

RS-47

PROVIDING VITAMIN - ADEQUATE RATIONS THROUGH FORTIFICATION

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Much of the original vitamin content of combat rations is destroyed before the food is delivered to the battlefield. Studies conducted in the Nutrition Division of the Quartermaster Food and Container Institute show that considerable losses of vitamins A and C which are sensitive to oxidation, and thiamine, which is sensitive to heat, take place during processing and storage of ration items. For example, processing losses of thiamine in canned food items have been found to run from 50 to 60 per cent with additional losses of 30 to 50 per cent occurring during storage for six months at 100° F. The following article provides an insight into the difficulties faced as well as the avenues of approach followed in arriving at workable solutions. A "chain-reaction" of technical team efforts—(a) intra Food and Container Laboratories, (b) inter Institute and industry, and (c) inter food industries via Associates task groups—is the keystone of success of the vitamin fortification program developed.

Since packaged operational rations consist of processed foods which must be stored for relatively long periods, frequently at extreme temperatures, it is necessary to resort to fortification in order to assure the presence of required amounts of these vitamins when the food is eaten. Fortified ration items available for use and their contribution to the vitamin needs of the soldier are shown in Figure 1. Since the figure was prepared, in December 1952, the level of fortification in the bread unit has been increased by the addition of fortified yeast.^a The present level of fortification is 0.38 mg., furnishing 32 per cent of the N. R. C. Recommended Allowance.

Current usage of these fortified ration items is tabulated below. (Table I).

The presently available fortified ration items, however, do not afford

^aThe fortified yeast incorporated into bread and crackers also supplies riboflavin and niacin, as does enriched flour used in making canned bread. The universal presence of a bread type unit in operational rations—crackers or canned bread—thus assures the supply of adequate amounts of riboflavin. Adequate niacin levels are maintained in operational rations without dependence upon the amounts furnished in bread or crackers.

a complete solution to the vitamin needs in packaged rations. There are still some menus of the Individual, Combat (C) and Small Detachment, 5-in-1 rations which fall below the recommended level of 5000 I. U. of vitamin A. Many of the rations are adequate in the amount of vitamin C provided only because of the presence of the fortified beverage powders. Practically 100 per cent of the ascorbic acid is supplied by these beverage powders in the C and Frigid Trail rations. Since many soldiers do not drink coffee, tea, or cocoa, however, they do not get an adequate amount of ascorbic acid unless other fortified carriers of this vitamin are provided.

The frequent substitutions and changes made in the rations and ration components make it essential to establish a greater number and variety of stable and tasty fortified carriers.

Many ration items which have been tested for use as possible vitamin carriers cannot be used because they have been found to be unstable, unacceptable, or have a limited utility. For the fruitful conduct of experimental vitamin fortification studies only those items possessing

the following characteristics should be fortified:

- a. High general *acceptability*
- b. Good *utility*—for operational rations
- c. Established *stability* for a minimum of one year at 100° F.
- d. Properties that suggest a high retention of added vitamins.

Ration items believed to have the desired characteristics are listed in Table II. The priorities assigned to these suggested ration items for fortification are based on the following considerations:

- 1. Need for specific vitamin fortification
- 2. Versatility in ration use
- 3. Most promising carrier from stability standpoint.

An appreciation of the comprehensive scope of fortification studies can perhaps be gained from a consideration of a specific example—the recently initiated study of fortified cocoa beverage powder.

the story of a typical "carrier"

The preliminary selection of cocoa beverage powder for study was followed by conferences with the expert food technologists in the General Products Division responsible for this item. These conferences confirmed the existence of the required characteristics for this item and the feasibility of fortification. Arrangements for the commercial manufacture of this item in the amount needed and in accordance with the specification were later made by the General Products Division with a local processor who had supplied this item under previous contracts with the Government.

The plan of fortification shown in Table III was designed to permit

complete factorial analysis of the independent effect of each vitamin and the interactions with the other vitamins. The levels of fortification were based on the policy of adding a uniformly significant percentage of the total need—specifically, supplying in one serving (1.5 oz.) one-half of the daily Recommended Allowance of the National Research Council. A sufficient overage was included to cover anticipated preparation losses.

Packaging aspects were discussed with the responsible technologists of the Subsistence Division, Container Laboratories. In addition to the flexible envelopes of aluminum foil kraft called for in the specification it was decided to include rigid containers (cans, vacuum packed) as a control. Advantage is currently being taken of the opportunity to obtain information during this study on the performance of substitute flexible packaging materials.

The tests to be made and the divisions conducting them are listed below:

Type of test	Division
Vitamin content	Nutrition
Palatability	Acceptance
Moisture	Stability
Free fatty acid	Stability
Peroxide value	Stability

The samples are being stored at the temperature extremes of interest—minus 20° F. and plus 100° F.—and will be withdrawn for examination after six, nine, 12, 18, and 24 months of storage.

Due to the large number of samples involved, the 40 judges used in the palatability tests will be divided into eight groups with each judge receiving four samples in an organized plan of presentation. The chemical tests were selected for their significance in accounting for possible alterations in palatability and vitamin content.

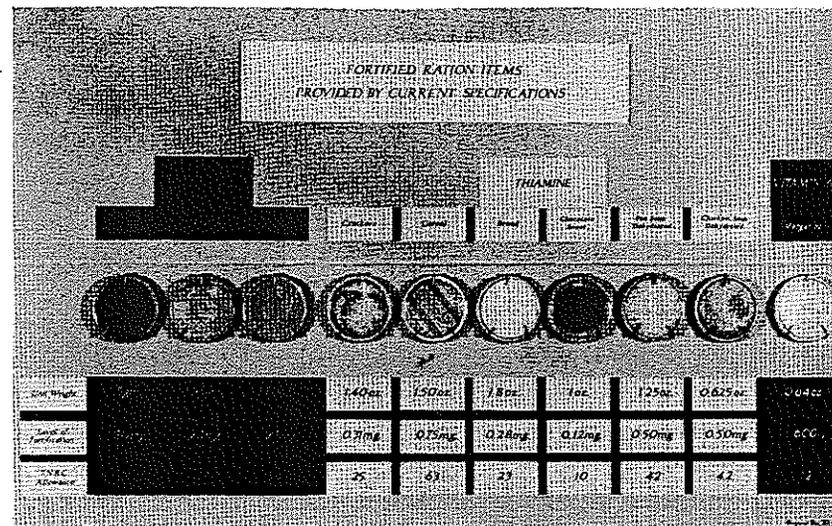


Figure 1. Fortified ration items provided by current specifications.

The number of analyses required is shown in the following table:

Division	Initial	Each Storage Withdrawal	Total
Nutrition	30	60	330
Acceptance ^b	16	32	176
Stability	48	96	528
			1034

^b Indicates number of samples only.

Due to the extensive nature of fortification studies as seen from the above illustration, only two or three such overlapping studies can be handled by the Institute staff at one time, and this is possible only by careful scheduling to avoid overloading and conflict with other essential studies.

industry answers the call

If the rate of establishing new vitamin carriers is to keep pace with ration needs, the help of the vitamin manufacturing industry must be sought. Assistance is needed not only in the periodic assay for vitamin re-

tention in fortified ration items stored at varying temperatures, but special attention must also be given to the development of stabilized forms of vitamins and/or substances which will promote the retention of vitamins added to ration items.

The need for help was transmitted to the Research and Development Associates which established a Nutrition Division of its Activities Committee. The generous cooperation of the vitamin manufacturing industry in answering the call for assistance has been reflected by participation of the best qualified representatives of the key firms in this industry in the Task Group on Vitamins.

In exploring the most effective means for harnessing the tremendous resources represented by the Task Group on Vitamins to provide the information needed by the Institute, two major problems were recognized. Their resolution during the deliberations of the round table discussion at the annual meeting

Table III. Plan of Fortification

Sample	Vitamin A I.U.	Thiamine Mg.	Ascorbic Acid Mg.
A	None	None	None
B	None	None	45
C	2,750	None	45
D	None	0.9	45
E	2,750	0.9	45
F	None	0.9	None
G	2,750	0.9	None
H	2,750	None	None

paved the way for the formulation of a satisfactory *modus operandi*.

The first of these problems was to develop a means for making available to the Institute confidential data which in many cases would be withheld from the public because of normal commercial competition. This primarily pertains to information on means of stabilizing vitamin A which is the result of independently planned research by laboratories represented by members of the task group. Since the ultimate aim is the development of information regarding the fortification of ration items which will be stable carriers of the added vitamins, the information must be available in a form which will make the respective specification a simple and reliable procurement instrument. For this purpose confidential information creates definite problems. It is not the policy of The Quartermaster General to incorporate into specifications any restrictive language such as that represented by the use of trade names. This difficulty was solved by the decision to state the stability requirements in the specification and by setting up the following procedure for establishing a list of approved suppliers.

The Requirements for Manufacturers of Vitamin A to Obtain Approval from the QM Food & Container Institute

1. The vitamin A manufacturer seeking to be listed as an approved supplier must furnish the Nutrition Division, QM Food & Container Institute with the following:

- a. Sufficient samples of the ration item fortified with the specific vitamins to be tested, for confirmatory palatability and stability tests, when tests to establish stability performance are initiated.
- b. Analytical data establishing that the particular form of vitamin A will meet the stability requirements when added to this specific ration item.

2. The stability requirements are:

- a. The fortified ration item must retain a minimum of 70 per cent of its original vitamin content after storage for one year at 100° F., and after reconstitution according to specification where required.
- b. The vitamins must impart no objectionable odor or flavor or other objectionable characteristic to the fortified product after storage for one year at 100° F., and after reconstitution according to specification where required.

The same requirements apply to the establishment of a fortified ration item as a suitable carrier for other vitamins (thiamine and ascorbic acid). This procedure does not require the release of any confidential information regarding the technology of manufacture.

How this would operate is illustrated in the proposed amendment of the specification for dehydrated precooked pea soup, MIL-S-3686.

“3.2 Materials

“Thiamine hydrochloride—Thiamine hydrochloride shall be of a grade conforming with ‘Pharmacopoeia of the United States.’

Vitamin A—The vitamin A shall be of edible quality which shall not impart an objectionable odor, taste or other objectionable characteristic to the prepared soup as served. The vitamin A used must be supplied by one of the manufacturers approved by the Quartermaster Food and Container Institute.”

The second problem revolved around the following needs: (a)

proper assignment of participating laboratories to fortification of specific ration items, and (b) arrangements for working with manufacturers of the basic ration item in the experimental fortification of that item. The solution was provided by the following plan.

For each item to be studied as a possible vitamin carrier a member of the task group will be designated by the chairman as leader for the coordination of fortification studies on this ration item. The designated leader will be responsible for:

- (1) contacting other members of the task group to ascertain their interest in the fortification of this particular ration item;
- (2) making necessary arrangement for small scale commercial runs in the experimental fortification of the particular ration item to assure that the fortified ration items are prepared:
 - a. according to specifications.
 - b. under industrial plant conditions whenever possible,
 - c. packaged as they are for ration use;

- (3) assuring that sufficient samples are furnished the Quartermaster Food and Container Institute in accordance with paragraph 1. a. of requirements for becoming an approved supplier.

The task group in this plan will serve as a clearing house for distribution of work to avoid over-emphasis of any single item and to assure desired plans of fortification efforts to increase the number and variety of fortified ration items.

With the machinery for the operation of the Task Group on Vitamins clearly established we are optimistically looking forward to the co-operation of the other task groups in the Associates organization with regard to the experimental fortification of their respective ration items in this team effort to assure the required amount of vitamins in packaged rations at the time of consumption.

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