:7.0	
	3	1:7.0	
AVERAGE		1:7.0	
(C) 50°F. water Overnight soak (24 hours) (Packers and Military Specification Method of Rehydration for use)	1	1:7.9	Color: Excellent Aroma: Weak Texture: Tough; but crisper than samples (A) and (B) above Flavor: Lacking; much weaker than samples (A) and (B) above
	2	1:7.8	
	3	1:8.0	
AVERAGE		1:7.9	

*Cabbage used in test was packed February 1961. Cabbage was 8 months old when rehydration study was conducted.

**The rehydration ratio and yield ratio in this case are equal.

ACCEPTABILITY OF DEHYDRATED RAW CABBAGE VS FRESH CABBAGE AS USED IN NAVY RECIPES

Procedure

An investigation was initially conducted to determine those cabbage recipes appearing most frequently in the Navy menus. This was accomplished by reviewing four quarterly issues of the Navy Food Service Bulletins, (July 1959, Oct 1959, Feb 1960 and May 1960). The results of the investigation indicated that fresh cabbage is most frequently used in cole slaw and buttered boiled cabbage. Therefore, only these recipes were prepared and organoleptically examined.

Experimental laboratory recipe testing was conducted prior to the comparative organoleptic examination of fresh to dehydrated cabbage, to determine the best recipe for preparing cole slaw and buttered boiled cabbage from dehydrated raw cabbage. Cole slaw was prepared, following two different recipes: (1) The packer's "Instructions and Recipes for Use" (same as the Military Specification's Instructions and Recipes for Use of Dehydrated Cabbage, Raw)*, and (2) by substituting the best reconstituted dehydrate for fresh cabbage in the Navy Recipe Service Card M, Salads and Salad Dressing No. 12, issue 8. Buttered cabbage was prepared as follows: (1) by substituting the reconstituted product for fresh cabbage in the Navy Recipe Service Card Q, Vegetable No. 52, issue 5, variation #1; and (2) by substituting the reconstituted dehydrate for fresh as prescribed in preceding method (1), but modifying the recipe by adding a seasoning or stock to the water in which the rehydrating cabbage was prepared. Three different additives used were: (1) Monosodium glutamate, (2) Ham stock, and (3) Fried bacon pieces and fat.

Comparative tests for acceptability of selected recipes prepared from both dehydrated raw cabbage and fresh cabbage were conducted by the NAVSUPRANDFAC taste panel, and at the following general messes:

1. Naval Air Station, New York, Floyd Bennett Field, Brooklyn, N. Y.
2. N. Y. Atlantic Group Reserve Fleet, Bayonne, N. J.
3. USS ROOSEVELT (CVA-42)

For the general mess tests, the item being evaluated was unknown to the participants. Each man was handed a coded questionnaire**, listing the buttered cabbage or cole slaw, plus two

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*See Appendix A - Appendix 20.
**See Appendix B.

additional food items being served at that particular meal. The completed questionnaires obtained at the NAVSUPRANDFAC taste panel and the field operational tests were used to determine the over-all hedonic rating,* and the percent dislike of the recipe being tested.

Findings

1. NAVSUPRANDFAC Taste Panel Results:

a. The Navy recipe M-12 was better than packer's directions for cole slaw; b. Q-52 for buttered cabbage where monosodium glutamate was added produced a better product than when ham stock, fried bacon or nothing was added - Table II.

b. Cole slaw and buttered cabbage prepared from the dehydrate were not as well liked as the same recipes prepared from fresh product, Table III.

2. Field Operational Test Results:

a. At the general messes, cole slaw prepared from dehydrated raw cabbage was somewhat similar in acceptability to cole slaw prepared from fresh - Table IV.

b. At both general messes, buttered cabbage prepared from the dehydrate was not as acceptable as the fresh, Table IV.

Discussion of Findings

The test results obtained at both the NAVSUPRANDFAC taste panel and the general messes indicated that the dehydrated raw cabbage generally was not equal to fresh cabbage. The NAVSUPRANDFAC taste panel rated "unacceptable" those recipes in which the dehydrated raw cabbage was used; whereas, the general messes barely tolerated the dehydrate in cole slaw, and rejected its use in buttered cabbage.

Participants in the field operational tests considered the product an unacceptable dehydrate for the following reasons:

Appearance: "Cabbage is chopped too fine", "Pieces are too small" (See Fig. 1, page 2)

Texture: "Not crisp", "Like rubber"

Flavor: "Completely lacking", "Tasteless", "Tastes like hay"

*Hedonic rating is an expression of over-all acceptance and is based on a 9 point scale of numerical values (1 to 9). The higher the numerical value, the better the acceptance.

TABLE II. NAVSUPPACDEPAC EVALUATION TO DETERMINE THE MOST ACCEPTABLE RECIPES FOR DEHYDRATED CABBAGE

	Recipe	AVERAGE HEDONIC RATING, PERCENT DISLIKE AND COMMENTS		
		Hedonic Rating*	Percent Dislike	Comments
COLE SLAW	Packer's Direction for Use	5.3	42	Cabbage was not crisp; piece size was too small.
	Navy Recipe M-12	5.8	20	
BUTTERED CABBAGE	Navy Recipe Q-52, with additive	5.0	29	Lacked typical cabbage flavor.
	Navy Recipe Q-52, plus monosodium glutamate	5.3	21	
	Navy Recipe Q-52, plus ham stock	4.7	54	
	Navy Recipe Q-52, plus fried bacon	5.1	30	

*Hedonic ratings of 4.0 - 4.9 = Dislike Slightly, and 5.0 - 5.9 = Neither Like Nor Dislike.

TABLE III. NAVSUPRANDFAC TASTE PANEL EVALUATION OF RECIPES PREPARED FROM DEHYDRATED AND FRESH CABBAGE

Test Recipe	Test No.	HEDONIC RATINGS AND PER CENT DISLIKES			
		Dehydrated Cabbage		Fresh Cabbage	
		Hedonic Rating*	% Dislike	Hedonic Rating*	% Dislike
Cole Slaw (Navy Recipe Card M-12)	1	5.2	33	6.9	0
	2	5.4	22	7.7	0
Buttered Cabbage (Navy Recipe Card Q-52) plus monosodium glutamate	3	5.0	33	7.5	0
	4	4.6	56	5.6	6

*Hedonic ratings of 4.0 - 4.9 = Dislike Slightly, 5.0 - 5.9 = Neither Like Nor Dislike, 6.0 - 6.9 = Like Slightly and 7.0 - 7.9 = Like Moderately.

TABLE IV. GENERAL MESS ACCEPTANCE RATINGS OF RECIPES PREPARED FROM DEHYDRATED AND FRESH CABBAGE

Recipe	Station	DEHYDRATED CABBAGE		FRESH CABBAGE	
		Hedonic Rating*	Percent Dislike	Hedonic Rating*	Percent Dislike
COLE SLAW (Navy Recipe Card M-12)	USS FRANKLIN D. ROOSEVELT	4.4	38	5.0	21
	N.Y. Atlantic Group Reserve Fleet Bayonne, N. J.	6.0	20	6.2	22
BUTTERED CABBAGE (Navy Recipe Card Q-52, plus mono-sodium glutamate)	NAS Floyd Bennett Field Brooklyn, N. Y.	5.3	30	6.0	2
	N. Y. Atlantic Group Reserve Fleet Bayonne, N. J.	5.3	33	6.1	4

*Hedonic rating 4.0 - 4.9 = Dislike Slightly, 5.0 - 5.9 = Neither Like Nor Dislike and 6.0 - 6.9 = Like Slightly.

Summing it up, the organoleptic test results indicate that the subject item, at best, is a mediocre product, leaving much to be desired. It is probable the over-all appearance of the dehydrate could be greatly improved and made to look like fresh cabbage, if the cabbage was shredded instead of diced.*

EQUIVALENT WEIGHT RATIO OF DEHYDRATE TO FRESH CABBAGE

Procedure

Preparational losses (stripping and coring of fresh cabbage) together with the rehydration ratio of the dehydrate (previously determined in the preceding section) was used to mathematically determine the equivalent weight ratio of the dehydrate to the fresh cabbage. The equivalent weight ratio, as used in this report, was the weight (pound as purchased, (A.P.)) of the dehydrate required to replace a predetermined weight, (A.P.) of fresh cabbage used in recipes. Mathematical computations were made in the following manner:

X = Weight of fresh cabbage required to yield 7 pounds Edible Portion (E.P.) of stripped, cored cabbage. (Seven pounds was selected since 1 pound (A.P.) of dehydrate, when reconstituted in 50°F. water for 3 hours, yields 7 pounds (E.P.) of reconstituted cabbage.

1 lb (A.P.) fresh cabbage	:	.75 lb (E.P.) of stripped, cored cabbage**	=	X lb (A.P.) fresh cabbage	:	7 lb (E.P.) of stripped, cored cabbage

Equivalent weight ratio = 1 lb (A.P.) of dehydrated : X lb (A.P.) of fresh cabbage

Findings

The equivalent weight ratio of the dehydrated raw cabbage to the fresh cabbage (A.P.) was 1:9.3.

Discussion of Findings

Preparational losses will vary, depending upon the physical condition of the fresh cabbage at the time of preparation and the manner in which the commissary personnel involved handle the product. The quoted yield (75%) for stripping and coring fresh cabbage, used in determining the equivalent weight ratio, was viewed to be a realistic figure -- it is an average, established by the Department of Agriculture** and it concurs with the NAVSUPRANDFAC file data. Consequently, the calculated equivalent weight ratio of 1:9.3 is a figure that can be utilized for logistical purposes.

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*See Appendix C for commercially available new cabbage product.

**Agriculture Handbook No. 16, Planning food for Institutions, U. S. Department of Agriculture, Jan 1951, page 54, and data in the Facility files give a preparation loss of approximately 25%.

STORAGE, WEIGHT AND SPACE COMPARISONS OF DEHYDRATE TO FRESH CABBAGE

Procedure

The BuSandA Manual, Volume IV (Chapter 1, Change 151) and the article "Dehydrated Foods"* were checked to obtain the optimum storage conditions and maximum expected storage life for both the dehydrated and fresh cabbage. In addition, cases of dehydrate and crates of fresh cabbage were measured, net weight checked, and cubic feet per container calculated. Subsequently, this information was used to determine the theoretical percent weight and space savings made available by substituting the dehydrated for the fresh cabbage.

Findings

1. Recommended usage of dehydrated cabbage is within 24 months from the date of pack, when stored at 70°F.

2. The approximate storage life of fresh cabbage is 3-4 months, when stored at temperatures of 32° to 35°F. with adequate ventilation and in relative humidity of 90-95%.

3. The average case of dehydrated cabbage measured approximately $12\frac{1}{2}$" x $7\frac{1}{2}$" x $18\frac{1}{2}$", occupied 1 cubic foot, as stamped on the case, and contained 6 No. 10 tin cans, with a gross weight of 11 pounds, 6 pounds net per case. The cube factor is .167 (cubic feet per unit of issue (lbs)).

4. The average crate of fresh cabbage measured approximately $24\frac{1}{2}$" x $13\frac{1}{2}$" x $13\frac{1}{2}$", occupied 2.5 cubic feet with a gross weight of 57.5 pounds, 50 pounds net per case. The cube factor is .050.

5. For each case of dehydrated raw cabbage substituted for fresh cabbage, there is an estimated 83% saving in shipping weight and a 64% saving in storage space, or 100% saving in chill space, since the dehydrate is a dry storage item.** In other words, the equivalent prepared cabbage made from dehydrated raw cabbage requires approximately 1/6 the gross weight and approximately 1/3 the cube of the conventional fresh cabbage.

Discussion of Findings

The actual shipboard storage life of fresh cabbage will vary, depending upon such factors as age and condition of cabbage when received and the available storage conditions. Fresh cabbage is normally stored under refrigerated conditions and, therefore, losses are due to normal spoilage which takes place over a period of time.

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*Dehydrated Foods, Dorothy W. Tousignant, Dehydrated Food Industries, Sep 1952.

**See Appendix D for calculation of weight and space saving.

Like a majority of the dehydrated foods, dehydrated raw cabbage is a dry storage item with an expected storage life of approximately two years. The prime advantages to be realized by the utilization of dehydrated raw cabbage are (1) the release of valuable chill box space occupied by the fresh cabbage, and (2) longer storage life.

COST COMPARISON OF DEHYDRATE TO FRESH CABBAGE

During the past 12 months (commencing with June 1961 and terminating May 1962) the average cost per pound (A.P.) for dehydrated raw cabbage was $1.3525; $0.0383 for fresh cabbage. Based on the equivalent weight ratio that 1 pound (A.P.) of dehydrate is equivalent to 9.3 pounds (A.P.) of fresh cabbage, the dehydrate costs $1.3525 as compared to $0.3562 ($0.0383 x 9.3) for an equivalent weight of fresh cabbage. Mathematically, this means that the dehydrate is almost four times more expensive than the fresh counterpart.

MAN-HOUR SAVINGS MADE POSSIBLE BY UTILIZING THE DEHYDRATE

Like the majority of the dehydrated food items, the dehydrated raw cabbage eliminates the unpleasant chore and man-hours required to prepare the fresh item. The man-hour requirement to strip, core and machine-shred 50 pounds of fresh cabbage for cole slaw is an estimated 0.40 man-hours. This estimation was based on the actual time required to prepare 150 pounds of cabbage at the St. Albans Hospital, St. Albans, N. Y., and by the Facility commissary personnel. The man-hour requirements will vary, depending upon the following factors:

1. Physical condition of the fresh cabbage
2. Personnel involved
3. Equipment used to shred the cabbage

Other man-hour considerations as break out, rehydration of dehydrate, cooking, etc., were not included, since they tend to be comparable for both products.

It is not difficult to visualize the possible man-hour savings that can be realized over a 12 month period by utilizing dehydrated raw cabbage in place of fresh. For example, the BuSandA Manual, Volume III, Chapter 7, page 41, states that the normal subsistence requirement is 3,338 pounds of fresh cabbage per 1,000 men for 30 days. For one year, this would amount to approximately 40,000 pounds of cabbage/1000 men. Based on the figure of .4 man-hours (man-hours required to make ready for use 50 pounds of fresh cabbage), a minimum of 320 man-hours are required to prepare 40,000 pounds. This is equivalent to one man working constantly stripping, coring and shredding fresh cabbage 8 hours per day for 40 days.

TECHNICAL DATA SHEET FOR DEHYDRATED RAW CABBAGE

CASE INFORMATION

Dimensions: $12\frac{1}{2}$" x $7\frac{1}{2}$" x $18\frac{1}{2}$"

Case cube: 1 cu. ft.

Gross wt/case: 11 lb

Net wt/case: 6 lb

Cube Factor: .167 cubic feet per pound net pound of food

Each case contains 6 No. 10 tin cans of dehydrate

BREAK OUT INFORMATION

1 case of dehydrated raw cabbage (6 lb net) is equivalent to approximately 55.8 lb (A.P.) of fresh cabbage.

RECOMMENDED REHYDRATION

Soak the dehydrate in 50°F. water for a minimum of 3 hours when used as a raw cabbage; when used as a cooked cabbage, the product can be soaked for 45 minutes.

COST

The dehydrate costs (at time of report) $1.35 per pound (A.P.), which is equivalent to $0.19 per pound ready to cook.

APPENDIX A

EXCERPTS FROM SPECIFICATION MIL-C-826A, 8 APR 1960
CABBAGE, DEHYDRATED

"3.5.2 Rehydrated product. The rehydrated product shall have good flavor, texture, and color (free from discolored pieces), typical of raw or cooked cabbage, as applicable.

"3.5.2.1 Style A. Style A cabbage shall rehydrate to approximately its original texture and form when 1 ounce of dehydrated product is added to 16 ounces of cold water and allowed to soak for 45 minutes. The rehydration ratio of the product shall be not less than 8 to 1 when tested as specified in 4.5.6."

"4.5.6 Rehydration ratio. Rehydration ratio shall be determined as follows: Prepare the cabbage as specified in 3.5.2.1 or 3.5.2.2. Distribute the cabbage evenly on a U. S. Standard No. 8 sieve (0.094-in. openings) 8 inches in diameter. The sieve shall be placed in an inclined position to facilitate drainage, and the product shall be allowed to drain for 1 minute. The material remaining on the sieve shall be weighed, and rehydration ratio calculated as follows:

$$\frac{\text{Weight of rehydrated material}}{\text{Weight of dehydrated sample}} = \text{rehydration ratio}"$$

"20. INSTRUCTIONS AND RECIPES FOR USE OF DEHYDRATED CABBAGE, RAW

Dehydrated cabbage, raw, is prepared by removing water from fresh, diced cabbage. Since it is not cooked in this process, the product upon reconstitution has the same crisp texture as fresh cabbage.

Use the following as a guide in substituting dehydrated raw, cabbage for fresh cabbage:*

Dehydrated cabbage, raw	Cabbage, fresh, as purchased	Cabbage, fresh, edible portion
2 ounces	1¼ pounds	1 pound
1 pound	10 pounds	8 pounds
1½ pounds	15 pounds	12 pounds

Soak dehydrated raw cabbage in cold water, preferably in the refrigerator. (Allow 2 gallons water for each pound of dehydrated cabbage.) Soak at least 45 minutes. A 3-hour or overnight soak increases crispness and is recommended.

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*The NAVSUPRANDFAC test results indicate a 75% yield for fresh cabbage against an 80% yield as mathematically obtained from the above figures. This 5% difference was considered insignificant, since yield is a variable depending upon such factors as variety and condition of the cabbage at time of preparation and personnel involved. Consequently, no recommendation for a change in the specification was made.

RECIPE FOR CABBAGE SLAW

"Yield: 100 portions Each portion: Approximately 3 ounces - 1/3 cup.

Ingredients	Weights	Measures	Method
Cabbage, dehydrated, raw	1½ pounds	4½ quarts	1. Soak cabbage in water 3 hours or overnight in refrigerator.
Water, cold	...	3 gallons	
Dressing:			2. Drain cabbage.
Sugar	15 ounces	2 cups	3. Combine ingredients for dressing.
Salt	3 3/4 ounces	6 tablespoons	
Pepper, black	...	1½ teaspoons	4. Add to cabbage. Toss together and serve cold.
Vinegar	...	2 cups	
Mayonnaise or salad dressing		1½ quarts"	

APPENDIX B

NAVY FOOD SURVEY

We need your help! The Navy tries all modern food improvements but needs your help to decide their suitability. The only real test is how well YOU like the foods. This survey is designed to secure your opinion on some of the foods served today.

After you finish eating, please answer all the questions on the form below. Remember, your answers will help decide what you eat in the future. Please return this form to the marked box at the scullery.

(A) Please circle the expression below which best describes your opinion of each of the foods. (For example, if you liked the meat moderately, circle the expression "Like Moderately" in the meat column. If you did not eat it, circle the expression "Did Not Eat". Do the same for each food.)

Did Not Eat		Like Extremely	Like Very Much	Like Moderately	Like Slightly	Neither Like Nor Dislike	Dislike Slightly	Dislike Moderately	Dislike Very Much	Dislike Extremely
Did Not Eat		Like Extremely	Like Very Much	Like Moderately	Like Slightly	Neither Like Nor Dislike	Dislike Slightly	Dislike Moderately	Dislike Very Much	Dislike Extremely
Did Not Eat		Like Extremely	Like Very Much	Like Moderately	Like Slightly	Neither Like Nor Dislike	Dislike Slightly	Dislike Moderately	Dislike Very Much	Dislike Extremely

(B) Do you normally like the foods served? (Check Yes or No for each of the foods.)

Yes _____ No _____ Yes _____ No _____ Yes _____ No _____

(C) What is your pay grade? _____
What is your length of service? _____(Years)

(D) Remarks:

(Form used for Field Operational Tests)

APPENDIX C

A DEHYDRATED PRODUCT BROUGHT TO NAVSUPRANDFAC ATTENTION DURING EVALUATION OF NAVY-ISSUED DEHYDRATED CABBAGE

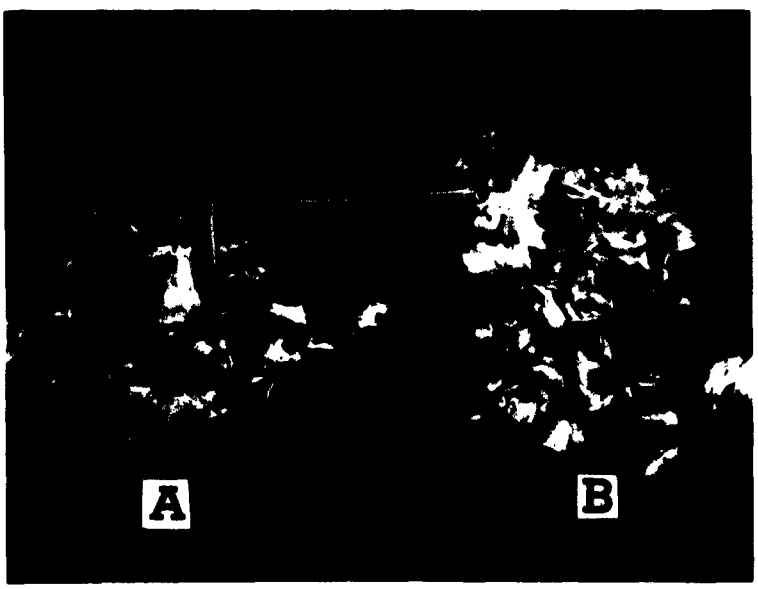

Fig. 2. - Dehydrated raw cabbage. (A) Before and (B) after rehydration. Based on a very limited inspection the reconstituted product appeared to be superior to the subject dehydrated raw cabbage under evaluation from the standpoint of color, piece size and flavor. A complete evaluation of this product has not been conducted. NAVSUPRANDFAC Photo No. 865-6.

APPENDIX D

CALCULATIONS OF ESTIMATED WEIGHT AND SPACE SAVINGS ACCOMPLISHED BY SUBSTITUTING DEHYDRATED RAW CABBAGE (A.P.) FOR FRESH CABBAGE (A.P.)

WEIGHT SAVING CALCULATIONS

1 case of dehydrate is equivalent to approximately 55.8 lb. of fresh cabbage (net wt. of dehydrate/case - 6 lb. and equivalent wt factor - 9.3; 6 x 9.3 = 55.8)

$$\frac{57.5 \text{ lb. (Gross Wt of crate of fresh cabbage)}}{50.0 \text{ lb. (Net Wt of crate of fresh cabbage)}} = \frac{X \text{ lb. (Gross Wt)}}{55.8 \text{ lb. (Net Wt of fresh cabbage desired)}}$$

$X = 64$ lb.

$$\frac{64 \text{ lb. (Gross Wt of fresh cabbage with crate to yield 55.8 lb. net wt of fresh cabbage)} - 11 \text{ lb. (Gross Wt/case of dehydrate which is equivalent to 55.8 lb. of fresh cabbage)}}{64 \text{ lb.}} \times 100 = 82.8\% \text{ savings in shipping wt.}$$

SPACE SAVING CALCULATIONS

$$\frac{57.5 \text{ lb. (Gross Wt/Crate of fresh cabbage)}}{2.5 \text{ cu.ft. (Space occupied by 1 crate of fresh cabbage)}} = \frac{64 \text{ lb. (Gross Wt required to yield 55.8 lb. Net Wt of fresh cabbage}}{X \text{ cu.ft. (Space occupied by the 64 lb., Gross Wt)}}$$

$X = 2.78$ cu.ft.

$$\frac{2.78 \text{ cu.ft. (Space occupied by 64 lb., Gross Wt of fresh cabbage and crate)} - 1 \text{ cu.ft. (Space occupied/case of dehydrate)}}{2.78 \text{ cu. ft.}} \times 100 = 64\% \text{ saving in storage space}$$

Naval Supply Research and Development Facility, Bayonne, N. J.

THE EVALUATION OF DEHYDRATED RAW CABBAGE FOR NAVY USE, by B. S. MacNulty. Oct. 1962. 14 p. App. A-D figs. tabs.

A study was conducted to compare dehydrated raw cabbage with fresh cabbage and to determine the suitability of the dehydrate for Navy use. The dehydrate failed to comply with Mil. Spec. MIL-C-826A. It lacked desirable "eye appeal," flavor and texture and was not comparable organoleptically with fresh cabbage. One pound of dehydrate was found to be equivalent to 9.2 pounds of fresh cabbage, (A.P.) and when substituted for the fresh it offered substantial saving in weight and space.

The dehydrate was not considered satisfactory for Navy use. It was recommended that the dehydrated cabbage available at present continue to be utilized; and that the Facility continue to evaluate dehydrated cabbage products as they become commercially available.

1. Cabbage (Dehydrated)—Test methods
2. Rations (Military)

I. Title

II. NT F015-13-002-63-45

III. System No. 2262-04945-2

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