

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

AD-A234 378

1b. RESTRICTIVE MARKINGS

3. DISTRIBUTION/AVAILABILITY OF REPORT

Approved for public release;
distribution unlimited

5. MONITORING ORGANIZATION REPORT NUMBER(S)

6. PERFORMING ORGANIZATION REPORT NUMBER(S)

6a. NAME OF PERFORMING ORGANIZATION
National Academy of Sciences
National Research Council6b. OFFICE SYMBOL
(If applicable)

7a. NAME OF MONITORING ORGANIZATION

6c. ADDRESS (City, State, and ZIP Code)

Washington, DC 20418

7b. ADDRESS (City, State, and ZIP Code)

8a. NAME OF FUNDING/SPONSORING
ORGANIZATION U.S. Army Medical
Research & Development Command8b. OFFICE SYMBOL
(If applicable)

9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER

Grant No. DAMD17-86-G-6036

8c. ADDRESS (City, State, and ZIP Code)

Fort Detrick
Frederick, Maryland 21702

10. SOURCE OF FUNDING NUMBERS

PROGRAM
ELEMENT NO.
62787APROJECT
NO. 3M1
62787A879TASK
NO.
BJWORK UNIT
ACCESSION NO.
WUDA311667

11. TITLE (Include Security Classification)

Continuing Support of a Committee on Military Nutrition Research

Title of Special Report (The Long Life Ration Packet)

12. PERSONAL AUTHOR(S)

Sushma Palmer

13a. TYPE OF REPORT

Special Report

13b. TIME COVERED

FROM _____ TO _____

14. DATE OF REPORT (Year, Month, Day)

February 18, 1991

15. PAGE COUNT

16. SUPPLEMENTARY NOTATION

17. COSATI CODES

FIELD	GROUP	SUB-GROUP
06	08	
06	10	

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)

Nutrition & Function; Environment; Physiology; Nutrient
Requirements; Work Performance; Cognitive Performance; RAI111

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT

☐ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT ☐ DTIC USERS

21. ABSTRACT SECURITY CLASSIFICATION

22a. NAME OF RESPONSIBLE INDIVIDUAL

Mrs. Virginia M. Miller

22b. TELEPHONE (Include Area Code)

301/663-7325

22c. OFFICE SYMBOL

SGRD-RMT-S

1

The Long Life Ration Packet

(LLRP)

Committee on Military Nutrition Research

Food and Nutrition Board

Institute of Medicine

Washington, D.C.

91 4 04 015

The Long Life Ration Packet

(LLRP)

A Brief Report Submitted by
The Committee on Military Nutrition Research
Food and Nutrition Board
Institute of Medicine

to

Major General Richard T. Travis
Commanding General
U.S. Army Medical Research and Development Command

February 18, 1991

Produced under grant number DAMD17-86-G-6036/R between the National Academy of Science and the U.S. Army Medical Research and Development Command.



NOTICE: The project that is the subject of this report was approved by the Governing Board of the National Research Council, whose members are drawn from the councils of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. The members of the committee responsible for the report were chosen for their special competencies and with regard for appropriate balance.

This report has been reviewed by a group other than the authors according to procedures approved by a Report Review Committee consisting of members of the National Academy of Sciences, the National Academy of Engineering and the Institute of Medicine.

The Institute of Medicine was chartered in 1970 by the National Academy of Sciences to enlist distinguished members of the appropriate professions in the examination of policy matters pertaining to the health of the public. In this, the Institute acts under both the Academy's 1863 congressional charter responsibility to be an advisor to the federal government and its own initiative in identifying issues of medical care, research, and education. Dr. Samuel O. Thier is President of the Institute of Medicine.

Publication IOM-91-03

The Long Life Ration Packet (LLRP)

Introduction and Background

The Committee on Military Nutrition Research (CMNR) (See committee roster in Appendix I) was asked by the U.S. Army Research Institute of Environmental Medicine (USARIEM) to review and comment on the nutritional adequacy of the Long Life Ration Packet (LLRP) under development by the U.S. Army Natick Research Development and Engineering Center (USANRDEC). At the June 28, 1990 CMNR meeting at Natick, Massachusetts information concerning the development of LLRP was presented to the committee. Copies of the briefing material received by the Committee are included in Appendix II.

In summary, the U.S. Army Quartermaster Center and School (PROV)(QMC&S) identified a need for an extended life operational ration that will be the primary assault/patrol and Pre-Positioned War Reserve Stocks (PWRS) ration. This extended life ration would be used during the initial ten days of conflict. The extended life capability of this ration would resolve current deficiencies noted in the Army's ability to rotate existing PWRS rations in a timely and cost effective manner. The LLRP will draw components from existing military rations, for example, from the Food Packet, Long Range Patrol; the Food Packet, Assault (FPA) and the Ration, Cold Weather (RCW). A description of these rations is provided in Appendix IIe. The expected shelf life of the LLRP would be ten years and it would thus meet many of the PWRS requirements with minimum rotation and restocking. The LLRP would also become the go-to-war ration for consumption from days one to ten (D+1 to D+10). It would be issued at one or two a day and then the Meals Ready to Eat (MRE) would be phased in as rear support becomes established. The LLRP would be compatible in terms of calories and other nutritional factors with the MRE to allow development of menu mixes to achieve acceptable interchange of the two rations.

The LLRP product presented to the Committee on Military Nutrition Research was shown to have reasonable troop acceptance, was inexpensive (approximately \$4.40), and had a projected ten year shelf life. The LLRP is provided in several menu forms each containing a dehydrated entree, a cereal bar, a cookie component, a candy component, an instant beverage and an accessory packet. It weighs less than one pound for an individual meal. The product under current development was projected to meet the specifications required and would thus reduce the logistical burden to the military of maintaining the PWRS as well as allowing reduced long term storage of the MRE's resulting in fresher, higher quality stocks of this ration.

Committee Recommendations

1. The Committee on Military Nutrition Research is of the opinion that the LLRP should be nutritionally equivalent, in terms of nutrient content on a calorie basis, to the MRE or to the Military Recommended Dietary Allowances (MRDA) for restricted rations. Further, the stability of the nutrients in the LLRP and its components over the anticipated shelf life (i.e., 10 years) should be established.

2. The Committee could not assess the nutrient adequacy of the five LLRP menus described to them. The Committee recommends that the nutrient profiles of these menus be determined and compared on a calorie basis, to the MRDA standards. An appropriate fortification strategy should be developed to address any observed discrepancies. The importance of providing at least 100 grams of carbohydrate in the ration is emphasized to help prevent ketosis when consuming a restricted level of calories. Consideration must be given to the ability of this ration to support soldiers' needs in a heavy work environment and the Committee on Military Nutrition Research recommends that this is best accomplished by conducting carefully designed field trials using the LLRP menus. The CMNR further recommends careful evaluation of an optimum ratio of carbohydrate, fat and protein that includes previous findings from research at USARIEM on increased carbohydrate calories and performance under varied altitudes and climatic conditions.

3. The Committee on Military Nutrition Research (CMNR) particularly noted that one of the requirements for the Long-Life Ration Packet was a 10 year shelf-life. The desirability of a long storage life for the LLRP is obvious. Minimizing ration rotation and restocking is important from a logistical and financial point of view. However, it is imperative to demonstrate that this long shelf life (i.e., 10 years) can be achieved while maintaining the stated nutritional objectives of LLRP. The CMNR wishes to emphasize the importance of an adequate quality assurance program to be certain that the ration delivers not only an adequate level of acceptance as verified with field trials but most importantly, the level of nutrients specified at the time of use which may be as long as 10 years following manufacture. This is viewed as very important as it is likely that this ration will constitute the only source of nutrition in the early phases of a military operation and its use could be continued for periods of several days and though not planned, extend for several weeks.

The CMNR has on at least three occasions¹ emphasized the importance of an appropriate surveillance program to document that rations planned for long periods of storage adequately meet the nutritional criteria not only at the time of manufacture but through long term storage. Storage evaluations should include exposure to the environmental extremes that may occur prior to actual use in military feeding. Accomplishing this will require repeated nutrient analysis of specific lots of LLRP components over a 10+ year period. This will establish the rates of change for specific nutrients and any needed formulation changes.

An effective quality assurance program starts at the time of ration development and is continued through ration procurement and storage under actual field conditions. While laboratory accelerated storage tests are important, periodic evaluation based on analysis of nutrient composition and organoleptic characteristics over the planned shelf life is essential to assure that a nutritionally adequate and acceptable ration is available when actually put to use.

Generally, chemical analysis of foods provides an acceptable measure of nutritional quality. Such conclusions assume that the nutrients are biologically available. This is a reasonable conclusion, as a general rule. However, in formulating rations and components of rations for extremely long shelf life and to survive environmental extremes, new or different technologies may be applied which could alter bioavailability. For example, chocolate coatings used in such rations are likely to have high melting points and hence be less digestible than coatings of lower melting points. This could significantly reduce available calories. Similarly, encapsulation of vitamins could be used to minimize loss in storage. Some encapsulating systems may protect the vitamin but also reduce its bioavailability. Consequently the committee believes it is desirable to assure the bioavailability of nutrients through appropriately designed animal tests.

4. The CMNR recommends that current Quality Assurance programs for other long shelf-life rations be examined to ascertain their adequacy in providing assurance that ration quality including nutrient content is maintained to the time of actual use by military personnel in the field.

1- Please note the comments in the Annual Reports of the CMNR for the year September 30, 1982 to September 29, 1983 (Pages 7 and 8); for the period September 30, 1983 to September 30, 1985 (Page 15) and the Annual Report for the period August 1, 1985 to July 31, 1986 (Page 8 and Appendix D page 25). Excerpts from these reports are included in Appendix III.

5. Instructions for rehydration of the entree should stress the use of potable water. The CMNR further suggests that instructions for use of the LLRP and other rations should be periodically reviewed for clarity and accuracy.

In conclusion, the Committee on Military Nutrition Research is pleased to provide these recommendations as part of its ongoing activities in assisting the Nutrition Division of USARIEM to assure the nutritional adequacy of combat rations.

APPENDICES

- Appendix I.** Roster: Committee on Military Nutrition Research
- Appendix II.** Agenda, Information Papers, military reference reports, and Presentation Graphics pertaining to The Long Life Ration Packet from the Committee on Military Nutrition Research meeting held June 28-29, 1990
- Appendix III.** Selected excerpts from reports of the CMNR pertaining to the need for surveillance programs to monitor the nutrient content of long life rations

CONTENTS OF APPENDIX I

**Current Roster
Committee on Military Nutrition Research (CMNR)**

COMMITTEE ON MILITARY NUTRITION RESEARCH

Robert O. Nesheim, Ph.D.
(Chairman)
President
Advanced Healthcare, Inc.
Monterey, CA

Richard Atkinson, M.D.
Professor of Internal Medicine
VA Medical Center
Hampton, VA

Andre Bensadoun, Ph.D.
Professor of Nutritional Biochemistry
Division of Nutrition Science
Cornell University

William Evans, Ph.D.
Chief, Human Physiology
USDA, Human Nutri. Center on Aging
Tufts University

Joel Grinker, Ph.D.
Program and Human Nutrition
School of Public Health
University of Michigan

Edward Horton, M.D.
Professor and Chairman, Medicine
Un. of Vermont, Coll. of Medicine

Richard Jansen, Ph.D.
Professor and Head, Dept of
Food Science and Human Nutrition
Colorado State University

Gilbert Leveille, Ph.D.
Staff Vice President, Science
Nabisco Brands Incorporated

John A. Milner, Ph.D.
Department of Nutrition
Penn State University

John Vanderveen, Ph.D.
Director, Division of Nutrition
Food and Drug Administration

ARMY Liaison:
COL E. Wayne Askew, Ph.D.
U.S. Army Research Institute
of Environmental Medicine
Natick, MA

FNB Staff:
Bernadette M. Marriott, Ph.D.
Program Director
Pamela Turner
Acting Senior Secretary

2/15/91

CONTENTS OF APPENDIX II

Committee on Military Nutrition Research Meeting June 28-29, 1990

- Ila - Agenda and List of Committee Participants**
- Ilb - Information Paper: Longlife Ration Packet (LRP) 21 March 1990**
- Ilc - Information Paper: Long Life Ration Packet (LLRP) 15 June 1990**
- Ild - Sample Long Life Ration Packet Menus as of June 28, 1990**
- Ile - Operational Rations, Current and Future of the Department of Defense,
 U.S. Army Natick Research and Development Laboratories, Natick,
 Massachusetts, January, 1983.**

APPENDIX IIa.

Agenda and List of Committee Participants

FINAL AGENDA

COMMITTEE ON MILITARY NUTRITION RESEARCH U.S. ARMY RESEARCH INSTITUTE OF ENVIRONMENTAL MEDICINE NATICK, MASSACHUSETTS

JUNE 28 - 29, 1990

Thursday, June 28:

**Food Engineering Directorate
Conference Room - Building E-100**

8:00 AM	Meet in hotel lobby for transportation to USARIEM
8:30 - 8:45	Welcome to USARIEM - Col. Joseph Denniston, Commander
8:45 - 9:00	Chairman's remarks, review of status of committee work and plan for the meeting - Robert O. Nesheim, Ph.D.
9:00 - 9:45	Physiological Considerations for Design of Survival Rations and an Historical Perspective - R. E. Johnson, M.D., D.D. Phil.
9:45 - 11:00	New Generation Survival Ration - Presentations by staff of the Food Engineering Directorate, NRDEC and discussion
11:00 - 12:00	Long Life Ration Packet (LRPII) - Presentations by staff of the Food Engineering Directorate, NRDEC and discussion
12:00 - 1:00	Luncheon: Committee will have opportunity to sample the rations
1:00 - 2:30	Alaska Cold Weather Comparison of MRE VIII + Supplemental Packet versus the Ration, Cold Weather - Lt.Col. John Edwards, Ph.D., Military Nutrition Division, USARIEM
2:30 - 2:45	Reconstituted Milk Processing Enhancements - Andre Senecal, Food Engineering Directorate, NRDEC
2:45 - 3:15	Army Nutrition Initiatives: Follow-up Discussion
3:15 - 4:00	Discussion of Plans to Review and Revise the MRDA's (AR 40-25, Nutritional Standards and Allowances) - Background information presentation - Lt.Col. Eldon W. Askew, Ph.D., Director, Division of Military Nutrition, USARIEM
4:00 - 4:30	Optional Informal Tour of Research Facilities
6:30	Pick-up at hotel for dinner
7:00	No host Dinner at Finnerty's, Wayland, Massachusetts

Friday, June 29:

Executive Session of the Committee

COMMITTEE ON MILITARY NUTRITION RESEARCH
Conference June 28-29, 1990
Committee Participants

Robert O. Nesheim, Ph.D.
Chairman)
resident
Advanced Healthcare, Inc.
Monterey, CA

Richard Atkinson, M.D.
Professor of Internal Medicine
VA Medical Center
Hampton, VA

Andre Bensadoun, Ph.D.
Professor of Nutrition Biochemistry
Division of Nutrition Science
Cornell University

Joel Grinker, Ph.D.
Program and Human Nutrition
School of Public Health
University of Michigan

Edward Horton, M.D.
Professor and Chairman, Medicine
Un. of Vermont, Coll. of Medicine

Villiam Evans, Ph.D.
Chief, Human Physiology
USDA, Human Nutri. Center on Aging
Tufts University

Janet C. King, Ph.D.
Professor of Nutrition
Dept of Nutrition Science
University of California, Berkeley

Hilbert Leveille, Ph.D.
Staff Vice President, Science
Fabisco Brands Incorporated

John Vanderveen, Ph.D.
Director, Division of Nutrition
Food and Drug Administration

NRC Staff:
Bernadette Marriott, Ph. D.
Nancy J. Fox
202/334-1740 FAX 202/334-2939

ARMY Liaison:
LTC E. Wayne Askew, Ph.D.
U.S. Army Research Institute
of Environmental Medicine
Natick, MA

Not able to attend:

John Kinsella, Ph.D.
Dept of Food Science
Cornell University

Richard Jansen, Ph.D.
Professor and Head, Dept of
Food Science and Human Nutrition
Colorado State University

APPENDIX IIb.

**Information Paper:
The Longlife Ration Packet (LRP)
(March 21, 1990)**

INFORMATION PAPER

SUBJECT: Longlife Ration Packet (LRP)

FACTS:

- The U.S. Army Quartermaster Center and School (PROV) (QMC&S) identified a need for an extended life operational ration that will be the primary assault/patrol and Pre-Positioned War Reserve Stocks (PWRS) ration. This extended life ration (ten year shelf life) will be used during the initial ten days of conflict (D+1 thru D+10). The extended life capability of this ration will resolve current deficiencies noted in the Army's ability to rotate existing PWRS rations in a timely and cost effective manner.
- The LRP will take advantage of current state of production technology. By using the LRP as the primary PWRS operational ration, significant savings will be realized as a result of its extended storage life characteristics.
 - The LRP will reduce the burden of maintaining a ration with a shorter shelf life in the PWRS and will thus greatly decrease the associated transportation, storage, and handling costs.
 - The LRP will allow soldiers to enjoy fresher, higher quality Meal, Ready-to-Eat (MREs) at current Army consumption rates due to reduced long term storage of MREs.
 - MRE enhancements/improvements will be in the hands of the soldier much quicker due to reduced long term storage of MREs.
 - The LRP can resolve all cold weather individual operational ration problems and would allow for PWRS storage in cold regions of a ration that would be suitable for operations in all seasons and climatic environments.
- The U.S. Army Natick Research, Development and Engineering Center developed the concept for the LRP that meets the QMC&S requirements. The LRP characteristics are as follows:
 - c Possesses a proven high troop acceptance.
 - Is inexpensive (approximately \$4.40).
 - Has a proven ten year shelf life.

- o Satisfies the MRDA, to include extreme cold weather requirements (1,500 + calories/meal).
 - o Is lightweight (less than one pound/meal).
 - o Will reduce to a highly significant degree the logistical burden of maintaining operational ration PWRS.
 - o Will allow troops to enjoy fresher, higher quality MREs at current annual consumption rates due to reduced long term storage of MREs.
 - o Allows MRE improvements to be rapidly fielded, again due to more rapid turnover of smaller quantities of MRE stocks.
 - o For an equal number of meals, more than halves the required cube and weight of war reserve stocks of individual meals. Over a ten year life cycle, the financial savings in transportation, storage, and handling costs due to this weight and space reduction would be enormous.
- O Each meal consists of a dehydrated entree which may be eaten as is or rapidly reconstituted with either hot or cold water; other low moisture ready-to-eat foods and several instant beverage powders that have demonstrated acceptance and shelf life through field testing.
- O The technical bases for the IRP are the demonstrated producibility and acceptance of the Food Packet, Long Range Patrol over a 17 year period and the extensive research and development efforts for the Food Packet, Assault (FPA) and Ration Cold Weather (RCW) carried out over a ten year period. The technologies for these ration systems are still valid and offer a beneficial edge in fielding this proposed ration for assault feeding.
- O A key issue to address under this program is timeliness. With the discontinuation of the FPA which replaced the highly popular Food Packet, Long Range Patrol, the military is left without an assault or short duration, lightweight ration for general field use. This void can be filled immediately.
- O A significant feature of this proposal is its impact on PWRS; with a ten year shelf life at normal temperatures, the IRP would be the only PWRS needed. MREs would not have to be stored for lengthy periods and rotational requirements could be established to assure

that high quality rations would be issued. The IRP would become our go-to-war ration for consumption from D+1 to D+10 (or longer). This could be issued at one or two per day and then the MRE would be phased in as rear support becomes established. The IRP would be compatible in terms of calories and other nutritional factors with the MRE to allow development of menu mixes to achieve acceptable interchange of the two rations.

- O Evaluations of the MRE FWRS levels are being conducted. For the European theater, it requires four and one half years to rotate the MRE in storage. Many of the MRE components show a significant degradation of quality when stored for more than three years; i.e. they are serviceable but not necessarily acceptable. The data of stockage level versus shelf life based on the current consumption of 600,000/year has been collected. If FWRS were stocked at required levels (4.6 M), it would take 8.6 years to rotate the MREs. The shelf life of MRE's would be exceeded and stock rotation at the current levels would only assure that some troops would be issued low quality, overaged products. Extension of the equation to a ten year shelf life would reduce the required consumption level to below 250,000/year for rotating FWRS in Europe. This in effect would reduce the cost of war stockage by 60 percent while at the same time assure supply of high quality MREs.
- O Logistically, in excess of 2.6 million cubic feet of storage space could be eliminated due to the IRP's low weight and volume and its operational usage level of one per day per man. This would be a significant savings in storage cost.
- O For cold weather feeding, a similar configuration of the IRP to the originally proposed arctic ration (two FPA's and an arctic supplement) would resolve most cold weather individual feeding problems. Two IRPs and an arctic supplement of 1,500 calories (or three IRPs) would provide the necessary 4,500 calories. The supplement packet could be issued with MRE's to provide an arctic ration configured with MRE menu items. This would allow prepositioning in cold regions of war reserves that would also be suitable for operations in all seasons.
- O For rapid deployment to meet world-wide emergencies, the low volume and weight of the IRP can conserve a significant amount of already critically limited airlift.

APPENDIX IIc.

**Information Paper:
The Long Life Ration Packet (LLRP)
(June 15, 1990)**

INFORMATION PAPER

SUBJECT: Long Life Ration Packet (LLRP)

BACKGROUND:

- O The U.S. Army Quartermaster Center and School (PROV) (QMC&S) identified a need for an extended life operational ration that will be the primary assault/patrol and Pre-Positioned War Reserve Stocks (PWRS) ration. This extended life ration will be used during the initial ten days of conflict. The extended life capability of this ration will resolve current deficiencies noted in the Army's ability to rotate existing PWRS rations in a timely and cost effective manner.

FACTS:

- O The LLRP will take advantage of current state of production technology by drawing components from existing military ration items. Demonstrated producibility and acceptance of components from the Food Packet, Long Range Patrol, the Food Packet, Assault (FPA) and the Ration, Cold Weather (RCW) offer a beneficial edge in fielding this proposed ration for assault feeding.
- O The significant feature of the LLRP is its impact on PWRS; with a probable ten year shelf life at normal temperatures, it would meet a considerable proportion of the PWRS requirements with minimum rotation and restocking. The LLRP would also become the go-to-war ration for consumption from D+1 to D+10. It could be assured at one or two a day and then the MRE would be phased in as rear support becomes established. The LLRP would be compatible in terms of calories and other nutritional factors with the MRE to allow development menu mixes to achieve acceptable interchange of the two rations.
- O The LLRP characteristics are as follows:
 - oo Possesses a proven high troop acceptance.
 - oo Is inexpensive (approximately \$4.40).
 - oo Has a ten year shelf life.
 - oo Satisfies the MRDA for restricted ration (1500 kcal/day).
 - oo Less than one pound per individual meal.
 - oo Reduces the logistical burden of maintaining PWRS.
 - oo Allows reduced long term storage of MREs resulting in fresher, higher quality food for the soldier.
 - oo Contains a dehydrated entree, a cereal bar, a cookie component, a candy component, an instant beverage and accessory packet.
- O Field testing of prototype LLRP scheduled for 4Q90 using Fort Drum LRP troops.
- O In-Process Review for acceptance of LLRP projected for 1Q92.

VICKI A. LOVERIDGE/AV 256-5035

APPENDIX IIId.

**Long Life Ration Packet:
Sample Menus
as of 28 June 1990**

LONG LIFE RATION PACKET 1990

AS OF: 28-Jun-90

MENU 1

	weight (g)	kcal
Chicken Stew	140	605
Cornflake bar	43	201
Oatmeal cookie bar	50	241
Tootsie roll	57	239
Cider drink mix	50	202
Coffee, cream and sugar	13	52
Total	353	1540

MENU 2

Beef Stew	140	692
Granola bar	43	209
Chocolate covered cookie	43	226
Caramels	35	149
Cocoa	43	192
Coffee, cream and sugar	13	52
Total	317	1520

MENU 3

Escalloped Potato and Pork	140	617
Cornflake and Rice Bar	43	201
Fig Bar	58	224
Chocolate bar w/Toffee	56	296
Cider drink mix	50	202
Coffee, cream and sugar	13	52
Total	360	1592

MENU 4

Chicken ala King	140	679
Cornflake bar	43	201
Chocolate covered cookie	43	226
Starch Jellies	57	213
Orange beverage	60	236
Coffee, cream and sugar	13	52
Total	356	1607

MENU 5

Chicken and Rice	140	682
Granola bar	43	209
Chocolate covered brownie	50	267
Starch Jellies	57	213
Lemon tea	28	116
Coffee, cream and sugar	13	52
Total	331	1539

MENU 6

Spag/w Meat Sauce	140	717
Cornflake and Rice bar	43	201
Oatmeal cookie bar	50	241
Tootsie roll	57	239
Beverage base (MRE)	34	150
Coffee, cream and sugar	13	52
Total	337	1600

MENU 7

Chili con Carne	140	693
Granola bar	43	209
Chocolate covered brownie	50	267
Charms	28	113
Orange beverage	60	236
Coffee, cream and sugar	13	52
Total	321	1570

MENU 8

Beef and Rice	140	730
Cornflake bar	43	201
Fig bar	58	224
M&Ms	48	240
Lemon tea	28	116
Coffee, cream and sugar	13	52
Total	330	1563

APPENDIX IIe.

**Operational Rations, Current and Future of the Department of Defense,
U.S. Army Natick Research and Development Laboratories,
Natick, Massachusetts.
January, 1983.**



OPERATIONAL RATIONS

**CURRENT AND FUTURE
OF THE
DEPARTMENT OF DEFENSE**

JANUARY 1983

**US ARMY NATICK
RESEARCH AND DEVELOPMENT
LABORATORIES
NATICK, MASSACHUSETTS 01760**

PREFACE

The US Army Natick Research and Development Laboratories (NLABS), located at Natick, Massachusetts, is responsible for research, development, and technical support of rations and subsistence items for all components of the Department of Defense. The operational rations that are now available to meet Military Service needs through NLABS' execution of this responsibility, together with those presently under development, are described in the following pages. Also included is a *brief review of past operational rations*, most of which were developed at NLABS' predecessor organization, the Quartermaster Food & Container Institute for the Armed Forces (originally, the QM Subsistence Research Laboratory), located in Chicago, Illinois until 1963.

CONTENTS

Preface	1
Introduction	5
General Operational Rations	10
Standard B Ration	10
Meal, Combat, Individual	12
Meal, Ready-to-Eat, Individual	14
Special Operational Subsistence	16
Food Packet, In-Flight, Individual	16
Food Packet, Long Range Patrol	18
Ration Supplement, Sundries Pack	20
Ration Supplement, Beverage Pack	22
Ration Supplement, Aid Station	23
Survival Subsistence	24
Food Packet, Survival, General Purpose	24
Food Packet, Survival, Abandon Ship	26
Food Packet, Survival, Aircraft, Life Raft	27
Future Feeding Concepts	28
Food Packet, Assault	28
Ration, Arctic	30
T-Ration (Tray Packs)	32
Historical Summary	34

INTRODUCTION

Since the revision of "Operational Rations Current and Future of the Department of Defense" in 1970, significant changes have been made to match the pace of changing military requirements. These have been accomplished through continuing effort in the field of food and packaging and the continual improvement of existing component items.

As we follow the evolution of the Armed Forces operational rations through the history of the United States, we find that, from the Revolutionary War through the Civil War and on to World War I, the basic military ration was composed of meat, bread, and beans. Changes were few and in the main were inspired by changes in the national food pattern — the increasing use of canned foods, for example. The soldier generally received his allowance of one to four days' rations at one time. These he either prepared by himself or pooled with those of a buddy who assisted in the preparation. That portion not immediately consumed was transported in his rucksack, or saddle bag, until the next meal.

The first of the Army Rations was established by Congressional Resolution on November 4, 1775:

Resolved, that a ration consists of the following kind and quantity of provisions: 1 lb. beef or 3/4 lb. pork, or 1 lb. salt fish per day; 1 lb. bread or flour, per day; 3 pints of peas or beans; 1 pint of milk per

man per day, or at the rate of 1/72 of a dollar; 1 half pint of rice or one pint of Indian meal, per man per day; 1 quart of spruce beer or cider per man per day, or 9 gallons of molasses per company of 100 men per week; 3 lbs. candles to 100 men per week, for guards; 24 lbs. soft or 8 lbs. hard soap, for 100 men per week.

The ration for U.S. troops in the Civil War was little improved over that of the Revolutionary War. Added, however, were coffee, tea, seasonings, and potatoes *when practicable*. This Civil War Ration was estimated to have cost 15 cents per man per day — in contrast to the Field Ration (A Ration) cost of \$3.53 per man per day as of September 1982. Preparation of the food and subsistence of the troops, however, was accomplished for whole companies rather than for individuals. In 1896 an individual Emergency (*Haversack*) Ration was established and subsequently followed by additional special rations. In 1901 the rations consisted of the Garrison, Emergency, Field, and Travel rations. When World War I began, the Field Ration had been replaced by the Reserve Ration. By 1918 the ration structure included the Garrison and Field rations, both with authorized substitutes, as well as the Reserve, Special Reserve, Travel, and Emergency rations.

The Reserve Ration, intended for individual use, provided one pound each of canned meat and hard bread, with coffee, salt, sugar, a cube of soup, and solidified alcohol. Each ration furnished approximately 3,300 calories in a gross weight of 2½ pounds. The Special Reserve, or *Trench*, Ration was designed to subsist 25 men per day. It was hermetically sealed in galvanized iron containers to protect against gas contamination and weighed 107 pounds. Both were to be supplemented with field ration components whenever possible. The Emergency Ration contained three 3-ounce cakes of beef powder and cooked wheat and three 1-ounce chocolate bars.

The development of operational rations used in World War II, Korea, and (in improved form) today began in 1934 when the Quartermaster Corps undertook the development of a ration to replace the old emergency ration. This replacement, subsequently designated the D Ration, was developed in Chicago by a predecessor agency of the Quartermaster Food and Container Institute for the Armed Forces. During the period 1941–1945, 23 different rations and ration supplements were developed for use by U.S. Armed Forces throughout the world. The most famous were the D Bar, C Ration, and K Ration.

Military nutritional requirements and subsistence situations have not changed basically since the days of Hannibal and Genghis Khan. Essentially, it has always been necessary to supply rations on the basis of (1) the individual, (2) the small group (squad or crews), and (3) the large group (company size or larger).

Conceding these basic situations, it is found that modern concepts of ration design have changed considerably to accommodate increasing demands for greater mobility and dispersion of combat forces and greater acceptability and convenience in military foods. To assure utility under anticipated future combat conditions, all rations must be minimal not only in cube and weight, but also in manpower and equipment requirements associated with their supply, storage, issue, and preparation. Requirements for nutritional adequacy, acceptability, and stability, however, remain relatively unchanged. To fulfill current and future operational ration requirements, off-the-shelf, conventional foods would be quite inadequate. Needed are foods preserved and packaged by new and ingenious methods. Consequently, the resources of modern science and technology are drawn upon all the way from design to finished product. New technologies have been brought to bear on foods for military use — for example, freeze-dehydration, reversible compression, and heat-processing in flexible pouches.

To stay abreast of new concepts and techniques of warfare, rations and feeding systems are under the constant scrutiny of the military analyst. The military and civilian food and packaging and packing research specialists are continually seeking component and design improvements as well as completely new and revolutionary ideas. As new requirements in military subsistence operations become evident, or as advances are made in experimental work leading to new or improved items, rations and/or entire concepts may be changed to reflect these advances. Typical of the ration modernization program designed to improve the individual feeding situation is the development of the Meal, Combat, Individual, followed by the Meal, Ready-to-Eat, Individual, as replacements for the C Ration (Ration, Individual, Combat). The Meal, Ready-to-Eat, Individual more closely fits the requirements of current operational concepts. It has the desired flexibility of use compatible with those concepts and may, in turn, be replaced in the future as technological capabilities increase by a lighter weight, less bulky packaged meal.

To meet food needs under the various conditions imposed by modern land, sea, and air operations, new approaches have been taken to insure feeding systems of greater logistical flexibility and simplicity. This has resulted in the design, for instance, of nutritionally interchangeable meals. To fully understand the advantages accruing from this design, one must first consider the limitations imposed by the use of the ration system.

As noted below, a ration consists of food for one man for one day and therefore must contain a minimum 3,200 calories as well as prescribed levels of the dietary nutrients essential to nutritional balance. An obvious limitation is that the entire ration must be eaten during the course of the day in order to maintain that balance. This means that one ration, if packaged as such, cannot be broken down into three basically interchangeable units as is the case in the system of nutritionally interchangeable meal families. Demands of modern warfare call for greater flexibility.

The purpose of this publication is to provide the essential facts pertaining to operational rations, food packets, and ration supplements used by the Armed Forces. Current design data and operational use concepts are also included. In the interest of clarity and mutual understanding, the terms describing various assemblies of food components are defined as follows:

A *ration* is the allowance of food for one person for one day as prescribed by military regulations. Rations are designed for group and/or individual feeding and must be nutritionally adequate.

A *meal* is a nutritionally balanced food unit consisting of approximately one-third of the prescribed daily requirement of a ration. Meals designed for use in the operational ration system are engineered to allow interchange with other operational meals while insuring nutritional adequacy. A combination of any three meals would constitute a ration as defined by Army regulations.

A *food packet* is a short-term source of nourishment for use in special operational situations. It consists of prepared foods, specially selected for maximum nutritional value, palatability, and stability commensurate with the requirements for minimum weight/cubage and other utility factors. One or more food packets do not necessarily constitute a nutritionally complete ration.

A *ration supplement* is a collection of food, beverage, condiment, or comfort items intended to add to the minimum essentials of a specific operational food item in terms of nutrition, palatability, and enhancement of morale.

To place these rations, meals, food packets, and ration supplements in proper perspective with relation to their intended use and to provide current data on the composition and status of each item, information is provided on (1) what items are currently available in the system, (2) where they are intended to be used, and (3) what items can be expected to be available in the future. This can best be presented by covering five broad categories:

- (1) General Operational Rations;
- (2) Special Operational Subsistence;
- (3) Survival Subsistence;
- (4) Future Feeding Concepts;
- (5) Historical Summary.

General Operational Rations. The need for an *operational* ration to subsist persons operating away from fixed feeding facilities and where supply lines are contested was recognized as early as pre-Revolutionary War days when our military action consisted principally of a guerrilla type of warfare on both land and sea. As will be evident, most operational rations and ration components have been designed to fulfill a general feeding requirement.

The items in this category — Ration and Meal — were designed to satisfy the feeding requirements dictated by the nature of the operation and its impact on the availability of food service personnel and equipment. These circumstances are paramount in defining subsistence situations and determining whether persons can be subsisted in groups or must carry, prepare, and eat food as individuals. The degree of flexibility allowed the commander in fulfilling his feeding requirement is dependent upon the type of operational ration available for his use.

Food items considered to fulfill general subsistence requirements may be used by all of the Armed Forces — Army, Navy, Marine Corps, and Air Force. These items are routinely procured and stocked.

Special Operational Subsistence. The various rations, packets and supplements classified and described in this group include those which, while authorized for use by all Services, are not routinely procured and stocked. Such items would, of course, be made available in the event of mobilization. Also included are those items authorized for limited or special purpose use, such as items developed to meet the specific requirements of one Service.

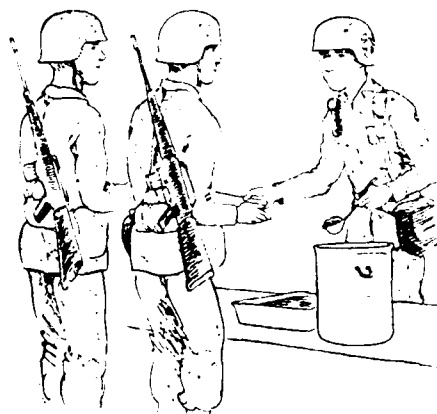
Survival Subsistence. Survival food packets are used only in emergency situations. Since the space provided for them aboard lifeboats and aircraft is extremely limited, the foods are highly concentrated. They are designed to fulfill one purpose — sustaining personnel during a period of emergency.

Future Feeding Concepts. Changing tactical and logistical requirements continue to mandate the simplification of logistics. Advances in food science and technology continue to increase our capability to respond to this challenge. Currently under development is a new family of *Tray Pack* products, heat-processed in rectangular, half-size steam table, multiserving metal cans. They require only heating and serving to furnish the basic components of hot meals. Tray Packs offer significant potential for simplifying future food service logistics. Development of a compact, lightweight food packet and a new ration for frigid conditions is an advance toward achieving significant reduction in both volume and weight of individually carried combat subsistence.

Historical Summary. Rations which have significantly affected those now in use, or which have been of some special interest in the past, are outlined in terms of their functions, contributions, and relationships to the present.

GENERAL OPERATIONAL RATIONS

STANDARD B RATION



The Standard B Ration is the field ration used for mass feeding where kitchen facilities, except for refrigeration, are available. It consists of approximately 100 so-called *nonperishable* items — mainly canned and dehydrated — and is supplied in bulk. Hot meals furnishing a minimum of 3200 calories per day for men and 2200 calories per day for women are prepared using a 10-day cycle of menus. Caloric content may be varied to meet requirements of varying climatic conditions and degree of physical activity of the troops as determined by the local medical authority.

The Hospital B Ration is planned for patients in military hospitals during operations in which the Standard B Ration is issued. The plan assumes that 70 percent of the hospitalized patients will subsist on the Standard B Ration, with about half of the remaining patients requiring solid or semi-solid foods and the balance liquid foods.

The Standard B Ration is currently under revision. Because Air Force mission requirements for the Standard B and Hospital B rations differ from those of the other Services, there will be separate Air Force publications for these.

Typical Menus

BREAKFAST

Tomato juice
Hot hominy grits
Scrambled eggs, Western
style
Bread
Margarine
Peanut butter
Grape jelly
Coffee
Cocoa

DINNER

Chicken pot pie
w/biscuit topping
Mashed potatoes
Buttered corn
Bread
Margarine
Yellow cake with
chocolate icing
Coffee
Tea
Orange beverage

SUPPER

Tomato vegetable soup
w/crackers
Fried fish squares
Macaroni and cheese
Buttered peas
Bread
Margarine
Fruit cocktail
Sugar cookies
Coffee
Tea
Fruit punch beverage

Gross weight/ration	3.639 pounds
Net weight/ration	3.086 pounds
Gross cube/ration	0.1173 cubic feet
Calories/ration	3900 approximately
B Ration described in	SB 10-495
	NAVSUP PUB 274
	MCO P10110.25C
	(Air Force)
	AFR 146-8

Hospital B Ration	SB 10-495-1
described in	NAVSUP PUB 436
	MCO P10110.26A
	(Air Force)
	AFR 166-4



STANDARD B RATION
100 PERSONS/ONE DAY

MEAL, COMBAT, INDIVIDUAL



The Meal, Combat, Individual was the first ration adopted to meet the subsistence concept of supplying nutritionally balanced meals rather than rations. It replaced the Ration, Combat, Individual (C Ration), which had replaced, but was similar to, the World War II C Ration.

The Meal, Combat, Individual was designed for issue as the tactical situation dictates, either in individual units as a meal or in multiples of three as a complete ration. Its characteristics emphasize utility, flexibility of use, and more variety of food components than were included in its predecessor, the Ration, Combat, Individual (C Ration). Twelve different menus are specified. Each contains one canned entree; one canned fruit or dessert; one B unit (with crackers and a cocoa beverage or candy); one can of spread (peanut butter, jam, or cheese); a plastic spoon; and an accessory packet holding coffee, cream substitute, sugar, salt, and chewing gum, along with matches and toilet paper. Each shipping case of 12 menus contains four can openers. Although the meat item can be eaten cold, it is more palatable when heated.

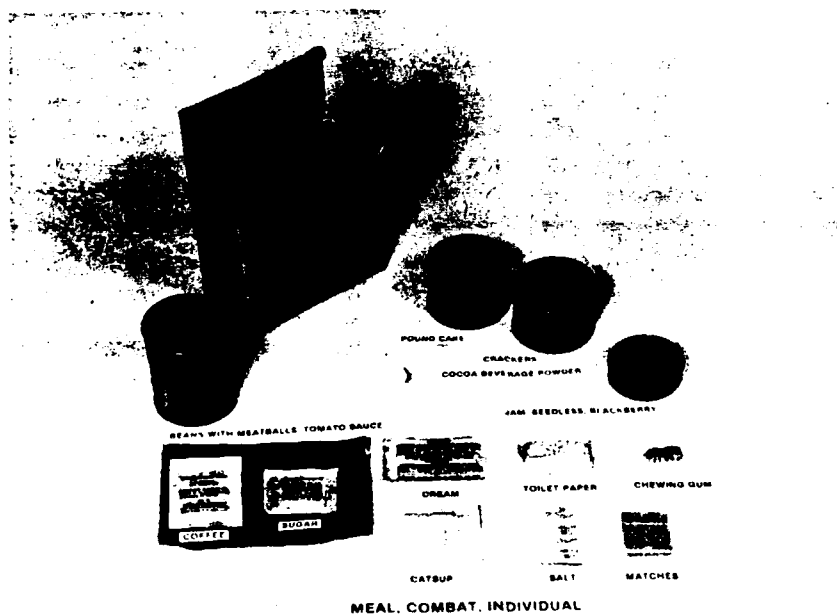
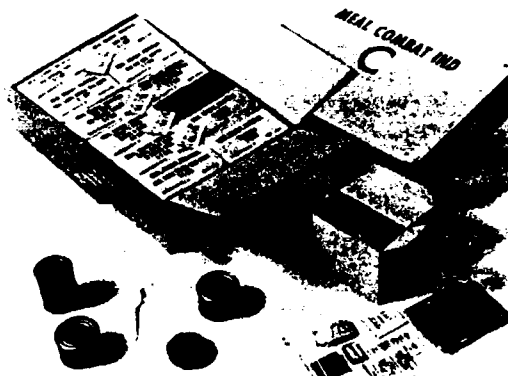
Each meal furnishes approximately one-third of the minimum nutrient intake prescribed by Army regulations.

Present stocks will be issued until depleted, when the Meal, Ready-to-Eat, Individual will be used.

Typical Menus

Beef with Spiced Sauce	Beef Slices & Potatoes	Boned Chicken
B-1 Unit	w/Gravy	B-3 Unit
Crackers (4)	Pecan Cake Roll	Crackers (4)
Candy Disc	B-2 Unit	Candy Discs (2)
Pears	Crackers (3)	Cheese Spread
Peanut Butter	Cocoa Beverage Powder	Peaches
Accessory Packet	Jam	Accessory Packet
	Accessory Packet	

Meals/case	12
Weight/case	25 pounds
Weight/meal (less shipping case)	1.81 pounds
Cube/case	0.80 cubic feet
Cube/meal	0.055 cubic feet
Calories/meal	1200 average
Specification	MIL-M-35048
NSN	8970-00-577-4513





MEAL, READY-TO-EAT, INDIVIDUAL

The Meal, Ready-to-Eat, Individual provides individual meals containing food components that are ready-to-eat and highly acceptable, even when consumed under conditions precluding preparation, except reconstitution of beverages. The Meal, Ready-to-Eat, Individual is suitable for use in the combat zone and under all circumstances where resupply is established or planned but operational conditions preclude other means of subsistence.

Like the Meal, Combat, Individual, the Meal, Ready-to-Eat, Individual has 12 menus; however the Meal, Ready-to-Eat has a greater variety of components. Each menu provides an entree (two of which are freeze dried), crackers, a spread (cheese, peanut butter, or jelly), a plastic spoon and an accessory packet. Six menus include fruits, six contain cakes; five provide chocolate covered brownies or cookies; three have beans in tomato sauce; two include freeze-dried potato patties; and seven have cocoa beverage powder. Each accessory packet contains coffee, cream substitute, sugar, salt, chewing gum, matches, and toilet tissue; depending on the menu, some accessory packets also include candy or an additional condiment or both (packets B, C, D, and E).

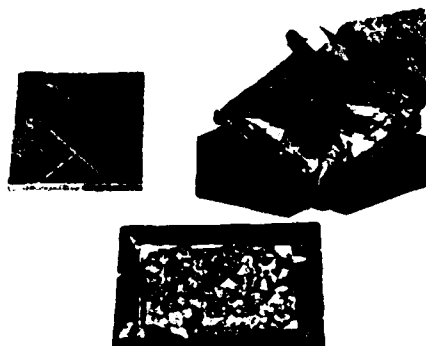
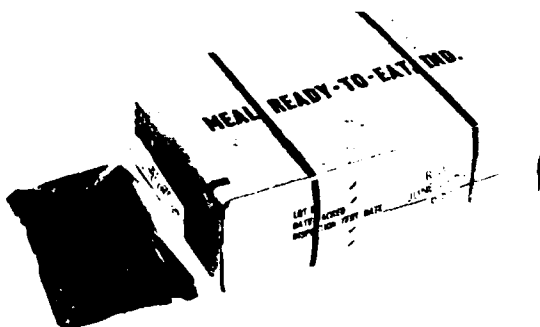
Typical Menus

Pork Patty (freeze-dried)
Applesauce
Crackers
Cheese Spread
Cookies
Cocoa Beverage Powder
Accessory Packet D
(catsup)

Beef Slices with
Barbecue sauce
Peaches (freeze-dried)
Crackers
Peanut Butter
Cookies
Accessory Packet C
(candy)

Beef Stew
Fruit Mix (freeze-dried)
Crackers
Peanut Butter
Cherry Nut Cake
Cocoa Beverage Powder
Accessory Packet A

Meals/case	12
Weight/case	16 pounds
Weight/meal	1.03 pounds,
(less shipping case)	approximately
Cube/case	0.9 cubic feet
Cube/meal	0.052 cubic feet
Calories/meal	1215 average
Specification	LP/P DES 33-74C
NSN	8970-00-149-1094



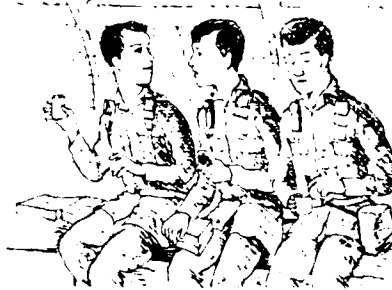
TYPICAL ENTREE



TYPICAL MENU

SPECIAL OPERATIONAL SUBSISTENCE

FOOD PACKET, IN-FLIGHT, INDIVIDUAL



The Food Packet, In-Flight, Individual furnishes food for use in subsisting Armed Forces personnel while on flights extending over one or more meal periods. Requirements for this food packet were established by the Air Force. The food packet consists principally of canned items — a meat, a fruit, juice, and a dessert — and an accessory packet including beverages. Ten menus are available.

On larger aircraft, special equipment is available for heating the meat and dessert items. However, all components can be eaten cold. Hot water is required for coffee and tea. The food is packaged in a telescoping container, which may be used as a tray and in which to dispose of waste.

This food packet is being replaced by the Meal, Ready-to-Eat, Individual.

Each menu contains one of each of the following commodity groups and all of the accessory items are listed below.

MEATS

Beef with Spiced Sauce
Beefsteak
Chicken and Noodles
Chicken or Turkey,
Boned

Ham and Eggs
Ham, Slices

Pork, Sliced
Spaghetti with Beef
Chunks in Sauce
Tuna Fish
Turkey Loaf

FRUITS

Apricots

Peaches

Pears

Fruit Cocktail

DESSERTS

Chocolate Nut Roll
Cookies

Fruitcake
Orange Nut Roll

Peacan Cake Roll
Pound Cake

JUICES

Grape

Grapefruit and Orange

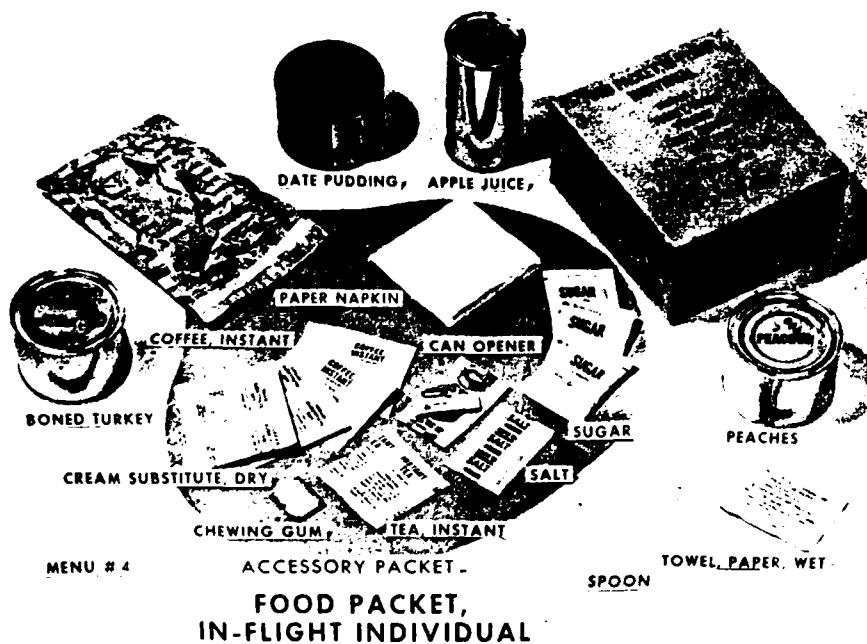
Orange

Tomato

ACCESSORY ITEMS

Instant Coffee	Gum	Spoon
Instant Tea or Tea	Salt	Instruction Sheet
with lemon and sugar	Napkins	Towel, Paper,
Cream Substitute	Can Opener	Cleansing, Wet
Sugar	Interdental Stimulator	

Packets/case	10
Weight/case	24 pounds (22 pounds net)
Weight/packet	2.2 pounds
Cube/case	0.63 cubic feet
Cube/packet	0.056 cubic feet
Calories/packet	1100 approximately
Specification	MIL-F-3764
NSN	8970-01-060-2899
	(10 packets per shipping box)
	8970-00-163-8871
	(20 packets per shipping box
	not authorized for future
	procurement)



**FOOD PACKET,
IN-FLIGHT INDIVIDUAL**

EARLY VERSION

FOOD PACKET, LONG-RANGE PATROL



Designed for troops in operations precluding resupply for periods up to ten days, the Food Packet, Long Range Patrol is the first flexibly packaged combat ration to enter the military supply system. In lightness, compaction, ease of carrying and use as well as versatility and utility in extended nonresupply operations, this food packet surpasses any packaged subsistence yet in the supply system. Its development took full advantage of available technological advances to accomplish.

The Food Packet, Long Range Patrol is based on a precooked freeze-dehydrated main dish in a reconstitution package. If conditions permit, the user can prepare a familiar and acceptable hot main course in seconds simply by adding hot water. If he is not in a situation where he can stop to heat water, he can rehydrate the main component in about five minutes in cold water or even eat it dry, like popcorn.

Other components include a plastic spoon, a confection, a cereal or fruitcake bar, coffee, cream, sugar, toilet paper, and matches. Some of the menus include cocoa beverage powder as well. There are eight menus; each furnishes over 1000 calories in an average gross weight of 11.3 ounces and volume of about 79 cubic inches.

Typical Menus

Beef Hash	Chicken Stew	Pork with Escalloped
Corn Flake Bar, Orange	Enriched Sweet Chocolate	Potatoes
Flavored	Bar with Almonds	Fruitcake Bar
Cocoa Beverage Powder	Coffee, Instant	Cocoa Beverage Powder
Coffee, Instant	Cream Substitute	Coffee, Instant
Cream Substitute	Sugar	Cream Substitute
Sugar		Sugar

Packets/case	40
Weight/case	36 pounds
Weight/packet (less shipping case)	0.70 pounds
Cube/case	1.84 cubic feet
Cube/packet	0.046 cubic feet
Calories/packet	1100 average
NSN	8970-00-926-9222

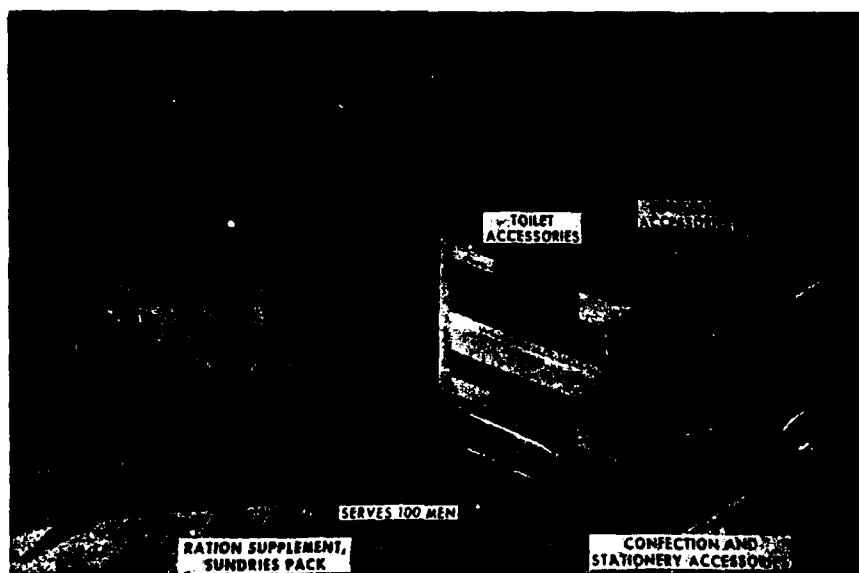
FOOD PACKET,
LONG RANGE PATROL

FOOD PACKET,
LONG RANGE PATROL

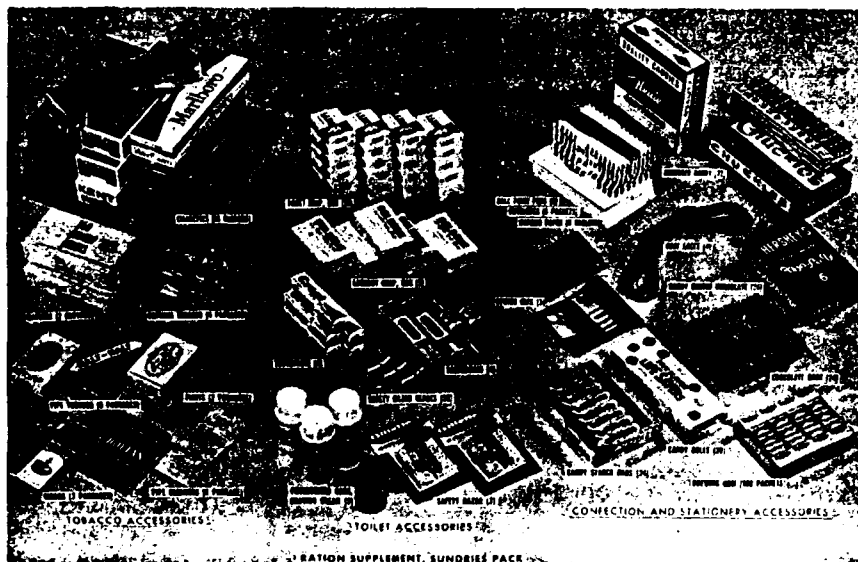
RATION SUPPLEMENT, SUNDRIES PACK



The Ration Supplement, Sundries Pack provides post-exchange-type comfort items to troops in forward areas where post exchange facilities are not available. It contains commercial health and comfort items authorized for gratuitous issue under such conditions and has consisted of a tobacco pack, a toilet article pack, and a confection and stationery pack to meet the requirements of 100 persons for one day. It has normally not been issued with packaged operational rations, meals, or food packets, as these generally provide the accessory items critical to their use. The items listed below are those set forth in the present purchase description for assembly of this ration supplement.



TOBACCO PACK	TOILET ARTICLE PACK	CONFECTION AND STATIONERY PACK
Cigarettes	Shaving cream	Hard candy tablets
Cigars	Safety razors	Coated chocolate discs
Chewing tobacco	Razor blades	Assorted candy
Safety matches	Tooth paste	Chewing gum
Lighter flints	Tooth brush	Ball point pens
Pipe cleaners	Toilet soap	Envelopes
Pipe tobacco		Tablet writing paper
		Sewing kits
		Boot laces
Basis of issue		1 pack/100 persons/day
Weight/pack		41 pounds
Cube/pack		1.67 cubic feet
NSN		8970-00-268-9934



1969 PROTOTYPE

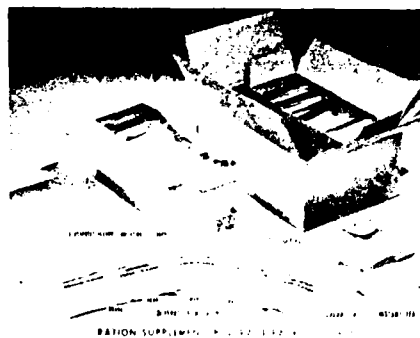
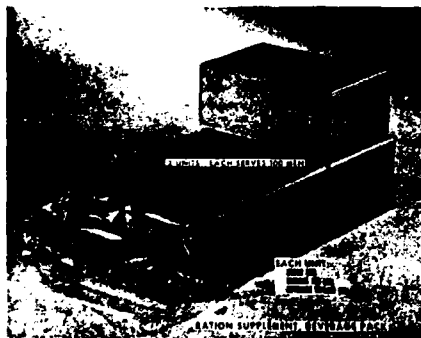
RATION SUPPLEMENT, BEVERAGE PACK

The Ration Supplement, Beverage Pack provides supplemental beverages for personnel subsisting on the Meal, Combat, Individual (or Meal, Ready-to-Eat, Individual) and the Food Packet, Long Range Patrol in hot climates. This supplement was developed in response to a request from the U.S. Army, Vietnam, and provided a means for overcoming the taste of drinking water treated with water purification tablets. It also met a specific climatic need without impairing the suitability of either the MCI or LRP for use in cold climates, where the beverages provided by this supplement would not be equally desirable. Each pack provides beverage supplementation for 100 individuals; two packs are provided in each shipping case.

Each supplement includes:

- 90 envelopes of fruit flavored beverage bases (18 each orange, lemon, lime, grape, and cherry)
- 15 envelopes of sugar
- 15 envelopes of instant tea
- 5 envelopes of lemon flavored instant tea

Basis of issue	1 pack serves 100 men
Weight/shipping case	22 pounds (2 packs)
Cube/case	0.99 cubic feet (2 packs)
Packs/case	2
NSN	8970-01-108-2858
Specification	MIL-R-43650



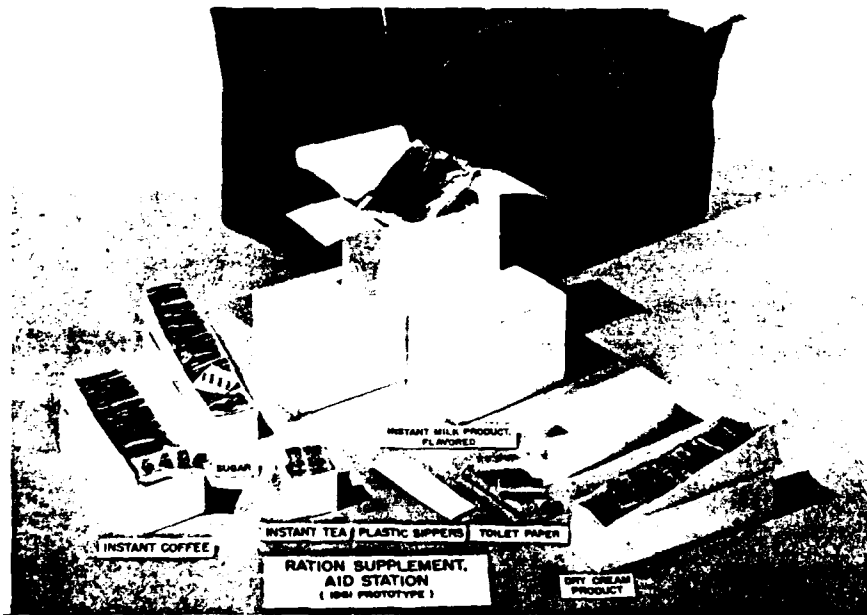
1968 DATE OF PACK

RATION SUPPLEMENT, AID STATION

The Ration Supplement, Aid Station, provides hot, stimulating beverages — coffee, tea, and a high calorie flavored milk product. It is for use at forward aid stations to provide drinks to casualties being evacuated. Preparation requires only the addition of water (hot or cold). The pack (16 pounds) is light enough for hand transport under combat conditions. The supplement provides 100 eight-ounce instant beverages and includes the following components:

Coffee	Toilet Paper	Chocolate — Coffee Flavored	Plastic sippers
Tea	Sugar	Dairy Drink, Dry	Cream Substitute

Number of 8-ounce drinks	100
Weight/pack	16 pounds
Cube/pack	1.01 cubic feet
Specification	MIL-R-1041
NSN	8970-00-128-6404



SURVIVAL SUBSISTENCE

FOOD PACKET, SURVIVAL, GENERAL PURPOSE



The Food Packet, Survival, General Purpose is suitable for use in any survival situation under all environmental conditions, including those where potable water is limited. Four food bars of uniform nutrient content comprise the major constituents of each food packet. The protein content of these bars is rigidly controlled so that the food packet conserves body water yet assures maximum value from protein at any level of consumption. This unique nutritional design allows the adjustment of issue and consumption to anticipated needs. It was adopted by all branches of the Armed Forces as a standard survival ration.

This food packet is the only survival packet designed to support at least limited operational capability for survivors. It replaced other survival food packets in the system (Survival Tropics and Survival Arctic) except for those designed for both specific space constraints and water limitation (i.e., Abandon Ship and Life Raft Aircraft).

The food packet is packaged in a 12-ounce rectangular can (key-opening type) and consists of the following:

Food bars, survival-type (four of five types randomly selected)

Fruitcake

Rice-Cornflakes

Chocolate Fudge

Cereal-Granola mixture

Cornflakes

Coffee, Instant

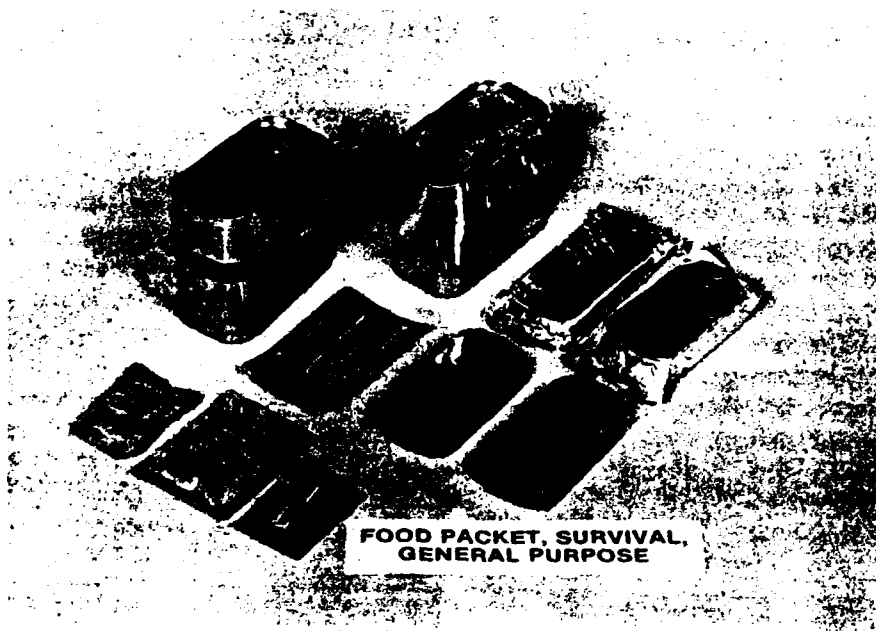
Sugar

Soup and gravy base, chicken flavored

Directions

Can opener, key-type (taped to container)

Packets/case	24
Weight/case	20 pounds
Weight/packet	12 ounces
Cube/case	0.43 cubic feet
Cube/packet	26.7 cubic inches
Specification	MIL-F-43231
NSN	8970-00-082-5665



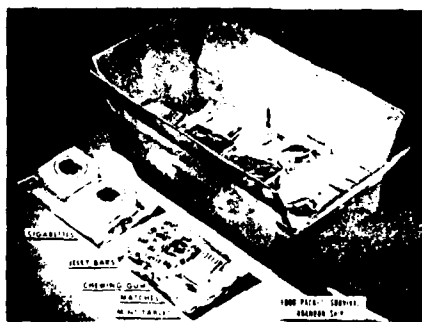
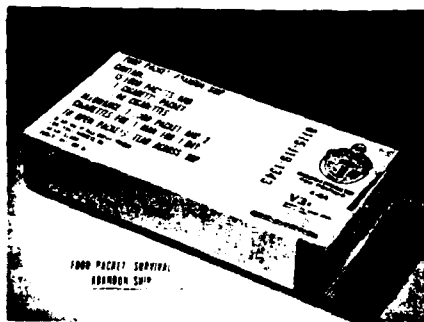
FOOD PACKET, SURVIVAL, ABANDON SHIP

The purpose of the Food Packet Survival, Abandon Ship is to sustain life until rescue or until other food is available. It is supplied to lifesaving craft aboard ships for survivors who have abandoned ship. Experience with ocean disasters has shown other supplies, such as lifesaving equipment and drinking water, to be more critical to survival than food.

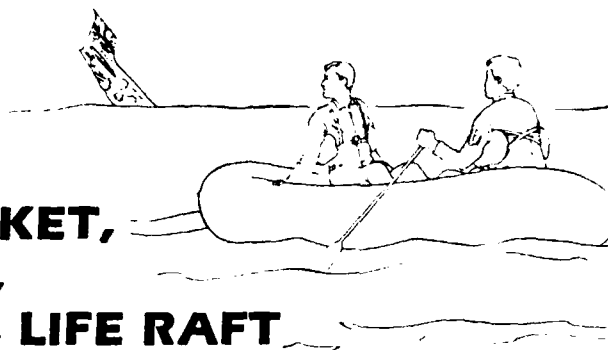
As currently specified, the Food Packet, Survival, Abandon Ship consists of two starch jelly bars, four mint tablets, chewing gum, and matches and is packaged in a sealed waterproof bag. Fifteen food packets and a cigarette packet are packaged in a carton; eight cartons are packed into a shipping case.

Each packet provides approximately 475 calories. It is issued on the basis of one packet per man per day. The components have maximum stability for storage in on-deck craft under all climatic conditions. In fact, since the Navy has indicated that this food must be stable at 140°F (60°C) for one month, even the starch jelly bar component must be specially formulated. Canned water in limited quantities or water-making equipment is provided on the lifesaving craft.

Food packets/carton	15
Cartons/case	8
Weight/case	48 pounds
Weight/carton	5.75 pounds
Weight/food packet	5.2 ounces
Cube/case	1.36 cubic feet
Cube/carton	0.16 cubic feet
Calories/food packet	475 approximately
Specification	MIL-F-16895
NSN	8970-00-299-1395



FOOD PACKET, SURVIVAL, AIRCRAFT, LIFE RAFT

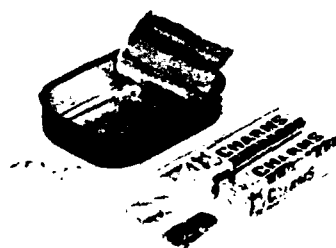


Used in survival kits and in life rafts of naval aircraft, the Food Packet, Survival, Aircraft, Life Raft is intended for short term use while awaiting rescue or air-drop of supplies.

User requirements are stringent. The packet must (1) withstand extreme temperature changes, (2) be of minimum cube and weight, and (3) consist of food which will be beneficial even when water supply is critically limited. The kinds of food suitable for use in this packet are therefore severely restricted. As revised to assure maximum stability when exposed to temperatures up to 71°C (160°F), the food packet contains two bars of fruit tablets (ten in each box) and two packets of gum. The fruit tablets are individually wrapped pieces and are provided in a variety of fruit flavors and colors to enhance acceptability. Approximately 300 calories are furnished in this all-carbohydrate food packet.

The ration is packaged in a small flat, aluminum, easy-opening can, or in a heat-sealed laminated bag. When the aluminum can is used, a waterproof bag is provided for storing leftover tablets. An instruction sheet and a piece of twine are also included in each packet.

Packets/case	36
Weight/case	8 pounds (gross)
Weight/packet	2.8 ounces
Cube/case	0.24 cubic feet
Cube/packet	12 cubic inches
Calories/packet	300 approximately
Specification	MIL-F-15381
NSN	8970-01-028-9406



FOOD PACKET, SURVIVAL, AIRCRAFT, LIFERAFT

FUTURE FEEDING CONCEPTS

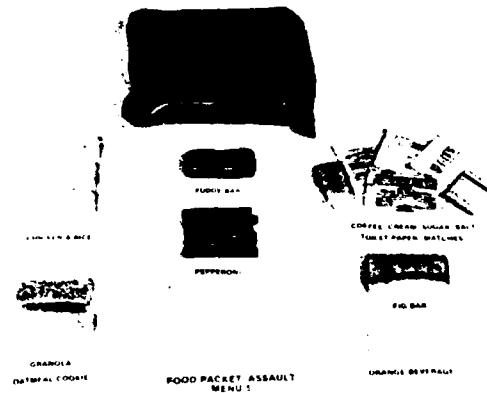
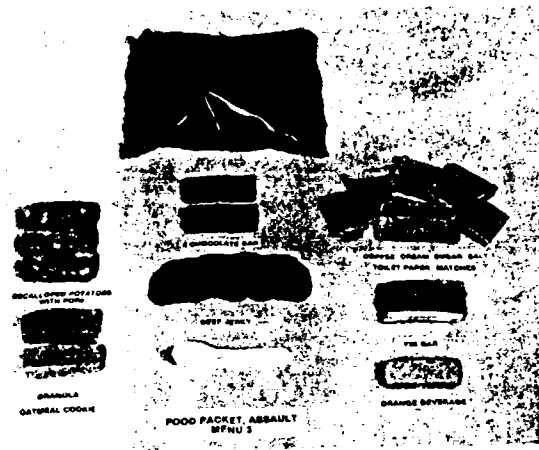
FOOD PACKET, ASSAULT



The Food Packet, Assault will be a compact, lightweight food packet of high nutrient density for individuals in non-resupply situations. It is being designed for use for up to ten days at the rate of one packet per person per day. The new food packet is based on technological advances in freeze drying and compression and is under development to meet a Marine Corps requirement that initially matched the Army's concept of the Food Packet, Individual, Combat (see Historical Summary) against which the Food Packet, Long Range Patrol was adopted as interim. These are being applied to reduce the volume as well as weight of the minimal amount of food required to maintain operational effectiveness. The target has been 1400 calories in a gross weight of one pound.

A 1981 prototype has met this target. It consists of six menus, each providing a variety of food bars. All can be eaten dry; many will rehydrate to give a familiar entree, dessert, or beverage. Each packet also includes a spoon, an entree mixing bag, coffee, cream, sugar, chewing gum, matches, and toilet tissue.

Packets/case	36
Weight/case	39 pounds
Weight/packet	0.98 pound
Cube/case	1.72 cubic feet
Cube/packet	0.043 cubic feet
Calories/packet	1550 average

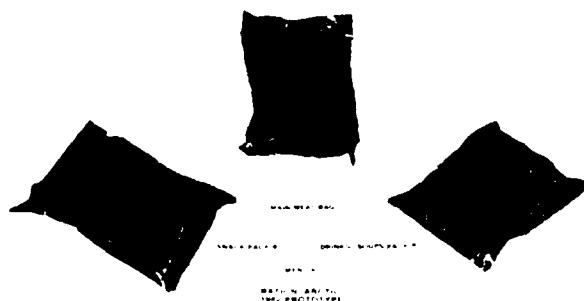


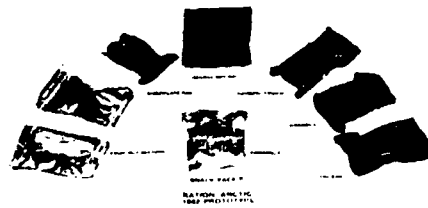
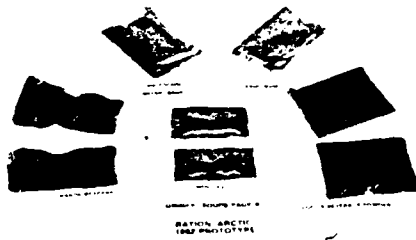
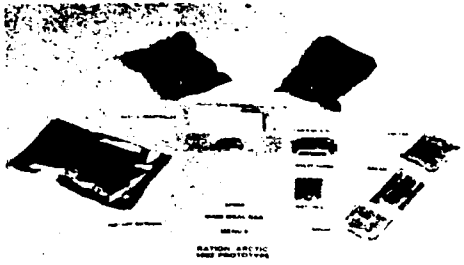
RATION, ARCTIC



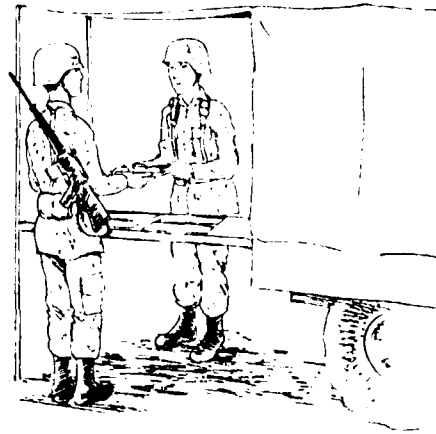
The prototype Arctic Ration is under development to meet a Marine Corps requirement for lightweight, compact, high caloric subsistence for assault, reconnaissance, and other non-resupply operations requiring heavy physical exertion under extreme cold. It is designed to provide approximately 4500 calories.

Six menus, based on dehydrated, compressed, and other low-moisture components that resist freezing, are under development. Initial prototypes, tested in 1981, consisted of two Assault Food Packets with supplemental bakery, soup, beverage, candy, and snacks items. A new design, in which three different packages form one ration, is being developed for further testing. (1) A main meal pack holds two freeze-dried compressed entrees, oatmeal mix, two plastic spoons, with an accessory packet containing coffee, cream, sugar, matches and toilet paper. (2) A snack pack provides cookie bars, fig bars, granola bars, candy, raisin nut mix, and a flexibly packaged brownie or orange nut cake. (3) A drink/soup pack holds orange beverage bars, chicken noodle and fruit soup mixes, cocoa beverage powder, and lemon tea. Twelve rations, two of each menus, are provided in each shipping case. On the basis of recommendations from the Naval Submarine Medical Research Laboratory, work is in progress to limit the sodium content of the ration. Controlled cold chamber studies with the prototype indicated that a lower sodium level will reduce the daily water requirement and prevent symptoms of dehydration in the users.



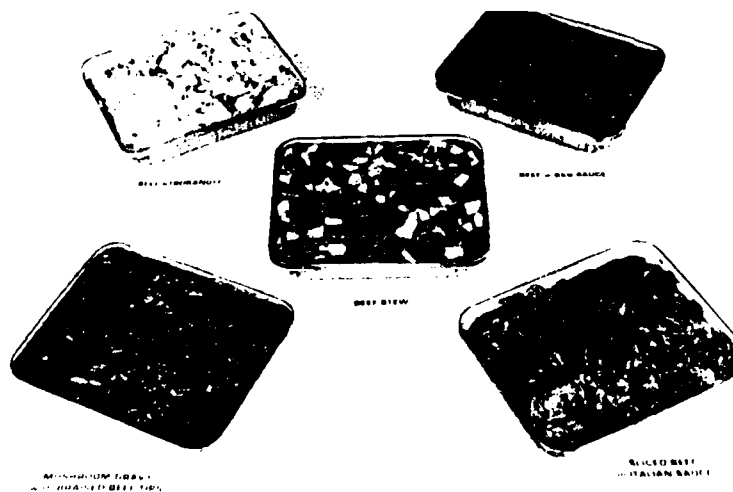


T-RATION (TRAY PACKS)



A variety of entree, vegetable, dessert, starch, bread, and salad items that have been heat-processed in rectangular, multiserving, half-size steam table, metal cans is being developed and introduced in the supply system for a new Army combat field feeding system. In conjunction with a new modular system of combat food service and related equipment, which is also under development, the T Ration (Tray Pack) is expected to increase the Army's capability for providing high quality, nutritionally adequate hot meals to its troops in the field, even where highly mobile, while significantly reducing the manpower, fuel, and water requirements of the present system. Tray Pack products also offer advantages for other Military Services.

The flat tray configuration gives greater quality potential for its heat processed contents than does the round metal can. It allows reduction of the processing time to attain the end point temperature for sterility. At the point of use, the Tray Pack foods are ready to heat and serve in a container that functions as a heating and serving vessel.



TRAY PACK ENTREES

EXAMPLES OF TRAY PACK PRODUCTS

Entrees

Beef Pepper Steak
Canadian Bacon

Cheese Omelet
Pork in Barbecue Sauce

Shrimp Newburg
Swedish Meat Balls
w/Gravy

Vegetables

Glazed Carrots
Mixed Vegetables
Sliced Beets

Salads

Potato Salad
Three Bean Salad
Macaroni Salad

Potatoes and Starches

Glazed Sweet Potatoes
Escalloped Potatoes
Spanish Rice

Breads

Blueberry Muffins
Breakfast Bread Pudding

Desserts

Fruits in Syrup
Cakes
Brownies
Pudding
Pie Fillings

Tray/case	4
Cube/case	0.79 cubic feet *
Cube/tray	0.15 cubic feet

* Military packaging, with liners and dividers or pads. Commercial shipping cases have a volume of 0.72 cubic feet.



SERVING A T-RATION MEAL

HISTORICAL SUMMARY

Air Crew Lunch (Pocket Lunch). Obsolete.

An individually packaged food packet developed during World War II to sustain fliers on bombing missions of one hour or more. This packet provided candies and chewing gum in a carton that facilitated dispensing into a gloved hand or directly into the mouth. Procurement stopped with the close of the war.

Airborne Lifeboat Ration. Obsolete.

This item was developed in 1944 in response to a request from the Army Air Force for food that could be stowed in lifeboats and dropped to survivors located in search and rescue activities over water. It consisted of a two-man breakfast and a two-man supper to provide 1000 to 1500 calories per man per day and included C and K ration components with canned soup, matches, and toilet paper. One Life Raft Ration (see below) was to be stowed in each lifeboat in place of every sixth Lifeboat Ration to give 60 man-days of food.

Assault Lunch. Replaced by Food Packet, Individual, Assault.

Developed late in World War II to maintain the efficiency of troops in initial phases of assault by providing items that could be easily carried by and acceptable to troops under nervous tension, this individual food packet provided candy, nuts, dried fruit, chewing gum, matches, and cigarettes. Although procured in some quantity and considered suitable, at least conceptually, it had not been fully tested when the war ended. Definition of the requirement changed in the postwar period.

Bail-Out Ration. Replaced in 1943 by the Parachute Ration.

The first of several survival food packets developed for fliers to carry on their persons in the event of disaster, this item was produced in 1943 at the request of the Army Air Force. It included D bars, hard candy, chewing gum, bouillon, lemon beverage powder, biscuits, and fruit bars. It was provided in flexible packages and failed to withstand the pressure, temperature, and humidity ranges inherent in its use.

C Ration. Replaced by Ration, Individual, Combat.

The first individually packaged combat ration in recurring procurement, the C Ration was developed, tested and adopted shortly before World War II. It became virtually a staple of that war, during which it underwent many changes, principally to increase its variety, acceptability, and utility.

Combat Lunch. (See Lunch, Flight, AAF)

D Ration. Obsolete.

The first food packet to enter the supply system, the D bar was developed shortly before World War II to be carried by individuals for use only in emergencies when other means of subsistence failed. Consisting of chocolate, oat flour, cocoa fat, sucrose, nonfat milk solids, flavoring, and fortification, it was not designed for acceptability, nor would it meet today's standards for either operational or survival food packets. Its issue in lieu of confection components in other packaged operational rations did not add to its popularity. Procurement ended with the close of the war.

Desert Ration. Eliminated in 1942.

This term was used for early variations of the K Ration: one with a No. 2 can of fruit juice for three persons, and the other with an individual can of juice (5-3/4 oz.). The first was difficult to utilize and the second difficult to obtain.

E Ration. (See Ration, Individual, Combat)

Five-in-One Ration. Replaced by Ten-in-One Ration.

Early World War II ration for five men for one day.

Food Packet, Individual, Assault. Replaced by Food Packet, Long Range Patrol.

Although a continuation of effort on the World War II Assault Lunch, this food packet was at times considered a replacement for the K Ration. Each packet provided a canned meat unit, a B-Unit (crackers and a cookie) and accessories. It was well received in some situations during the Korean War but in others was

misused — either as a full meal in lieu of the Ration, Individual, Combat, which could not be issued on a meal basis, or as a supplement. Although a requirement for the Food Packet, Individual, Combat was established to replace this item, authorization for procurement of the existing item was withdrawn before any replacement was available.

Food Packet, Individual, Combat. Food Packet, Long Range Patrol adopted as interim.

The Army established a requirement in the early 1960's for an extremely compact, lightweight food packet capable of sustaining men in nonresupply operations for ten consecutive days without impairing their performance or causing irreversible physiological damage. The Army subsequently cancelled this requirement shortly after funding became available because it entailed establishment of compaction technology rather than engineering development; however, the Marine Corps had established a counterpart requirement for the Assault Food Packet, for which funding later became available.

Food Packet, Survival, Abandon Aircraft. (SAC PAC) (Ration, Special, Survival). Obsolete.

This food packet was intended for escape and evasion activities after evacuation of long range aircraft and was used in training by the Air Force Survival School. Developed at the request of the Strategic Air Command in 1950, it consisted of the highly concentrated (high fat, high protein, high caloric) food bars SAC stipulated, providing about 3475 calories in the two metal cans that constituted each packet. The packet weighed 34 ounces and occupied a volume of 71.3 cubic inches. Despite its nomenclature, this item was not strictly a survival ration, and its composition made it unsuitable for consumption when drinking water was limited. As one of its major components, meat food product bars, had been produced by only one manufacturer, procurement became virtually impossible when the manufacturer altered his equipment in the 1970's. Procurement authorization was discontinued in 1977.

Food Packet, Survival, Arctic, SA. Replaced by Food Packet, Survival, General Purpose.

Developed in the post World War II period to provide food for one man for one day in emergencies in cold regions, this food packet was based on concentrated

food bars. It included cereal, fruitcake, cheese, sweet chocolate, and starch jelly bars with coffee, tea, cream substitute, sugar, and a polyethylene bag for unused components. It was packaged in a rectangular metal can. Authorization for procurement ended with adoption of the Food Packet, Survival, General Purpose in 1961.

Food Packet, Survival, Tropic, ST. Replaced by Food Packet, Survival, General Purpose.

Developed in the post World War II period to provide food for one man for three days or three men for one day in emergencies in tropical areas, this food packet included starch jelly bars, coffee, tea, and chewing gum in a flat, rectangular can. Authorization for procurement ended with adoption of the Food Packet, Survival, General Purpose in 1961.

Hospital Supplement. (See Ration Supplement, Hospital).

Jungle Ration. Replaced by Ten-in-One Ration.

Early World War II ration for one man for four days.

K Ration. Obsolete.

Under development when World War II began, the K Ration became one of the best remembered rations of that period. It was the first packaged ration assembled so as to allow use on a meal basis, with breakfast, dinner and supper packages. Although modified later in the war to improve acceptability, the earlier versions of the K Ration — which emphasized nutrient density — were the ones best known to the troops. Authorization for procurement was terminated when the war ended.

Kitchen Spice Pack. (See Ration Supplement, Spice Pack, Kitchen).

Life Raft Ration. Obsolete.

Developed in conjunction with the Aero-Medical Laboratory for use in disasters over water, where food and water intake would be limited, this item was stored

in rubber life rafts on aircraft. Initially it was based on hard candy and chewing gum for six men for one day or one man for six days and packaged in a square, hermetically sealed, key-opening can. In 1945 the quantity of components was somewhat reduced, malted milk tablets and an empty plastic bag were added, and a seamless drawn rectangular metal can was used as the ration package.

Lunch, Flight, AAF (Combat Lunch). Obsolete.

This was a World War II subsistence package providing food and extra beverages for three persons in flight. It required preparation aboard the aircraft and failed in acceptability and utility. The need for in flight subsistence during the postwar period was met by the Food Packet, Individual, In-Flight and by perishables, such as sandwich/beverage or cooked, frozen flight meals.

"M" Packet. Prototype failed; requirement cancelled.

In late 1963-64 higher Army echelons perceived the need for a combat food packet as extremely urgent. It was clear that the Food Packet, Individual, Combat, on which work had barely started, would not be available within the time frame envisioned. Although the Food Packet, Long Range Patrol had just been successfully tested and was in limited procurement for this purpose, there was some reluctance to rely on an item based on dehydrated components. In terms of a conceptual 24-hour battle day, need for effort on other packaged rations, such as the Meal, Ready-to-Eat, Individual, was perceived as of secondary importance. NLABS was accordingly directed to place priority on development of an individual food packet based on two prototype MRE retortable pouch components. Six such menus were developed, procured, and subjected to Engineering/Service tests in 1966. As a result of a series of DA reviews following the failure of the "M" Packet prototypes in these tests, the requirement for this packet was terminated, the Food Packet, Long Range Patrol was adopted as Standard pending development of the Food Packet, Individual, Combat, and development of the Meal, Ready-to-Eat, Individual continued.

Meal, Quick-Serve. Prototype succeeded; requirement cancelled.

Twenty-one menus (a 7-day cycle) based on rapidly rehydrating precooked dehydrated foods in multipurpose flexible packages had been successfully

developed and Service tested by the early 1960's. Designed to provide highly acceptable meals to small, mobile combat groups over extended periods without support from food service personnel or equipment, each meal module included expendable food service equipment. An hermetically sealed aluminum insert in each module provided a water heating vessel as well as additional protection to the contents. Canned bread and cakes were among the components. Although assembled in various module sizes during its developmental cycle, a 6-man configuration was considered the most useful and versatile. Four 6-man modules were packed in each shipping case, providing potential for large as well as small group application. This ration was highly successful in its Service tests. DA, however, determined that it added another line item to the system (the Ration, Small Detachment, 5 Persons having been discontinued by that time), and that the need for which it was developed could be met by the developmental Meal, Uncooked, 25-Man (for which the requirement was also subsequently cancelled) and the Meal, Ready-to-Eat, Individual. Work on the Quick-Serve Meal provided the technological and product development base for extremely rapid development and testing of the Food Packet, Long Range Patrol in 1963.

Meal, Small Unit. (See Small Unit Meal).

Meal, Landing Force, 25 Persons. Requirement cancelled.

This item was developed at the request of the Marine Corps for situations that did not require use of individual rations (Ration, Individual, Combat), but where the B Ration could not be made fully available or prepared. There were 21 meal packs: seven breakfasts and 14 lunches or dinners. All consisted of canned foods with dehydrated soups and beverages. Only test quantities were procured. The Marine Corps, as the sole user, withdrew its interest in this item in 1962.

Meal, Uncooked, 25-Man. Requirement cancelled.

Under development from the late 1950's to the early 1960's, this meal was intended to replace the B Ration, particularly in early days of emergencies in situations which permitted limited food preparation, but a balanced B Ration had not yet become available. The Uncooked Meal was to provide a factory assembled,

stable, packaged meal which, when supplemented by bread and cakes, could maintain the performance of combat troops over extended periods without supplementation by perishables. A 6-day cycle based on dehydrated foods in flexible packages had been developed before the requirement was cancelled. This effort provided the technology and product development base for some current dehydrated components of the B Ration (in metal cans, however).

Mountain Ration. Replaced by Ten-in-One Ration.

This was an early World War II ration for four men for one day or one man for four days.

Parachute Emergency Ration (Parachute Emergency Vest Pocket Type). Obsolete.

An individual survival food packet developed during World War II for the Army Air Force, the Parachute Emergency Ration included candies, a cheese and cracker bar, bouillon cubes, sugar, cigarettes, chewing gum, and an empty cellophane bag for unused components after the ration can was opened. The ration container was a seamless drawn metal can, 5-1/2 by 3 by 1-5/16 inches, with a can opener taped to the lid. This ration became obsolete in 1948 and was replaced initially by the Food Packet, Survival, Tropic and the Food Packet, Survival, Arctic until the Food Packet, Survival, General Purpose became available.

Parachute Ration. Replaced in 1944 by the Parachute Emergency Ration.

This item included cheese, crackers, biscuits, chocolate bars, coffee, lemon powder, sugar, and chewing gum in a nonstandard size metal can measuring 6-9/16 by 4-1/16 by 1-7/16 inches. The can, which was not commercially available, occupied excessive space and the unit packaging did not adequately protect against flavor, moisture, and fat transfer. The ration was procured only once.

Quick-Serve Meals. (See Meal, Quick-Serve).

Ration, Individual, Combat. (See also C Ration.) Replaced by Meal, Combat, Individual.

As World War II ended, modifications of the C Ration were already beginning towards improving its nutritional content, acceptability, and utility. Some of these improvements (e.g. inclusion of canned fruit and canned bread) were considered so significant as to warrant new terminology, and the revision was entitled the "E" Ration. The "E" Ration was successful in field testing but further work was required to assure the wholesomeness of the new canned bread component, which thus could not be included in initial postwar procurements. Without this item, the new name was abandoned and the terminology of "C—" followed by a number (C-2 through C-10) used instead, until the nomenclature of Ration, Individual, Combat was adopted. The shipping container showed the letter "C" following this designation and the ration continued to be known as the C Ration, even though it differed considerably from its World War II predecessor by that time, as it included canned cakes as well as bread and fruit, and packed each ration in its own individual carton inside the shipping case to facilitate issue. Even the Meal, Combat, Individual, which bore no letter "C" following its nomenclature and differed even more radically from the World War II ration, continued to be called the C Ration, causing much confusion in the early days of the Vietnam War when the Ration, Individual, Combat was still in the supply system.

Ration, Individual, Trail, Frigid. Obsolete.

Developed during the post World War II period for individual use on the trail under cold conditions, this ration consisted primarily of calorically dense foods such as meat bars, cereal bars, fruitcake bars, canned bacon or ham, and canned processed cheese. Procurement was limited to test purposes.

Ration, Isolated Site, 3 Persons. Obsolete.

Eight menus, each consisting of one breakfast, one dinner and one supper, were developed for three persons at small isolated Air Force sites with minimal food preparation or freezer capability. The ration was based on commercial canned foods, which were not always available; some Meal, Combat, Individual and B Ration components were also included. It was discontinued in the early 1970's.

Ration, Small Detachment, 5 Persons. (See also Ten-in-One Ration.) Obsolete.

This ration was essentially a continuation of Ten-in-One Ration in five person configuration. It was misused during the Korean War in situations for which an individually packaged ration would have been more suitable. Authorization for procurement was withdrawn in 1963 in anticipation of replacement by the Meal, Quick-Serve, 6-Man.

Ration Supplement, Hospital. Obsolete.

This item was procured in 1944 to provide 25 servings of soft and liquid foods to supplement other subsistence available to patients in field hospitals. Although subsequent development work resulted in a small procurement during the Korean War, definition of the concept of use at that time showed that the need could be met without a special supplement pack, as suitable items were already authorized for the B Ration Hospital Supplement in SB 10-495.

Ration Supplement, Spice Pack, Kitchen. Obsolete.

Developed late in World War II to simplify the problems of distribution, breakdown, and issue in obtaining a balanced B Ration in the field, this supplement provided a pre-assembled assortment of spices, leavening agents, condiments and miscellaneous items for 1000 rations. It did not prove to be a satisfactory solution to the problems. For example, components and quantities were not fully compatible with those desired at any specific using unit. Some of the specified components were not available. Procurement of some components in commercial rather than the specified, but unavailable, packaging resulted in severe deterioration of contents. Although the specification was revised for use during the Korean War, procurement ended with World War II. Guidance on units and weight requirements, with conversion factors, is now provided for all B Ration menus and components in SB 10-495/NAVSUP PUB 274 Revision/MCO P10110.25C and (for the Air Force) in AFR 146-8.

Small Unit Meal. Requirement cancelled.

A four-person variation of the Quick-Serve Meal, this item was under development for the Marine Corps in the early 1970's. Prototypes did not include canned foods and took advantage of evolving reversible compression techniques for some components. The aluminum insert for use as a water heating vessel was a commercially available type, with a crimped-on lid. The requirement was cancelled because of a change in the USMC philosophy of field feeding.

Ten-in-One Ration. Replaced by Ration, Small Detachment, 5 Persons.

Developed during World War II for ten persons for one day, the Ten-in-One was intended as a "connecting link" between individually packaged rations and B Ration meals prepared by food service personnel. There were five menus, with canned meats and some dehydrated meat products in metal cans, canned vegetables, canned spread, canned puddings, jam, biscuits, cereal, and beverages for breakfast and supper, and a partial dinner unit of K Ration components for the noon meal. Although radical revision was underway to increase the acceptability of the components and eliminate the partial dinner unit, the war ended before procurement of the redesigned ration was accomplished.

Trail, Frigid. (See Ration, Individual, Trail, Frigid).

CONTENTS OF APPENDIX III

Excerpts from CMNR Annual Reports dealing with Long Life Rations

Military Nutrition Research Annual Report

September 30, 1982—September 29, 1983

**Committee on Military Nutrition Research
Food and Nutrition Board
Commission on Life Sciences
National Research Council**

**NATIONAL ACADEMY PRESS
Washington, D.C. 1983**

accelerated water uptake from such solutions (Hecker, 1983). The optimal composition of such solutions, however, is not known.

- o The thirst mechanism can fail in extreme environments, with dehydration resulting unless fluid intake is virtually forced. The mechanism of thirst failure is not known, nor have possible dietary or chemopreventive approaches to this problem been well explored.

- o If tactical or survival situations are likely to involve small numbers of soldiers in isolation for considerable periods--e.g., several days to a week--with subsistence consisting of nutrient-dense "survival" rations, the importance of a soldier being able to provide himself with potable water becomes obvious. The technology of water purification for such circumstances appears to have lagged.

The committee recommends that a workshop be held, using a literature review as the starting point, to identify the research needed to improve hydration under environmental stress. It should consider the specific topics outlined above and any other important related issues that may emerge. This workshop might be integrated with that on computer models described above.

SURVEILLANCE OF NUTRIENTS IN OPERATIONAL RATIONS

Military rations differ from civilian feeding systems in three ways: first, in combat situations, the soldier may have to depend completely on combat rations for energy and nutrients; second, rations are expected to have longer shelf-lives than commercial foods (4 to 6 years, rather than 1 to 2 years); and third, in hostile environments, military rations are likely to be exposed to more adverse temperatures and humidities than foods in domestic warehouses. Because rations could be used for periods longer than 30 days, changes in their nutrient composition during such storage, which may adversely affect military performance, need to be assessed.

During the development of the MRE (meal-ready-to-eat) ration, selected nutrients were assayed in menu composites held at controlled temperatures for specified periods of time. Prototype and current studies of the MRE are not designed to assess the rate of nutrient destruction that would occur if rations were inadvertently stored at 120 to 145°F, which could occur during transport or storage under wartime conditions.

Data available in the scientific literature imply dramatic losses of vitamins A, E, and C in MRE rations stored for extended periods above 85°F (Goldblith, 1971). Substantial losses of thiamin, riboflavin, and vitamin B₆ would also be expected in rations that were subjected to storage temperatures of 120 to 150°F.

The bioavailability of macronutrients, including proteins and lipids, may also be affected by storing military rations at high temperatures. These losses could occur because of browning reactions and lipid oxidation, which can result in the cross-linking of lipids

and proteins. The chemical reactions would result in important losses in the nutritional values of the rations because they would decrease absorption in the gut (Gardner, 1979).

The committee encourages the development of testing systems to assess changes in nutrient contents and availability over the shelf-lives of all operational rations subjected to realistic, but adverse, storage conditions. Annual peacetime procurement of military rations ranges from \$100 to \$200 million. Such an investment deserves periodic assessment to ensure that the nutritional standards for combat rations are met not only at the time of procurement, but, more importantly, at the time of consumption.

REFERENCES

- Bijlani, R. L. 1980. Effect of dehydration and rehydration on human performance. *Indian J. of Physiol. and Pharmacol.* 24:255-266.
- Bower, G. H., ed. 1977. *Human Memory: Basic Processes*. New York: Academic Press.
- Colquhoun, W. P. 1975. Evaluation of auditory, visual, and dual-mode displays for prolonged sonar monitoring in repeated sessions. *Hum. Factors* 17:425-437.
- Egan, J. P. 1975. *Signal Detection Theory and RDC Analysis*. New York: Academic Press.
- Gardner, H. W. 1979. Lipid hydroperoxides reactivity with proteins. *J. Agri. Food Chem.* 27:220-229.
- Gisolfi, C. V. 1974. Thermal effect of prolonged treadmill exercise in the heat. *J. Med. Sci. Sports* 6:108-113.
- Goldblith, S. A. 1971. Thermal processing of foods: a review. *World Review of Nutrition and Dietetics* 13:165-193. Basel, Switzerland: Karger.
- Gopher, D. 1982. A selective attention test as a predictor of success in flight training. *Hum. Factors* 24:173-183.
- Hecker, A. L. 1983. Digestive, absorptive, and metabolic characteristics of glucose polymers. Paper presented at Nutrient Utilization During Exercise, Ross Symposium held at Tarpon Springs, Fl. November 3-5, 1982. Copies available from Ross Laboratories, Columbus, Ohio 43216.
- Knochel, J. P. 1974. Environmental heat illness. *Arch. Int. Med.* 133:841-864.

Military Nutrition Research

**Report of Committee Activities
September 30, 1983—September 30, 1985**

Committee on Military Nutrition Research
Food and Nutrition Board
Commission on Life Sciences
National Research Council

NATIONAL ACADEMY PRESS
Washington, D.C. 1985

Studies should be performed over reasonable caloric ranges, e.g., 1,000-1,800 kcal/day. Similarly, studies should be undertaken over the macronutrient ranges described in the composition above. The degree of maintenance of glycogen stores and lean body mass should be determined in selected, carefully controlled studies, as should water balance. As for any ration system, data on packaging integrity, organoleptic acceptability, and macronutrient and micronutrient stability under anticipated storage conditions should be collected throughout the shelf-life of the ration.

General guides to ration composition and tests in soldiers include the following: weight loss should not exceed about 10-12%; high-fat diets should be avoided, and relatively high carbohydrate content is desirable; attempts to "adapt" soldiers to rations for long periods before use in the field seem unrealistic; and it is important to keep potassium content reasonably high (70-80 mEq), but sodium content is less important because of renal conservation.

MILITARY NUTRITION RESEARCH

Report of Committee Activities
August 1, 1985 - July 31, 1986

Committee on Military Nutrition Research
Food and Nutrition Board
Commission on Life Sciences
National Research Council

National Academy Press
Washington, D.C.
1986

Supported by

U.S. Army Medical Research and Development Command
Fort Detrick, Frederick, Maryland 21701-5012

Grant No. DAMD17-85-G-5041

Approved for public release; distribution unlimited

The findings in this report are not to be construed as an official
Department of the Army position unless so designated by other authorized
documents.

NUTRITIONAL ADEQUACY OF OPERATIONAL RATIONS

In its review of the Combat Field Feeding System (CFFS) study conducted in Hawaii in 1985, the committee was concerned that there was a lack of complete nutritional information on the Meals-Ready-to-Eat (MRE) rations. In addition, the committee was unsure that an adequate nutritional quality assurance program was in place to be confident that the MRE ration was meeting the nutritional needs of the troops in the field at the time of consumption. The committee chairman visited Natick to review the ration development program as it was related to meeting the nutrient specifications for operational rations. A well-designed program was in place at the Natick Laboratories for formulating products to meet nutritional specifications and evaluating nutrient stability through the expected period of use and ranges of storage conditions, but several subjects require further review, in light of the desire to use the MRE ration for extended periods.

- o. In the current AR-40-25, the nutrient standards for packaged operational rations do not include requirements for the nutrients listed in Table 10, "Estimated Safe and Adequate Daily Dietary Intakes of Selected Vitamins and Minerals," for adults in the Recommended Dietary Allowances (NRC, 1980) (Appendix C). Inasmuch as the MRE ration is being evaluated for use for periods considerably longer than 10 days, the specifications for the MRE should be expanded to include these nutrients.

- o The nutrient database for ingredients used in formulating these operational rations should include the full range of nutrients for which there are RDAs and for which safe and adequate ranges are suggested by the National Research Council (NRC, 1980).

- o Data on consumption of the individual ration items by persons in field tests using the MRE ration should be reviewed to determine whether fortified items are consumed in sufficient amounts to ensure the intake of adequate amounts of all nutrients.

The committee plans to continue its evaluation of the adequacy of the nutritional assurance program for operational rations designed for extended use, following the general outline of the 10 items listed in Appendix D.

APPENDIX D

OUTLINE OF SUGGESTED NUTRITIONAL ASSURANCE PROGRAM
FOR OPERATIONAL RATIONS DESIGNED FOR EXTENDED USE

1. Specifications for nutrient content of operational rations (AR-40) should include all nutrients for which there are RDAs and other nutrients for which safe and adequate amounts are suggested by the National Research Council, (NRC, 1980).
2. A nutrient database for development of these rations should include all the above nutrients. Menus that meet the nutrient standards are developed from the baseline component data.
3. Rations that specify the nutrient content of each component of the ration are developed. Components now suited for fortification should be identified and evaluated as carriers for the necessary nutrients.
4. Stability studies on the individual ration components that are important contributors of any of the nutrients should be conducted with conditions that include the extremes expected in field storage and use. Overall ration stability studies on entire rations should also be carried out for organoleptic and nutrient content.
5. Acceptance of individual ration components should be evaluated to ensure adequate consumption of key sources of nutrients. The evaluations should include field studies with troops to determine whether laboratory data can be extrapolated to field conditions.
6. Specifications for individual components should include assurance that expected nutrient content will be provided. Fortified items should be identified for special attention for both nutrient content and organoleptic evaluation.
7. Fortification premixes that include an indicator that can be readily and economically analyzed to ensure appropriate fortification should be used.
8. The initial procurement should be sampled, and individual components analyzed, to determine whether expected nutrient content is achieved. Experience might indicate that only indicators need to be analyzed in some components as a means of reducing expense and time necessary to get results.
9. A continuing audit of rations in storage is suggested, to ensure that rations are organoleptically acceptable and nutritionally adequate. With identification of critical nutrients and possibly the use of indicators, the number of nutrient analyses can be minimized.
10. A disposition program for rations determined to be approaching limits of shelf-life--either organoleptic or due to loss of nutrient content--should be established. (i.e. immediate use, use within specified period, or destroy.) Indicators will probably be required.