

THE EFFECT OF REPETITIVE FEEDINGS ON THE ACCEPTABILITY OF SELECTED METABOLIC DIETS

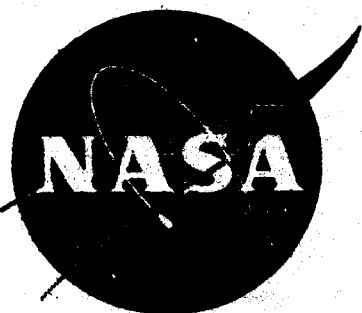
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FOREWORD

This research was initiated by the Aerospace Medical Research Laboratories, Wright-Patterson Air Force Base, Ohio, and was accomplished by the Department of Research of the Miami Valley Hospital, Dayton, Ohio, and the Biotechnology Branch, Life Support Division, Biomedical Laboratory, Aerospace Medical Research Laboratories. This effort was supported jointly by the USAF under Project No. 7164, "Biomedical Criteria for Aerospace Flight," Task No. 716405, "Aerospace Nutrition," and NASA Manned Spacecraft Center, Houston, Texas, under Defense Purchase Request R-85, "The Protein, Water, and Energy Requirements of Man Under Simulated Aerospace Conditions." This contract was initiated by 1st Lt John E. Vanderveen, monitored by 1st Lt Keith J. Smith, and completed by Alton E. Prince, PhD, for the USAF. Technical contract monitor for NASA was Paul A. Lachance, PhD. The research effort of the Department of Research of the Miami Valley Hospital, was accomplished under Contract AF 33 (657)-11716. Bernard J. Katchman, PhD, and George M. Homer, PhD, were technical contract administrators, and Robert E. Zipf, MD, Director of Research, had overall contractual responsibility. This report was presented at the 45th Annual Meeting of the Ohio Dietetic Association held in Dayton, Ohio, 11-13 May 1966.

The authors wish to acknowledge the assistance of Mr. Virgil Rehg, Research Associate, Ohio State University, for statistical analysis of the data, and SSgt Earl T. Rawls of AMRL for his role in the preparation of the metabolic diets used in this research.

This technical report has been reviewed and is approved.

WAYNE H. McCANDLESS
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ABSTRACT

In three separate metabolic balance studies, the repetitive serving of a liquid, fresh food, and experimental bite-sized, compressed and dehydrated diet was evaluated by means of a graduated hedonic scale for organoleptic acceptability for extended periods of time. A liquid diet, having a low degree of initial acceptability, became monotonous when served for twenty-one days. However, both the one-day cycle menu of fresh foods and the two-day cycle menu of experimental foods remained acceptable over periods of forty-two and thirty days, respectively. Since significant differences among individuals has been demonstrated, and because repetition does not necessarily result in decreased acceptance, more emphasis should be placed on the variation in food preferences of individuals. Perhaps dietitians and homemakers could benefit by using a simple food preference questionnaire, prior to actual menu planning, to ascertain the preferences of the individuals they are responsible for feeding. In relation to the acceptability of individual food items on the fresh diet, it was found that all beverages, peaches, brownies and poundcake, and sliced turkey contributed most to the high acceptability of this diet.

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SECTION I

INTRODUCTION

Considerable effort has been expended to develop foods suitable for manned space travel. The length of these flights was initially limited, but now projected space journeys are being planned in terms of months and years. Extensive technological research has resulted in the bite-size, compressed and dehydrated food diet presently incorporated in Project Gemini; however, research endeavors must be continued to develop feeding concepts that will meet the nutritional requirements of extended space flight. The unique advantages of a liquid formula diet prompted the Biospecialties Branch of the Aerospace Medical Research Laboratories, Wright-Patterson Air Force Base, Ohio to evaluate this feeding concept under conditions simulating space travel (1).

While food technology has made rapid advances in the development of these foods, the infinite variety of a fresh diet cannot yet be duplicated. Because of the limited variety of foods available in present feeding concepts, one must examine the organoleptic acceptability of these concepts to ascertain the effects of their repetitive use over extended periods of time. Additional importance may be attached to this study since it has been reported by Schutz and Pilgrim (2) and other investigators (3,4) that a correlation exists between the palatability ratings and food consumption. The primary objective in planning meals for space flight feeding is to insure adequate nutrient intake; therefore, it is essential to have a diet which is organoleptically acceptable.

The monotonous effect of repetitive feeding has a more general applicability than that of the space nutrition program. Dietary regimens planned for use in metabolic balance studies must take this effect into consideration, as it is often necessary to limit food variety in order to maintain specific nutrient balances. When complete consumption of food is a prime objective, acceptability over extended periods of time becomes an important requisite.

There have been few studies related to food monotony reported in the literature. In studying the ratings given to foods served in three- and six-day cycle menu plans at the beginning and end of a twenty-four day period, Kamen (5) found no change in acceptability. Schutz and Pilgrim (2) on the other hand, reporting on a five-week study in which a four-day cycle menu was used, found that foods initially rated low decreased significantly, while those initially rated high did not change. Some foods actually showed an increase in rating. In a study of ten selected items from a two-day cycle menu utilized for eighteen days, Siegel (4) found that the overall acceptability decreased with time, but items originally rated high showed a smaller decrease in acceptability than those initially rated low.

The studies cited above were not carried out under either the precise, controlled conditions of a metabolic balance study or of simulated space flight. It is our purpose to report the effects of repetitive servings of three types of diets (liquid, fresh, and bite-sized, compressed and dehydrated food) on acceptability ratings under the precise controlled conditions of a metabolic balance study and of simulated space flight. Attention will be given as to whether monotony can best be minimized by incorporating more variety into the diet, or by limiting variety and placing emphasis on well-liked and highly rated foods.

SECTION II

METHODS AND MATERIALS

Data was collected from three, six-week studies in a series of twelve joint USAF/NASA experiments. These experiments were designed to study the precise caloric, protein, and water requirements of man under controlled environmental conditions and to evaluate personal hygiene procedures during long-term space flights. The duration of the experimental periods in this report are as follows: (a) liquid diet, three weeks; (b) fresh diet, six weeks; and (c) bite-sized, compressed and dehydrated diet, four weeks. Certain periods in the studies utilizing the liquid and experimental diets were not applicable to the topic discussed and are, therefore, omitted.

The liquid diet was a commercially prepared powder, in six flavors, which was reconstituted with water (table I). Fourteen ounces of this beverage were given at each meal (1). Fresh, frozen, and heat-processed foods were used in preparing the fresh diet which was divided into four equivalent meals (table II). Food items were prepared and frozen prior to the start of each experiment. The diet composed of precooked, bite-sized, compressed and dehydrated foods was arranged into a two-day cycle with four meals per day (table III). This type of food has been used in previous experiments (6). All of the diets ranged from 2500 to 2800 calories, and each diet was considered to be nutritionally adequate.

TABLE I
LIQUID DIET

Strawberry
Vanilla
Cherry
Chocolate
Raspberry
Butterscotch

Four of the six flavors were served each day in a three-day cycle menu pattern.

Eleven, healthy male college students (four in each study) were maintained in a controlled environment; one of the subjects participated in two experiments of the series reported here. During these balance studies all food was served at room temperature and subjects were required to consume all meals. Immediately after having eaten a meal, the subjects rated component food items individually and then each meal as a whole according to a graduated nine-point rating scale. These ratings were subjected to analysis of variance (7) to determine the significance of repetition.

TABLE II
FRESH FOOD DIET

<u>Meal A</u>	<u>Meal B</u>
Canadian bacon and cheese sandwich	Sliced turkey
Sliced pineapple	Cornbread
Honey graham crackers	Apricot halves
Grape juice	Brownies
	Milk
<u>Meal C</u>	<u>Meal D</u>
Roast beef sandwich	Sliced baked ham
Sliced peaches	Biscuits and butter
Pound cake	Applesauce
Orange juice	Sugar wafers
	Chocolate milk

One-day cycle menu composed of fresh, frozen, and heat processed foods.

TABLE III
EXPERIMENTAL DIET

Cycle I	Cycle II
<u>Meal A</u>	
Bacon squares	Bacon squares
Chicken sandwich	Cheese sandwich
Gingerbread	Strawberry cereal cubes
Coconut cubes	Brownies
Grapefruit drink	Orange drink
<u>Meal B</u>	
Beef bites	Bacon and egg bites
Apricot cubes	Toasted bread cubes
Date fruitcake	Pineapple cubes
Cinnamon toast	Grapefruit drink
Grapefruit drink	
<u>Meal C</u>	
Beef sandwich	Chicken bites
Pineapple fruitcake	Toasted bread cubes
Strawberry cubes	Apricot cereal cubes
Orange-grapefruit drink	Peanut cubes
	Orange-grapefruit drink

Two-day cycle menu composed of bite-sized, compressed foods and dehydrated beverages.

SECTION III

RESULTS AND DISCUSSION

With the exception of the bittersweet, chocolate-flavored beverage, the other flavors of the liquid diet were initially acceptable and showed a significant decrease with time ($P < 0.001$) as reported previously (1). The fresh diet, with an initially high degree of acceptability, showed no significant trend with time over the six-week period ($P < 0.10$). The experimental diet also did not show any effect of monotony. The diet was moderately acceptable in the beginning of the experiment and it did not show a significant change ($P < 0.25$) as a result of repetitive serving. These results are represented in figure 1.

From the data presented here, it appears that repetitive use of a restricted diet within the outlined conditions does not always cause the acceptability to decrease significantly with time. If a diet was initially acceptable, as the fresh and experimental diets were, little significant change resulted; but, if initial ratings were low, as in the liquid diet, significant decreases in diet acceptability did occur. From these observations we suggest that the dietitian, faced with similar circumstances, should concern herself less with variety and give more consideration to initial individual acceptance. This is particularly important since we have demonstrated a significant variation ($P < 0.01$) among individuals with respect to the acceptability rating of a particular food, even within the narrow population from which the subjects for these experiments were taken.

At the conclusion of each experiment, each subject completed a questionnaire designed to ascertain the degree of menu variety they would have preferred, in retrospect. Their comments did not correlate with the objective findings of the analysis of variance (7). When four subjects had completed forty-two days of a one-day cycle menu of fresh foods, the ratings indicated no significant effect of repetition, but the subjects stated a preference to a three-day cycle menu plan with greater variety. However, at the end of thirty days utilizing a two-day cycle menu of bite-sized, compressed and dehydrated foods, all four subjects stated a preference for a self-planned one-day cycle menu. Whether this difference should be attributed to differences inherent in individuals or to the type of diet cannot be stated at this time since the experimental design did not permit statistical verification. Assessment of dissatisfaction with pre-planned menus lends support to those observations of Kamen and Peryam (5) who concluded that self-planning does as much to increase satisfaction as doubling the amount of variety.

Since information concerning the acceptability of individual food items and food groups is of value to those responsible for planning metabolic regimens, an outline of the relative acceptability of the foods that were utilized in the fresh diet, as these

compared to the overall acceptability, is presented in figure 2. All beverages were consistently highly acceptable. Fruits in general were also acceptable. While bakery items were rated well, the home-baked products rated above the others. The subjects, however, were not satisfied with home-baked cornbread. Perhaps the fact that this item can be considered a regional food made it a poor choice for our menu. Cornbread was the only item in the fresh diet that averaged in the unacceptable range. Plain sliced meats and sandwiches showed variation but no major problems were associated with any particular items.

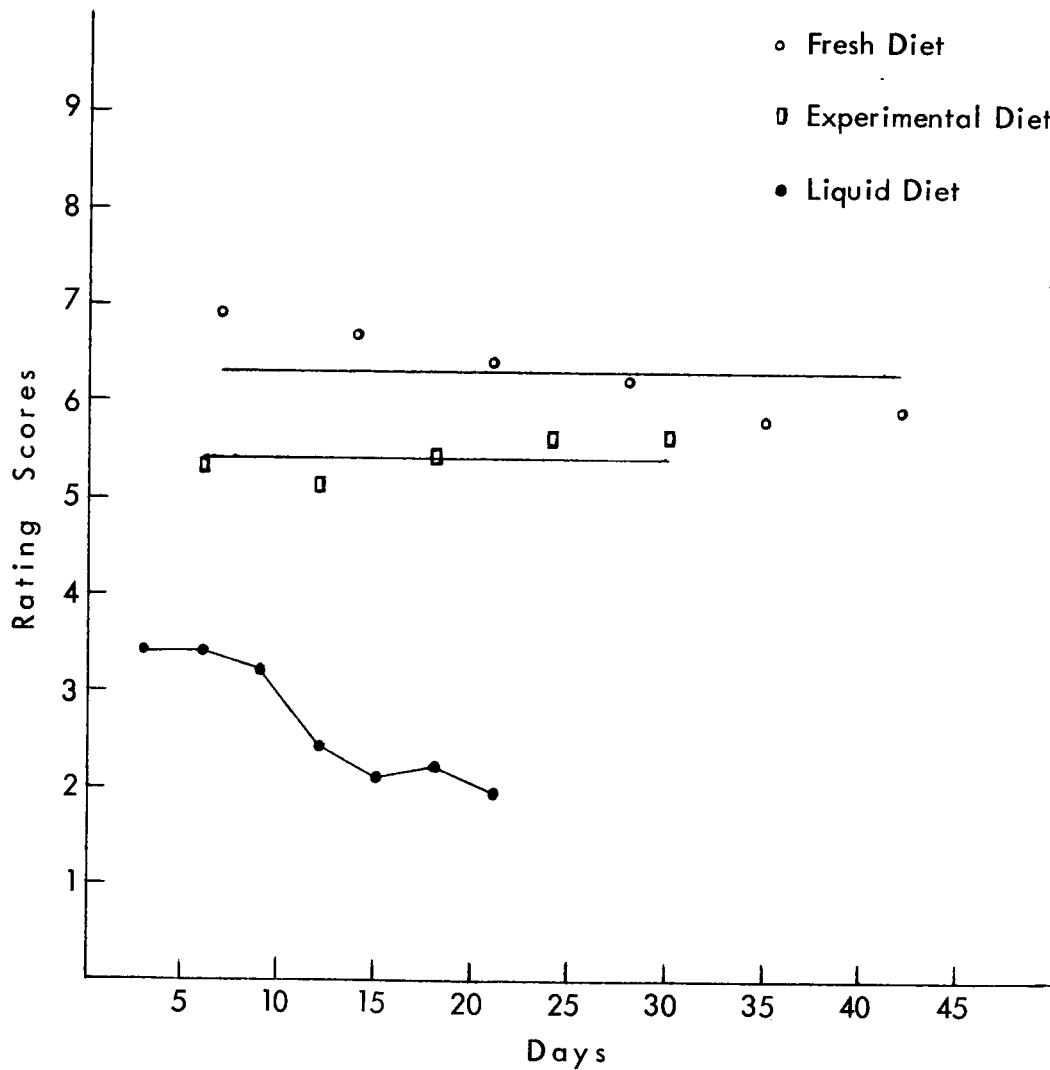


Figure 1. Mean acceptability of fresh, liquid, and experimental diets.

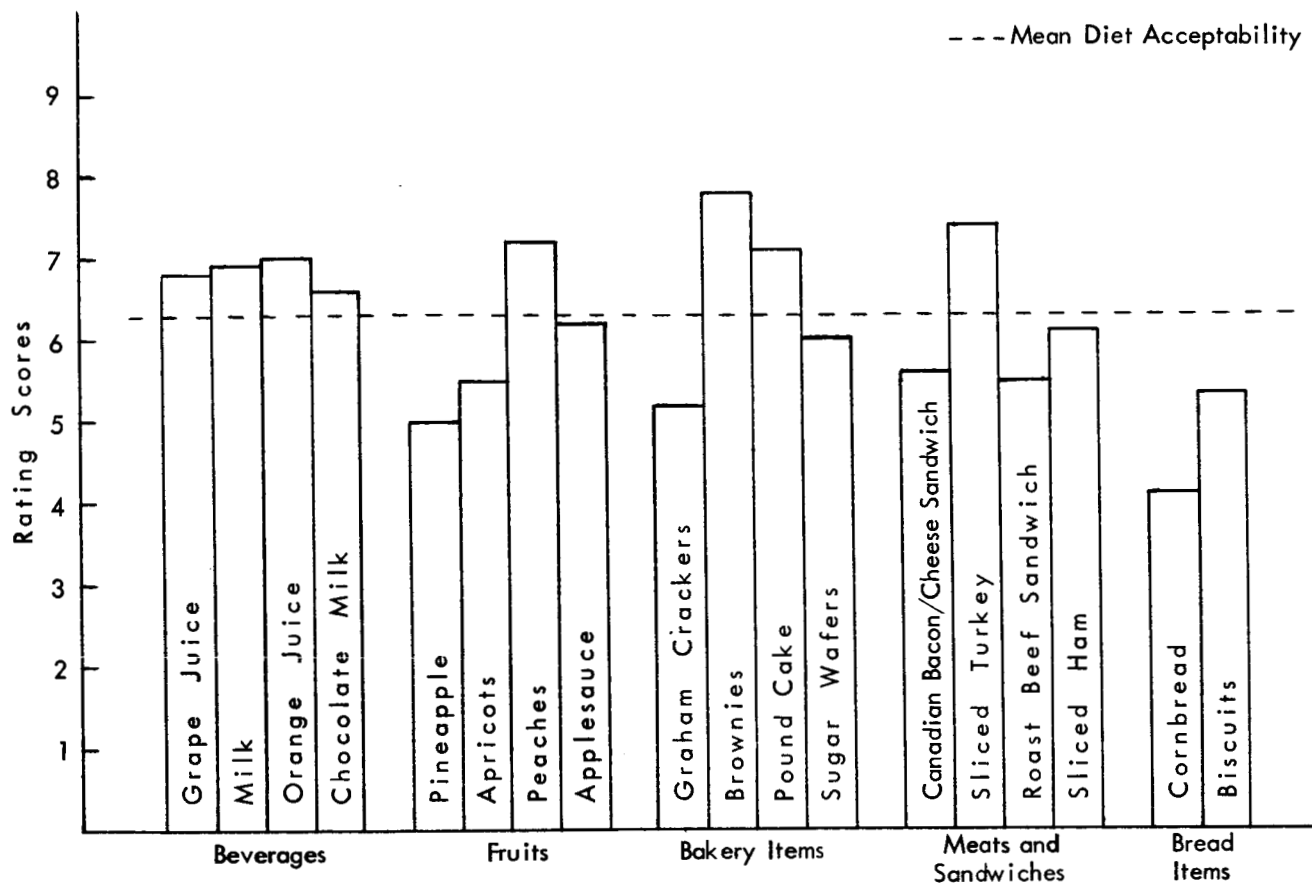


Figure 2. Relative acceptability of food groups in the fresh diet.

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