Foods with Different Satiating Effects in Humans

BARBARA J. ROLLS, INGRID C. FEDOROFF. JOANNE F. GUTHRIE and LOUISE J. LASTER
Department of Psychiatry and Behavioral Sciences, The Johns Hopkins University School of Medicine

The aim of this study was to identify particular properties of foods that can affect satiety. Two levels (50 and 200 kcal) of three preloads (tomato soup, melon, cheese on crackers) were given just before two different second courses (macaroni and beef casserole, grilled cheese sandwiches), allowing us to examine the effects of caloric level, energy density, and sensory-specific satiety on food intake in normal weight, non-dieting males. Eating time and initial palatability ratings were held constant. Soup was found to reduce second course intake significantly more than the other preloads. This reduction could be partially accounted for by the low energy density of tomato soup; however, soup reduced intake more than the melon preload, which was matched for energy density. Sensory-specific satiety did not explain the satiating efficiency of the soup. Thus, during a meal, tomato soup is more satiating than the melon and cheese on crackers. Further studies are required to determine why these foods have different effects and to determine whether soup consumption can be beneficial in weight reduction programs.

INTRODUCTION

Different types of foods satisfy hunger to different extents (Kissileff, 1984; Rolls et al., 1988b). The reasons for these differences in satiating effect are not clear. Among the factors that have been suggested to play a causal role are rate of consumption of a food, energy and nutrient content of a food, the energy density or volume of the food, the sensory properties of the food, and beliefs about the satiety value of a food (Kissileff, 1984).

The primary aim of the present investigation was to identify particular properties of foods that can affect satiety. Soup was chosen for the study because previous studies have indicated that soup may play a role in lowering caloric intake. In a clinical survey in which intakes were analyzed from food diaries, Jordan et al. (1981) found that meals which included soup were associated both with lower caloric intakes within the meals and with lower total daily caloric intakes than those without soup. It was not clear from Jordan's study whether the rate of soup consumption or particular properties of soup such as energy density affected total intake.

In controlled laboratory studies, Kissileff et al. (1984) compared the effects of soup as a first course with those of cheese on crackers and juice on the intake of a macaroni and beef casserole served as a second course. When two caloric levels of...
soup were consumed, it was found that, calorie for calorie, the soup decreased intake of the casserole more than the cracker, cheese and juice combination. Kissileff et al. (1984) suggest that the reason for the difference in satiating efficiency is not attributable to differences in bulk, energy density, or fat content, but may be due to differences in nutrient dispersion, orosensory cues or food temperature.

In this study, we confirmed that tomato soup is more satiating than other foods and investigated several factors that may be critical for this effect. Two levels (50 and 200 kcal) of three different preloads (tomato soup, canteloupe, Muenster cheese on crackers) were given before two different main courses (macaroni and beef casserole, grilled cheese sandwiches). Offering large and small servings of each preload allowed us to investigate the effect of caloric level on satiating efficiency. To determine whether the energy density of soup, which influences the volume consumed, was a possible factor in its satiating effect, it was compared with canteloupe, which has the same energy density. The energy densities of these two foods were much lower than that of the cheese on crackers. To eliminate eating time as a factor, the preloads were consumed over a fixed period of time. All three preloads were rated by the subjects as having similar palatability.

Rolls et al. (1986, 1988c) have shown that consumption of a food decreases the pleasantness of the taste not only of that food, but also of other foods with similar sensory properties. The possibility that the tomato soup may have suppressed intake of the casserole, which was tomato based, because of sensory-specific satiety was also investigated. The changes in the pleasantness of the sensory properties of the food to be eaten as the main course were assessed from before to after consuming the preloads. To determine whether the similarity between the preload and the main course affected intake, two different main courses followed the preloads. The main courses were rated by the subjects as being of similar palatabilities, but one was more similar in its constituents (i.e. tomato or cheese) to the preload than the other.

**METHODS**

**Subjects**

Twelve male subjects between the ages of 19 and 34 (mean age: 25.6 years) were recruited from among Johns Hopkins University students and employees. All were healthy non-smokers without health-related food restrictions or allergies, and none were taking any medication or drugs. Subjects were accepted for the study only if they were of low dietary restraint (<10), as indicated by the restraint factor of the Eating Inventory (Stunkard & Messick, 1985), and were within normal range of weight for height (Metropolitan Life Insurance Tables, 1959). The subjects had no history of an eating disorder (score of less than 15 on the Eating Attitudes Test, Garner & Garfinkel, 1979) and were not depressed, as indicated by low scores (0 or 1) on the General Health Questionnaire (Goldberg & Hillier, 1979).

Before final acceptance into the study, all subjects were required to sample the test foods and rate the pleasantness of the taste of each. All foods had to be rated 50 mm or above on a 100 mm visual analog scale. The three foods to be used as preloads (tomato soup, canteloupe, Muenster cheese on crackers) and the two foods to be used as second courses had to be rated within 15 mm of each other to ensure that they were of similar acceptability to the subjects.
Foods

Campbell’s Condensed Tomato Soup, Kraft Muenster Cheese on Ritz Crackers, and fresh canteloupe were used as either 50 kcal or 200 kcal preloads (Table 1). Both the soup and the fresh canteloupe are low energy density foods, with a high water content and calories derived primarily from carbohydrate (78% kcal and 93% kcal, respectively). The cheese on cracker preload, in contrast, was drier and derived most of its calories from fat (Muenster Cheese: 81% of kcal; Ritz Cracker: 46% of kcal). Consequently, the cheese on cracker preload was 11 times more energy dense than the soup and melon preloads.

With the preload, subjects were given a glass containing 225 g of water at 1.1°C which was to be consumed in its entirety. The tomato soup was prepared as instructed on the label, using equal weights of tap water and soup, and was served at 60°C. The Muenster cheese and crackers, presented as a square of cheese placed on top of each cracker, was served at room temperature (21.1°C). The canteloupe was cut into bite-sized pieces served at room temperature as well. The second course foods, which were offered in amounts greater than the subjects could consume, were grilled cheese sandwiches (American cheese on Roman Meal bread, grilled with Pam butter flavored non-stick cooking spray), and Stouffer’s macaroni and beef casseroles. Four sandwiches, each cut into four triangular pieces, were presented to each subject. The total weight of the sandwiches was approximately 330 g. Three prepackaged frozen casseroles were used per subject receiving macaroni and beef in the second course. These were prepared in the oven according to the directions on the package and were served together in one large bowl (approximately 900 g). Both second courses were served at 60°C and were given to the subject along with a 300-g glass of water (1.1°C).

The weight of food consumed in the second course was converted into energy intake by multiplying the weight of food consumed by the caloric value of the second course test food (casserole: 1.2 kcal/g, grilled cheese: 3.5 kcal/g). The caloric values of all the foods were taken from the manufacturer’s information, except for the melon which was taken from food composition tables (Pennington & Church, 1985).

<table>
<thead>
<tr>
<th>Table 1</th>
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<tr>
<td><strong>Experimental foods</strong></td>
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</table>

<table>
<thead>
<tr>
<th>Foods used as preloads</th>
<th>Amount consumed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tomato soup (0.4 kcal/g)</td>
<td>50 kcal 135.1 g 200 kcal 540.5 g</td>
</tr>
<tr>
<td>Canteloupe (0.4 kcal/g)</td>
<td>50 kcal 140.4 g 200 kcal 561.0 g</td>
</tr>
<tr>
<td>Cheese and crackers (4.4 kcal/g)</td>
<td>50 kcal 11.6 g 200 kcal 46.2 g</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Foods eaten in second course</th>
<th>Amount consumed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Macaroni, beef and tomato casserole (1.2 kcal/g)</td>
<td>ad libitum</td>
</tr>
<tr>
<td>Grilled cheese sandwiches (3.5 kcal/g)</td>
<td>ad libitum</td>
</tr>
</tbody>
</table>
Subjects came to the laboratory at their usual lunch time (between 1100 and 1330 hrs) on 12 different days by appointment. They were instructed not to eat anything between breakfast and the test session and to eat the same breakfast before each of the test sessions. The subjects were given food diaries to record both the time and content of the breakfast and dinner before each session, and these were checked before each test session. Subjects were also told that it was important to keep their daily activity level and food intake normal and to report any vigorous exercise or unusually large or small meals before each session so that the session could be rescheduled.

Test session

On the first test day, subjects were weighed, their height was recorded, and informed consent was obtained. Subjects were seated in a private test cubicle and were shown how to mark visual analog scales to record subjective responses appropriately. For example, subjects rated their hunger on a 100-mm visual analog scale from “not at all hungry” to “extremely hungry”. Thirst, desire to eat, prospective consumption, fullness, satisfaction, nausea, bloatedness and mouth dryness were rated in a similar manner.

On all test days, subjects were seated in the cubicles and rated their initial subjective sensations. The initial hunger rating was checked before each session, and if this rating differed by more than 15 mm from the baseline (first session) hunger rating, subjects were told that they would have to reschedule that session. This kept hunger levels within 15% of baseline for each individual.

Subjects were then given a rating tray containing samples of eight sweet and savory foods, including the second course foods, in 20-ml plastic containers. The total energy content of all eight samples presented on each rating tray was approximately 30 kcal. Intake of these was consistent across conditions and was not included in the analyses. Subjective ratings of the pleasantness of the taste of these foods were assessed on 100-mm visual analog scale ratings from “very unpleasant” to “extremely pleasant” in order to determine the effects of the different preloads on “sensory-specific satiety” or the changing hedonic response to foods.

After the initial rating tray, subjects were given 225 g of water at 1-1°C, and a preload of either 50 or 200 kcal of tomato soup, Muenster cheese on cracker, or fresh canteloupe. Subjects were given a timer and were told that they had 10 min to consume the entire preload including the water. Whether the preload was large or small, subjects were told to pace their eating and drinking to take the entire 10 min. Subjects had little difficulty complying with this instruction.

Two min after consuming the preload, subjects again rated hunger and satiety and were given a second rating tray. Immediately after completing these ratings, the subjects were given a second course of either grilled cheese sandwiches or macaroni and beef casserole. Subjects were given up to 15 min to eat and drink ad libitum. They were not allowed to read or do any work during the time of this meal, and could not pick apart the food. The foods were weighed before and after being presented to the subject. A final rating tray was given 2 min after this meal.
This study employed a repeated-measures design. Within-subject factors included: preload type (soup, melon or cheese on crackers), caloric level of preloads (50 kcal, 200 kcal), and test-meal type (casserole, grilled cheese sandwiches). To assess the change in subjective sensations relevant to hunger and satiety following each preload, difference scores were calculated from the difference in pre- and post-preload visual analog scale ratings. Data on food intake and on changes in subjective sensations were analyzed using repeated-measures analysis of variance. The satiating efficiency of each preload was determined by calculating a simple linear regression equation for each preload-test meal combination. Preload type was the independent variable and second course energy intake the dependent variable in each of these equations, and the inverse of the slope obtained was defined as the satiating efficiency (Kissileff, 1984).

The relationship between changes in visual analog scale ratings and subsequent intake in the second course was assessed using Pearson's product-moment correlation. The visual analog scale difference scores were computed from ratings made before the preload minus ratings following the preload. Only complete data sets were included in the analyses.

**RESULTS**

**Energy Intake in the Second Course**

Subjects significantly altered their intake according to the type of preload presented \[F(2,22) = 5.01, p < 0.02\]. Paired comparison analyses demonstrated significant differences between energy intake following the soup preload relative to the melon preload \[F(1,11) = 5.04, p < 0.05\] and the cheese on cracker preload \[F(1,11) = 7.25, p < 0.02\]. This indicates that, across all conditions, significantly fewer calories were consumed following soup than following both the melon and cheese on cracker preloads. Energy intake following the melon and cheese on cracker preloads did not differ significantly.

Subjects consumed fewer calories when the second course test food consisted of casserole than when grilled cheese sandwiches were presented \[F(1,11) = 19.64, p < 0.001\]. For both types of second course, however, subjects decreased their intake of the second course when presented with the high-calorie level preloads \[F(1,11) = 44.95, p < 0.0001\]. Paired comparisons of the soup preload and the cheese on cracker preload showed a significant interaction of preload type and caloric level \[F(1,11) = 5.77, p < 0.04\], indicating that at the high-calorie level, the satiating effects of the soup preload increased in comparison to the cheese on cracker preload (see Figure 1). Calculation of the satiating efficiency of each preload confirmed that the satiating efficiency of the soup preload was higher than the efficiency of the other two preloads for both second course conditions (see Table 2).

**Subjective Sensations**

Measures of the following subjective sensations were obtained before and after subjects were fed all preloads: hunger, prospective consumption, fullness, desire to
FIGURE 1. Mean (±SEM) energy intake (kcal) of casserole and grilled cheese sandwiches in a second course after subjects consumed the 50 and 200 kcal preloads.

eat, satisfaction, nausea, bloatedness, thirst and mouth dryness. Subjects did not differ significantly in these subjective sensations before consuming the preloads. Following the preload conditions, there were no significant differences in the changes in ratings of thirst and mouth dryness.

Changes in visual analog scale ratings of all other subjective sensations tended to follow either one of two patterns, which are illustrated in Figure 2. The mean
SATIETY FOLLOWING VARIOUS FOODS

Table 2
Mean (±SEM) energy intake (kcal) of foods consumed in the second course; satiating efficiencies of preloads

<table>
<thead>
<tr>
<th>Casserole Second Course</th>
<th>Soup</th>
<th>Melon</th>
<th>Cheese on crackers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-calorie preload</td>
<td>659.6±40.1</td>
<td>655.3±33.3</td>
<td>681.3±51.3</td>
</tr>
<tr>
<td>High-calorie preload</td>
<td>450.3±69.9</td>
<td>499.2±49.6</td>
<td>577.2±38.8</td>
</tr>
<tr>
<td>Satiating efficiency</td>
<td>1.28</td>
<td>0.96</td>
<td>0.82</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grilled Cheese Second Course</th>
<th>Soup</th>
<th>Melon</th>
<th>Cheese on crackers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-calorie preload</td>
<td>848.8±72.7</td>
<td>919.1±67.7</td>
<td>887.5±68.0</td>
</tr>
<tr>
<td>High-calorie preload</td>
<td>626.2±73.6</td>
<td>778.6±97.2</td>
<td>830.5±78.6</td>
</tr>
<tr>
<td>Satiating efficiency</td>
<td>1.37</td>
<td>0.83</td>
<td>0.38</td>
</tr>
</tbody>
</table>

difference in hunger ratings following consumption of the preloads was greatest for the high-calorie level melon preload, followed by the high-calorie level soup preload. The low-calorie level of the soup and melon preloads, as well as both levels of the cheese on cracker preloads, produced much smaller decreases in hunger sensations. A similar pattern was seen for prospective consumption and desire to eat. Analyses of variance, followed by paired comparisons of the three types of preloads, confirmed that this difference in the interaction of preload type with caloric level was statistically significant when the cheese on cracker preload was compared to either the soup preload or the melon preload [all F-values p<0.05]. Thus, at the high-calorie level, the ability of the soup and melon preloads to suppress feelings of hunger, desire to eat, and prospective consumption increased in comparison to the cheese on cracker preload.

As shown in Figure 2, the greatest mean increase in ratings of fullness was seen after the high-calorie melon preload, followed by the high-calorie soup preload, while smaller changes were seen with the remaining preloads. Changes in ratings of bloatedness, satisfaction, and nausea followed a similar pattern. Analyses of variance indicated that, for all of these subjective sensations, there was a significant interaction of caloric level with preload type when the melon preload was compared with the cheese on cracker preload [all F-values, p<0.05]. Thus, at the high-calorie level, the ability of the melon preload to induce feelings of fullness, bloatedness, satisfaction, and nausea increased in comparison to the cheese on cracker preload.

When the soup preload was compared with the cheese on cracker preload, the interaction of preload type and caloric level was significant for fullness and bloatedness [F(1,11)=7.94, p<0.05, and F(1,11)=19.11, p<0.001, respectively]. This indicates that, at the high-caloric level, the effects of the soup preload on these subjective sensations increased in comparison to the cheese on cracker preload. For satisfaction, only the effect of caloric level was significant when these two preloads were compared [F(1,11)=29.26, p<0.001]. No differences in nausea ratings were significant when the soup and cheese preloads were compared.

Overall, subjective ratings of hunger and satiety following the soup and melon preloads were similar; however, in terms of intake, soup was more satiating.
The relationship between these changes in subjective ratings, as measured by difference scores, and subsequent intake in the second course was examined using Pearson's product-moment correlation. Changes in hunger and fullness were significantly correlated with subsequent intake following not only the high-calorie soup preload ($r = 0.47$, $r = 0.51$, respectively; both $p < 0.02$), but also the high-calorie melon preload ($r = -0.41$, $r = 0.47$ respectively; both $p < 0.05$), and the high-calorie cheese on cracker preload ($r = -0.50$, $r = 0.54$; both $p < 0.01$).
The change in ratings for desire to eat was negatively correlated with subsequent intake for the high-calorie melon ($r = -0.47, p < 0.02$) and the high-calorie cheese on cracker preload ($r = -0.43, p < 0.04$); however, in the case of the high-calorie soup preload, the correlation just failed to reach significance ($r = -0.39, p < 0.06$). Changes in ratings of satisfaction and prospective consumption were significantly correlated with subsequent intake only following the high-calorie soup preload ($r = 0.52, r = -0.57$ respectively; both $p < 0.01$).

**Sensory-specific Satiety**

To access the effect of sensory-specific satiety on intake of the second course, the changes in pleasantness of the taste of the second course foods when they followed a preload with some similar sensory properties were examined (i.e. changes in grilled cheese following cheese on cracker; tomato beef casserole following tomato soup). Mean differences in pleasantness ratings of those foods to be eaten in the second course from before to just after the low-calorie preloads were extremely small (less than 4 mm), while differences following the high-calorie preloads were only slightly greater (less than 10 mm) and were not explained by sensory-specific satiety.

When grilled cheese sandwiches were served as the second course, the mean pleasantness ratings of the second course food decreased by only 2 mm following consumption of the high-calorie cheese on cracker preload. Mean differences in pleasantness ratings of grilled cheese were slightly higher following the high-calorie melon and soup preloads (5 mm and 3 mm, respectively). These results contradict the assumption that the similarity of the cheese on cracker preload to the grilled cheese sandwiches would result in the greatest decline in pleasantness of the second course food.

When the tomato beef casserole was served as the second course, mean declines in pleasantness of the casserole following the high-calorie melon and soup preloads were very similar (6 and 7 mm, respectively), while its pleasantness declined less following the high-calorie cheese on cracker preload (3 mm).

**DISCUSSION**

The results show that, calorie for calorie, tomato soup can be more satisfying than some other foods when given as a preload. This confirms and extends the previous findings of Kissileff et al. (1984) and Jordan et al. (1981). This study was based on that of Kissileff et al. (1984), but differed in some important ways. In the present study, the rate of consumption of the preloads was held constant so the possibility raised in previous work (Jordan et al., 1981) that it could have been a critical variable was eliminated. A fixed amount of water was given with the preloads and *ad libitum* water was given with the second course. Subjective ratings indicated that this held thirst constant across conditions and thus eliminated that possible confound in previous studies. The differences in the preload sizes were greater in this study (50–200 kcal) than in that of Kissileff et al. (1984, 37–115 kcal).

We tested only men, whereas Kissileff et al. (1984) tested both men and women. Although they did not find soup to be more satiating in men, we tested only men and found that soup produced a higher satiating efficiency compared to other foods. This difference in findings may be due to the larger preload size which could have contributed to the difference in the satiating efficiency of the foods.
In the present study, both equicaloric and equigravimetric controls were run. Whereas, in the previous study (Kissileff et al., 1984), only equicaloric preloads were tested. This study extended the finding that tomato soup suppresses intake of casserole to another food, grilled cheese sandwiches.

The low energy density could contribute to, but does not entirely explain, the high satiating efficiency of soup. This conclusion is based on the finding that although melon and soup, which are of the same energy density, had similar effects on subjective sensations associated with hunger and satiety, soup reduced subsequent food intake more. The cheese on crackers, which had 11 times the number of calories in a given weight as the other two foods, had very little effect on any of the subjective sensations associated with hunger and satiety (see Figure 2). These subjective responses probably reflect the differences in the volume of the preloads.

Obviously, in comparing soup and melon, a number of factors other than energy density varied between the foods. However, a more controlled study by Kissileff et al. (1984) has also tested the hypothesis that the low energy density of soup could explain its high satiating efficiency by adding butter or water to vary the energy density. That study led to the conclusion that energy density was not the explanation for the effectiveness of soup in reducing subsequent intake. Certainly, if energy density were the only explanation, then soup and melon should have had similar effects on subsequent intake in our study, but we found that soup reduced intake more. Thus, some other factors contribute to the satiating efficiency of tomato soup.

It has been suggested that the palatability of foods can affect subsequent subjective ratings of hunger and satiety (Hill et al., 1984), but we only tested subjects that gave the foods used as preloads similar palatability ratings. Kissileff et al. (1984) also suggested that the temperature of the soup could be important. We have compared the satiating efficiency of hot and cold vegetable juice in subjects that rated them of equal palatability, and did not find that the hot juice decreased subsequent intake of grilled cheese sandwiches more than did the cold juice (Rolls et al., in press). Another possibility is that the salt content of the soup could affect subsequent intake. However, we did not find any difference in satiating efficiency of regular tomato juice (Campbells) and tomato juice with no added salt (B. J. Rolls, I. C. Fedoroff, L. J. Laster, S. Kim, Note 1). The negative findings with the temperature and salt content of vegetable juice do not rule out these factors as part of the explanation for the high satiating efficiency of soup, but make it seem unlikely that they play a major role.

Kissileff et al. (1984) found that tomato soup reduced subsequent intake of a tomato-based casserole more than did cheese and crackers and apple juice. It is possible that this was because of sensory-specific satiety (Rolls, 1986; Rolls et al., 1986) for the tomato base. We tested the possibility that similarities between the preload and the subsequent course could be a factor, by offering two second courses, one the tomato-based casserole used by Kissileff et al. (1984) and the other grilled cheese sandwiches which would be similar to the cheese and cracker preload. We did not find that the tomato soup decreased the pleasantness of the taste of or the desire to eat the casserole more than the other preloads. Nor did the cheese and crackers reduce the pleasantness of the taste of or the desire to eat the grilled cheese sandwiches more than did the other preloads. Furthermore, the cheese and crackers did not reduce the intake of the grilled cheese sandwiches more than the other preloads. It may be that our assumptions about what would have made the preloads and test meals similar (i.e. tomato or cheese) were wrong, and that interactions between other properties of the foods such as temperature were more important. We have found
previously that sensory-specific satiety for particular flavors in foods (e.g. tomato) is not seen when other properties of the foods are very different (Rolls et al., 1988c).

Some other properties of soup which have not been investigated which could affect its satiating efficiency are its nutrient content, the rate at which it empties from the stomach, and that it is a liquid (Kissileff, 1985). However, a recent study suggests that when the same food is presented in liquid or solid form, the solid reduces subsequent intake more (Louis-Sylvestre et al., 1989). If the relative satiating efficiencies were simply a reflection of the rate at which nutrients were absorbed, metabolized etc., then it is likely that the delay between the preload and the second course would be critical.

Another factor which could be important is the way that soup is perceived. Soup is often perceived as a filling, satisfying food. On the other hand, melon is perceived as a light, low-calorie food and cheese and crackers are usually eaten as a snack. Beliefs about foods may be an important determinant of the satiating efficiency (see Rolls et al., 1988b). However, an argument against this hypothesis from the present data is that soup and melon were perceived as similar in that they had very similar effects on the subjective ratings associated with hunger and satiety.

The question of whether visual analog ratings provide a sensitive index of hunger and satiety is one that is frequently raised. We have found in some situations that changes in some ratings such as hunger and fullness are correlated with subsequent food intake (Rolls et al., 1988b), but this is not invariably the case (Rolls et al., 1988a). In the present study, although the changes following the high-calorie preloads in ratings of hunger, fullness, and desire to eat correlated well with subsequent intake, these ratings did not differentiate between soup and melon. The main conclusion that follows from the subjective ratings is that the energy density of the preload is the most important influence on hunger and satiety. However, the measurement of food intake in the second course indicates that there are other factors affecting the satiating efficiency of the foods.

Thus, these results show that some foods are more satiating, calorie for calorie, than others. The intake (kcal) of casserole consumed was reduced by 22% following the high-calorie soup preload compared to the high-calorie cheese on crackers preload and intake of grilled cheese sandwich was reduced by 25%. Although it is not yet clear why tomato soup has a higher satiating efficiency than some other foods, the explanation is not simply the rate at which it is consumed, its low energy density, or sensory-specific satiety for the second course. Further studies are required in which possible factors which could affect the satiating efficiency of soup are systematically isolated and varied. Such studies will contribute to our understanding of why some foods are more satiating than others.

Reference Notes
1. Rolls, B. J., Fedoroff, I. C., Laster, L. J. and Kim, S. Food intake 2 h after preloads of 6 oz or 10 oz of regular tomato juice or tomato juice with no added salt or a no-load condition did not differ regardless of sodium content or dose. Ratings of thirst increased significantly after the regular tomato juice but this did not impact on food intake.

References


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