*BEHAVIORAL NUTRITION:
CONSUMPTION OF FOODS OF THE
FUTURE BY TODDLERS¹*

EMILY HERBERT-JACKSON AND TODD R. RISLEY

THE UNIVERSITY OF KANSAS

Behavioral measures of food consumption and tasting were combined with nutrient analysis of foods served at a toddler day-care center to determine whether children at the stage of initial exposure to adult diets would accept textured vegetable protein (TVP) and nonfat dry milk as well as they ate other sources of protein and calcium. Main dishes were prepared alternately with TVP, meat, or neither; others were prepared with or without nonfat dry milk. The variation in ingredients appeared not to affect the amount children ate, the percentage sampling the foods, or the percentage eating half a portion or more. Dishes made with TVP increased protein intake comparable to the amount obtained with meat supplements, and calcium intake increased with nonfat dry-milk supplements. In light of these findings, it appears that TVP and nonfat dry milk are practical alternative sources of protein and calcium in menus for young children.

DESCRIPTORS: nutrition, food intake, behavioral nutrition, traditional *versus* future foods, toddlers

In the past several years, shortages and high prices of agricultural commodities have given rise to concern about the long-term balance of world food supply and demand (*e.g.*, U.S. Congress, 1974). Population growth and relative lack of economic prosperity have focused attention on the problem of insufficient supplies in less-developed countries, especially south Asia. Further, there is mounting concern over the wasteful consumption of the economically advantaged of all countries where the preferred practice is to eat high on the food chain (Poleman, 1975). A major focus for change is decreased consumption of animal products, especially meat. Just a small reduction (10%) in

the consumption of beef, pork, and poultry by the average U.S. citizen would free 12 million tons of grain for uses other than animal feed. The potential social importance of this saving is demonstrated by the fact that one million tons of grain will feed six million people for an entire year (Mayer, 1975). Not only is the practice of eating high on the food chain expensive in terms of natural resources, but there is mounting evidence that the diseases of affluence, *e.g.*, coronary heart disease and some types of cancer, may be related to excessive consumption of animal fat and low consumption of fibrous foods (*e.g.*, Chan and Cohen, 1975; Connor and Connor, 1972; Keys, Grande, and Anderson, 1974; Reilly and Kirsner, 1975).

The problem of dietary change, as typically approached by nutritionists and other health-care professionals, is to recommend menus of foods which, if eaten in the recommended amounts, would meet people's nutrient needs and promote the desired change. But good advice is often not translated into practice. Even when the desired menus are actually prepared and served to people, they are not necessarily eaten, especially by children (*e.g.*, Patton, Car-

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ver, and Hunt, 1958). Behaviorists typically take another approach, measuring eating behavior directly and using contingency management to produce the desired changes. But this approach has been shown to be temporary, working only so long as the contingencies are applied (*e.g.*, Madsen, Madsen, and Thompson, 1974) and possibly is associated with overconsumption of certain nutrients, especially calories.

A combined strategy is presented here as an example of a new approach that behavioral researchers might use in addressing nutrition-related problems. This approach combines use of nutrient analyses with behavioral management technology, repeated measures and comparisons with the same persons, and reliance on available maintaining conditions for durable changes. In this example, measures of the amounts of foods actually eaten by children in normal eating situations are compared to identify foods that are eaten in sufficient quantities to produce an adequate nutrient intake while promoting the desired dietary change.

It is the toddler-age child (1 to 3 yr) who, in making the transition from an infant to an adult diet, may be most able to adapt to significant modifications in diet. For example, previous research with toddlers shows that they accept nonfat dry milk as well at room temperature as when chilled; children only slightly older (4 to 5 yr) expressed negative attitudes toward "warm" milk (Herbert-Jackson, Cross, and Risley, 1977). While examining toddlers' acceptance of a variety of foods that not only provide essential nutrients but are also inexpensive and convenient to prepare in group child-care programs, we investigated children's consumption of dishes made with textured vegetable protein (TVP) as a substitute for meat. TVP is an extruded soybean product resembling meat; it has been shown to be equivalent to hamburger in protein nutritive value when eaten by adult males in amounts approaching the recommended dietary allowances for protein (Kies and Fox, 1971). The children's eating

of dishes supplemented with nonfat dry milk solids was also examined for improved calcium nutrition.

METHOD

Participants and Setting

Twenty-one children (ages 12 to 30 months) from a variety of socioeconomic and ethnic backgrounds attending a toddler day-care center participated in the study. An average of 17 children attended each day. At the center, the children were provided two snacks and lunch. Initial servings at lunch were 80 g of a main dish and 40 g of vegetable, as well as 80 ml of prepared nonfat dry milk. The children could eat as much or as little of any food as desired; unlimited additional portions of the foods served in the same portion sizes were available.

All meals were served at a large round table seating eight children. Children entered the eating area individually and left as soon as they were finished or after 20 min, making room for other children. When a child entered, his or her place was already set with a mug of milk and a served sectioned dish and spoon. One caregiver assisted children in the eating area by helping them to their places, giving additional servings, and preparing new places. The children were not prompted or encouraged to eat but were assisted in self-feeding as needed and prompted to request second servings politely.

Food Preparation

Comparisons of consumption were made in the context of easily prepared, low-cost main dishes shown previously to be eaten well by the children. These included: liver loaf, beef loaf, rice/broccoli/cheese soup casserole, canned Spaghettios®, canned bean soup, lima bean soup, canned pork and beans, blackeyed pea soup, macaroni and cheese, canned split pea soup, and pea/rice/cheese soup casserole. Except for the addition of meat, TVP, or nonfat dry milk, the same basic recipe was used each time the

dish was prepared. When canned or other processed ingredients were used, the same brand was always purchased. All foods were served to the children at near room temperature. (Earlier work with toddlers in this center showed that they ate about the same amounts of five main dishes served in a counterbalanced order across days at three temperatures ranging from hot to room temperature.)

Granular fortified TVP flavored to resemble beef, ham, or chicken was furnished by the Cremette Corporation, Minneapolis, Minnesota. The TVP was hydrated by soaking overnight in two parts (by weight) water to one part TVP. Recipes for the use of TVP typically recommend use as a meat extender; however, with the exception of the loaf dishes that were prepared with half meat and half TVP, the dishes were prepared with either meat, TVP, or the basic recipe served with no additions (a list of the variations for each dish appears in Table 1). When meat or hydrated TVP was added to a dish, it was combined with the other ingredients to make up 20% to 40% of the weight of the total recipe. These proportions are higher than would usually be used, but were selected in order to compare consumption at levels that would rarely be exceeded.

When nonfat dry milk was added to a dish (see list, Table 2) it accounted for 6% to 10% of the weight of the total recipe.

Measurement

Group food-weighing procedures were used to determine the amount consumed of each food served at the meal (Twardosz, Cataldo, and Risley, 1975). The prepared food was weighed on a Universal dial gram scale before serving, then individual portions were weighed and placed in the children's dishes. At the end of the meal, the amount left over (not served) and garbage from children's plates and bibs and from the table and floor was collected, weighed, and subtracted from the amount prepared. The mean grams consumed per child was then calculated by dividing the total weight

consumed by the number of children served that food.

To characterize individual children's eating within the group, a mealtime observer recorded each child's tasting of the foods served and tallied each additional serving given each child. The lower end of the distribution of individual children's eating was of particular interest. Relevant information was obtained after the meal by inspecting the dishes of children who did not receive seconds and noting who had eaten at least half of their first serving of the main dish. The percentage of children served the meal who ate at least half a portion was computed from these data.

Once a week, measurement reliability was assessed for all observations. A second observer independently weighed the prepared food, leftovers, and scraps and calculated the mean amount consumed per child for each food. Percentage agreement on the mean grams consumed per child, calculated by dividing the smaller amount obtained by one observer by the larger amount and multiplying by 100 averaged 93% (range 86 to 100%). An independent observer also recorded tasting and additional servings and noted whether individual children had eaten half a serving or not. The percentage agreement between two observers' records of tasting of main dishes, scored for occurrences only, averaged 93% each meal (range 81 to 98%); agreement between records of additional servings computed the same way averaged 97% (range 93 to 100%). Agreement on recordings of children who ate half of their first portion but did not get seconds, scored by child and food item, averaged 86% (range 50 to 100% across meals).

Food tables (Watt and Merrill, 1963, Table 1) and manufacturers' information (*The Growing Challenges*, 1974) were used to estimate the amounts of the nutrients, protein and calcium supplied in 100 g of each ingredient making up a main dish. The amount of nutrients supplied in a standard (100 g) portion of each dish was then calculated by determin-

ing the weight of each ingredient, calculating the proportional contribution by weight of each to the whole recipe, and finally multiplying the proportional amount of each ingredient by its table value. The sum of the nutrient values for the recipe ingredients then equalled the amount of nutrient supplied in a 100-g portion of the food. For protein, these estimates were not adjusted for differences in quality because no standard methods for doing so have been established (Guthrie, 1975, pp. 74-76).

Design

The same basic main dish was presented once a week or less often. Thus, basic dishes, for example, macaroni and cheese, rice/cheese soup casserole, blackeyed pea soup, were interspersed across days. Within-dish comparisons were also interspersed; for example, macaroni and cheese was served supplemented with TVP and unsupplemented in an irregular order, so that not all meals featuring one kind of supplement preceded or followed the comparison dish.

Previous work with toddlers showed no systematic effects of repeated presentations on the average amounts eaten of particular foods (Herbert-Jackson, Cross, and Risley, Note 1). Nevertheless, to guard against the possibility that the children's reactions to the TVP dishes would not be characteristic of their long-term exposure, dishes prepared with TVP were served an average of every third day during the three months preceding this study.

RESULTS

The children's consumption of the TVP dishes was very similar to their consumption of the more usual meat or unsupplemented dishes. Table 1 presents the mean amounts (g) eaten of the comparison dishes and the protein (g) supplied in the amount eaten. While the children's consumption varied among dishes, for example, they typically ate more Spaghettios® than blackeyed pea soup, the

amounts eaten within dishes were not much different as a function of the addition of meat or TVP. Consumption varied by a mean of 4% between unsupplemented dishes and those prepared with TVP, and by 1% between dishes supplemented with meat and those with TVP. Statistical analyses corroborated the apparent lack of systematic differences between conditions in amounts consumed. For the mean amount eaten of TVP *versus* unsupplemented dishes $t(6) = 0.114$, for TVP *versus* meat supplements, $t(5) = -0.044$.

When TVP supplemented a recipe, the protein obtained in the mean amount of food eaten increased from a mean of 5.0 g for the unsupplemented dishes to 9.7 g. For children 1 to 3 yr of age, the recommended daily allowance for protein is 23.0 g (National Academy of Sciences, 1974); thus the TVP supplements improved protein intake by an average of 20% of the daily requirement. Using TVP, as compared to meat supplements, reduced protein intake by approximately 1.0 g, or 4% of the daily requirement.

Data on individual children's eating were congruent with the group data. The children were as willing to sample TVP dishes as those prepared with meat or unsupplemented. The percentage of children tasting the unsupplemented recipe averaged 80%; for the same dishes with added TVP, the average was 90%. For meat dishes, tasting averaged 93% compared to 95% for the same dishes made with TVP. The lower limit of the distribution of individual children's eating, expressed by the percentage of children eating at least half a portion (40 g), was also similar across preparation methods: 59% for the unsupplemented recipes, 68% for TVP; 64% for meat, 78% for TVP.

Dishes prepared with TVP cost considerably less than those prepared with meat. TVP cost \$1.50 per pound at the completion of this study when purchased in 25-pound quantities. Hydrated 2:1, this cost was comparable to meat at 50¢ per pound. The retail cost of the same

Table 1
Toddlers' Consumption of Dishes Supplemented with TVP, Meat, or Unsupplemented

Dish	Mean g Consumed/ g Protein in Amount Consumed		
	Unsupplemented	Supplemented	
		TVP	Meat
lima bean soup	70.2 4.0	104.3 ^b 9.4	—
liverloaf with catsup	—	74.4 ^b 10.8	72.2 ^b 12.2
beef loaf	—	64.6 ^b 9.5	63.3 ^b 9.8
pork and beans	117.9 7.2	117.3 ^b 15.0	—
rice/broccoli/cheese soup	120.1 3.1	73.8 ^b 6.0	78.8 ^b 4.8
Spaghettios®	191.0 4.0	142.6 ^b 9.0	163.5 ^b 10.3
rice/cheese soup	—	93.0 ^c 6.2	46.0 ^c 4.0
bean soup	—	92.7 ^h 7.0	110.7 ^h 12.2
blackeyed pea soup	70.4 4.6	95.0 ^h 9.7	—
macaroni and cheese	103.8 4.4	90.7 ^h 6.7	—
split pea soup	96.9 7.6	119.6 ^h 12.3	—
Average	110.0 5.0	106.2 9.7 90.2 8.0	89.1 8.9

^bBeef or beef flavored.

^cChicken or chicken flavored.

^hHam or ham flavored.

quantity of lean hamburger was \$1.00 per pound.

The children's consumption of dishes supplemented with nonfat dry-milk solids was also very similar to their eating of unsupplemented recipes. Table 2 presents the mean amounts eaten and the calcium obtained in that amount of each dish. Taken across the three dishes, the children ate an average of 69.7 g of those prepared with extra dry milk and 64.7 g of the unsupplemented recipes. Calcium intake, recommended at 800 mg daily (National Academy of Sciences, 1974), increased from a mean of

33.4 mg to 80.1 mg with the nonfat dry milk supplements. Measures of tasting and additional servings revealed no large or systematic differences between supplemented and unsupplemented dishes. Tasting averaged 90% when nonfat dry milk was added and 87% for unsupplemented dishes. The percentage of children eating at least half a portion averaged 54% for supplemented and 51% for unsupplemented dishes.

Fluid milk, as a dish supplement, is not directly equivalent to nonfat dry milk because many recipes could not absorb all the liquid

Table 2

Toddlers' consumption of dishes supplemented with nonfat dry milk or unsupplemented.

Dish	Mean g Consumed/ mg Calcium in g Consumed	
	Unsupplemented	Supplemented with Nonfat Dry Milk
chicken/rice/ cheese soup	53.9 15.2	49.5 69.2
pea/rice/cheese soup	63.0 24.0	53.7 38.9
split pea soup with ham TVP	77.2 60.9	105.9 132.1
Average	64.7 33.4	69.7 80.1

in the fluid milk. Nevertheless, nonfat dry milk retains a cost advantage, in addition to offering greater convenience. At the completion of this study, the best buy we found for fluid milk was 1.1¢ per ounce, while nonfat dry milk cost 0.7¢ for equivalent calcium.

DISCUSSION

In this study, a combination of behavioral and nutritional measures was used to identify TVP as a promising meat substitute and both TVP and nonfat dry milk as desirable supplements to basic recipes for toddler-aged children. Behavioral measures (amount consumed, tasting, eating at least half a portion) and intra-subject comparisons showed toddlers' eating of the supplemented and unsupplemented dishes to be very similar. Nutritionally, the protein or calcium content of recipes was increased with the addition of TVP or nonfat dry milk solids, respectively. Compared to meat, TVP provides similar amounts of protein and iron at about half the calories, with no animal fat and more calcium and fiber. While the quality (digestibility and biological value) of vegetable protein is rated lower than meat, protein sources may be combined in the same meal so that limiting amino acids complement one another,

thereby improving the protein quality of non-meat dishes (Lappé, 1971). In the dishes served here, nonfat dry milk solids added to the basic recipe could be expected to improve the quality of the TVP soy protein while doubling the available calcium. Food economics also favor use of TVP and nonfat dry milk. TVP may be purchased in large quantities at about half the cost of ground beef for equivalent amounts of protein and stored without refrigeration until mixing with water. Nonfat dry milk costs about a third less than fluid milk and may also be purchased in large quantities and stored without refrigeration until mixing with water.

Of course, these results should not be interpreted as a recommendation to eliminate meat or fat-containing milk from toddlers' diets. Variety remains the most frequently cited key to adequate nutrition (e.g., Mayer, 1975). Rather, this particular study exemplifies a behavioral nutrition approach to one of the pressing problems facing mankind, identifying alternative foods. As an example, it indicates that a combination of behavioral technology with measures of dietary adequacy is a promising strategy for addressing diet-related problems. Many problems remain to be solved and the skills of energetic behavioral researchers are needed to solve them.

REFERENCE NOTES

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