NUTRITIONAL CONSIDERATIONS IN DESIGNING COMBAT RATIONS

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To be able to conduct military operations in any area of the world has come to be an absolute requirement for our own and other armed forces. Modern transport facilities can surmount all geographic barriers, but the efficiency of our armed forces is dependent not upon machines but upon the ability of individual men to operate under extremes of climate and terrain. Fed poorly, their fighting efficiency drops. The objective of rations development is, therefore, to provide the food that will assure fighting efficiency under all circumstances.

Tactical situations, climate, terrain, and feeding methods and equipment create a large number of feeding problems which are met by a number of different rations, supplementary packs and food packets.

Rations must be evaluated in terms of military needs. Unless these rations, supplements and packets possess the functional qualities which are necessary or desirable under the circumstances of their use, they will fail wholly or in part to fulfill their purpose in the field. The success of a ration in meeting this challenging objective is measured in terms of four military characteristics—these are the guide lines of ration planning—(a) nutritional adequacy—should possess maximum nourishment compatible with the tactical situation and have no detrimental physiologic effects (*e.g.*, abnormal thirst, gastric disturbance); (b) acceptability—should provide sufficient variety to be palatable and acceptable when consumed *hot* or *cold* for several consecutive days; (c) stability—should be stable for two years at fluctuating temperatures ranging from −80°F. to 160°F. and relative humidity from 10 to 90 per cent; (d) utility—should be economical of weight and space, suitable for the individual to carry, easily prepared for consumption under all climatic conditions, and capable of withstanding military handling during transportation, storage and issue.

With the arrival on the military scene of new weapons—rockets, guided missiles, jet propelled planes, long range bombers, snorkle-equipped submarines—the complexity of armed forces feeding problems has vastly increased. If these weapons are to provide an advantage over the enemy, the men who operate them must also have a superiority in physical fitness that can be achieved by adequate nutrition. One stubborn obstacle stands in the path of an easy attainment of nutritional adequacy, namely, the severe limitation imposed by the essential requirements of acceptability, stability, and field utility.

To determine quantitatively whether or not a ration is nutritionally adequate it is necessary to compute the total nutritive value from reliable data on the nutrient content of component ration items. Conventional tables of food composition are not a valid source of nutrient data for most components of packaged rations. Almost all of the published data represent naturally occurring or standard foods in general use, whereas a majority of the ration components are specially formulated to meet military requirements. It is necessary, therefore, to determine by laboratory analysis the nutrient content of ration items manufactured according to formulations prescribed by specifications. Furthermore, the effects of storage are such that the average values given in standard tables of food composition may not apply to ration items. To integrate properly all aspects of nutritive values of

rations, a centralized source of this type of information must be established and kept up-to-date.

The food composition reference manual just completed is based on extensive data obtained from Quartermaster Food and Container Institute analyses. The manual lists the nutritive values of standard ration unit weights of all packaged ration components.

The Quartermaster coordinated research and development program on dehydration has drawn attention to the need for more information on the nutritive value of dehydrated fruits, vegetables, meats and eggs. Dehydrated commodity items have great utility advantages for both military and civilian feeding in time of emergency. Dehydrated white potatoes already have a wide-scale use in the standard B rations.

Although operational rations produce fairly good growth in rats, a greater growth rate is observed when the rations are supplemented with proteins and vitamins. Packaged rations which contain processed foods may be in actuality incomplete in nutrients despite the fact that they appear to meet, by calculation, nutritional standards. It is important, therefore, to devise and conduct feeding tests with laboratory animals (rats, guinea pigs, chicks, dogs and monkeys) to ascertain the physiologic availability of the nutrients in packaged rations. Such studies are useful as a guide to possible nutritional inadequacies.

Extremes of storage temperatures and long military supply lines explain the significant losses of nutritional value before rations reach the fighting men. The effects of storage under various known conditions of temperature and humidity on the nutrient stability and physiologic availability of rations as consumed must be determined. It is also desirable for practical reasons to establish a correlation between laboratory storage tests and military storage for loss of nutritional factors in rations.

Animal experimentation is useful as a "pilot test" for providing guiding information on the nutritional adequacy of operational rations. However, due to qualitative, but particularly quantitative, species differences between laboratory animals and man in their nutritive requirements, information secured from animals is frequently inapplicable to man. Under stress conditions the laboratory animal generally responds so differently, in kind or degree, from the human subject as to render comparison dubious. It is, therefore, essential to ascertain the significance of feeding tests with laboratory animals in relation to the nutritional welfare of members of the armed forces before proceeding to ration modifications. To achieve this purpose, arrangements have been made for collaboration with the Quartermaster Climatic Research Laboratory in using enlisted personnel for studying the relationship of nutrition to climatic stress. To impart realism and vitality to laboratory investigations of combat rations, field studies in collaboration with other national military establishment agencies will also be a profitable source of data.

It is a responsibility of the Surgeon General to prescribe basic standards of diet for the armed forces. Army Regulation 40-250 dictates the minimum allowances of nutrients which a ration must supply in order to be considered adequate. These values, patterned after the recommendations of the National Research Council, were modified in the light of previous experience to meet the needs of the Army. They now reflect what are considered to be practicably obtainable levels.

In normal civilian feeding and when troops are maintained on Field Rations A or B the recommended allowances can be attained with a good variety of common foods which will also provide other minerals and vitamins for which requirements are less well known. It is not safe to make this assumption for operational rations since they consist largely of processed foods. Furthermore, members of the vitamin B-complex group other than thiamine,

riboflavin and niacin should be given consideration in planning military rations. Considerable evidence has been obtained suggesting a need for additional pyridoxine in operational rations.

General Doriot has said: "It is one thing to feed a man; it is yet another to maximize the safety and efficiency of a soldier through food. Food is a munition and our objective is to maximize its military effectiveness." To implement this excellent principle we must continue the search for new information on military nutrition with the goal of describing and ultimately developing the optimum operational ration—one which will permit military personnel to carry on their activities with greatest possible efficiency.

Diet is only one pillar of good nutrition. Nutritional deficiencies may result not only from simple failure to obtain the right kind of food, but also from factors which interfere with the ingestion, absorption, or metabolism of needed nutrients, or increase the nutrient requirements. In modern global warfare military personnel are frequently exposed to various degrees of environmental physiologic and psychologic stress. Such climatic extremes as the tropics and the arctic, and stresses induced by combat, fatigue, or complete isolation, produce changes in metabolism and food requirements. Understanding of the nature and extent of such changes is basic to designing rations which will best meet the nutritional requirements of troops under these types of stress.

Additional information on the relationship of nutrition to climatic stress is needed, as a critical analysis of the available experimental and observational findings will show. Fundamental physiologic information is meager concerning the effect of diet under conditions of climatic stress on those organs and systems of the body most intimately concerned with tolerance to climatic stress. Adequate knowledge of the role of body temperature, the transfer of oxygen from the atmosphere to the tissues, and the heat economy of the human subject under these stresses has not yet been obtained.

We have some knowledge of the nutritional reactions of work fatigue, and of injury, it is true, but we know almost nothing about the interactions of these two under the emotional stress of combat further complicated by completely foreign environmental influences. Another, possibly additive, stress should also be mentioned—atomic radiation. Its effect on nutrient metabolism and nutrient requirements will require intensive study.

Because of space and weight limitations in planes and ships a high-carbohydrate food packet is the best interim solution to an all-purpose survival ration. While such a ration will support life for short periods of time, it is not optimal. The goal is a ration which will maintain the best possible state of physical well-being and enable the survivor to cope with his adverse environment until rescue takes place. With this objective in mind, special emphasis has been placed upon the feasibility of incorporating in the ration a suitable quantity of protein, high in nutritional value, to spare and replenish body tissues. This would also aid men suffering from injury, burns, loss of blood, or shock, as well as improve palatability and acceptability of the ration, promote a sense of well-being, and increase the morale of the victims of disaster.

The chief stumbling block to incorporating protein in a survival ration has always been the classic physiologic concept that protein fed at low caloric levels would perforce be burned for energy. Since the nitrogenous end products of protein thus metabolized require additional urinary water for excretion, it would be both hazardous and uneconomical to feed protein when the intake of water is limited. It has been tentatively concluded that protein can be included in a survival ration without detrimental effect, even when the energy supply is only 900 calories and water is limited to 800 cc. The suggested ration contains 900 to 1000 cal-