

Short Communication

Effect of food service form on eating rate: meal served in a separated form might lower eating rate

Hyung Joo Suh PhD¹, Eun Young Jung PhD²

¹Department of Public Health Sciences, Graduate School, Korea University, Seoul, Republic of Korea

²Department of Home Economic Education, Jeonju University, Jeonju, Republic of Korea

In this study, we investigated the association between food form (mixed vs separated) and eating rate. The experiment used a within-subjects design (n=29, young healthy women with normal weight). Test meals (white rice and side dishes) with the same content and volume were served at lunch in a mixed or separated form. The form in which the food was served had significant effects on consumption volume and eating rate; subjects ate significantly more ($p<0.05$) when a test meal was served as a mixed form (285 g, 575 kcal) compared to a separated form (244 g, 492 kcal). Moreover, subjects also ate significantly faster ($p<0.05$) when the test meal was served as a mixed form (22.4 g/min) as compared to a separated form (16.2 g/min). Despite consuming more when the test meal was served as a mixed form than when served as a separated form, the subjects did not feel significantly fuller. In conclusion, we confirmed that meals served in a separated form might lower the eating rate and, moreover, slower eating might be associated with less energy intake, without compromising satiety.

Key Words: eating habit, eating rate, energy intake, food mixing, obesity

INTRODUCTION

Eating behaviors, particularly eating rate, have long been of interest as one of the factors that contribute to the development of obesity.¹ Eating rate has attracted attention as an indicator of appetite avidity and satiety sensitivity; a higher eating rate is thought to indicate a greater motivation to eat, and a more rapid deceleration over the course of a meal is thought to indicate a stronger response to internal satiety signals.^{1,2} Experimental studies that manipulated the eating rate in a controlled setting confirmed that faster eating is associated with greater energy intake; eating rate is a potentially significant key factor among eating behaviors in obesity prevention strategies and public health practices.^{3,4} Several studies have explored potential associations between eating rate and obesity; however, most previous studies on eating rate have compared obese and non-obese subjects.⁴ Few studies have examined the food factors that might affect eating rate. In a previous study, we found that food type (amorphous vs distinct form) and food unit size (big unit vs small unit food) might affect energy intake via eating rate.⁵ In this study, we investigated the association between the form in which food was served (mixed vs separated form) and eating rate.

METHODS

The study was approved by the Ethical Committee for Human Experimentation of the Jeonju University and was conducted in accordance with its rules and regulations (Jeonju 1041042-140614-02). The conditions and procedures of the investigation were reviewed with all individuals before they provided written informed consent. Subjects were recruited through advertisements in a local

newspaper. Individuals who responded to the advertisements were interviewed in order to ensure they met the following criteria: healthy women, 20-30 years of age; body mass index (BMI) of 18-30 kg/m²; not using medication known to affect energy intake or appetite; not athletes in training; not pregnant or lactating; non-smokers; free from food allergies; stable in weight for the past 6 months; not dieting to gain or lose weight; and regularly eating 3 meals per day. The experiment used a within-subjects design. Subjects came to the lab on two separate days and were asked to keep their evening meals and activity levels as similar as possible on the days prior to each test day. They were also instructed not to refrain from consuming any foods or energy containing beverages between meals on the test day. On each test day, subjects ate alone in a private room. Test meals (white rice and side dishes) in the same content and volume (500 g) were served at lunch as either a mixed or separated form, containing 175 g rice, 50 g beef, 50 g seasoned bean sprouts, 50 g seasoned spinach, 50 g seasoned bracken, 50 g seasoned white radish, 50 g seasoned carrot, and 25 g hot pepper paste (Figure 1). Subjective satiety and hunger were measured by using a conventional 100 mm visual analogue scale (VAS) rating. Subjects completed

Corresponding Author: Dr Eun Young Jung, Department of Home Economic Education, Jeonju University, 303 Cheonjam-ro, Wansan-gu, Jeonju 560-759, Republic of Korea.
Tel: +82-63-220-2827; Fax: + 82-63-220-2053
Email: jjjj@jj.ac.kr

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this rating 4 times: before, immediately after, 1 h after, and 2 h after lunch.

All statistical analyses were analyzed using a repeated measure analysis of variance (ANOVA) with one within-subject factor and Bonferroni-adjusted pair-wise comparisons using SPSS software (ver. 12.0, SPSS Inc., IL, USA).

RESULTS

Thirty-two subjects were selected for participation in the study. Two subjects failed to complete the study. Large servings of meals were provided to ensure that food intake was not limited by the food amount served.⁵ One subject consumed all the test meals that were served; however, she was excluded from the analysis because we could not quantify the effect of food type and food unit size on the consumption volume. Thus, the final subjects consisted of 29 individuals with an average age of 22.3 y, weight of 53.2 kg, height of 161 cm, and BMI of 20.4 kg/m². In addition, the mean scores for the Eating Attitudes Test,⁶ which assesses attitude toward foods and eating, and the Zung Self-Rating Questionnaire,⁷ which measures symptoms of depression, were 12.2 and 38.5 points, respectively. When the subjects were asked to rate taste pleasantness at the start of lunch using the VAS, there were no significant differences among test meals (data not shown).

Figures 2 and 3 present the consumption volume, eating rate, and VAS results (subjective satiety and hunger rating) for test meals served as a mixed or separated form. The form in which food was served had significant effects on consumption volume and eating rate; subjects ate significantly more ($p < 0.05$) when a test meal was served as a mixed form (285 g, 575 kcal) compared to a separated form (244 g, 492 kcal). Moreover, subjects also ate significantly faster ($p < 0.05$) when the test meal was served as a mixed form (22.4 g/min) as compared to a separated form (16.2 g/min). Despite consuming more when the test meal was served as a mixed compared to separated form, the subjects did not feel significantly fuller. In addition, there were no significant differences in the hunger rating between the 2 test meals served as 2 different forms for 1 h and 2 h after eating the test meals.

DISCUSSION

Bibimbap, which literally means “mixed rice,” is a signature Korean dish. This mixed meal is served as a bowl of white rice topped with sautéed and seasoned vegetables with hot pepper paste. Sliced beef is a common addition. The ingredients are stirred together thoroughly just prior to eating.⁸ Some scholars assert that this mixed meal originates from the traditional practice of mixing all the food offerings made at an ancestral rite in a bowl before par-

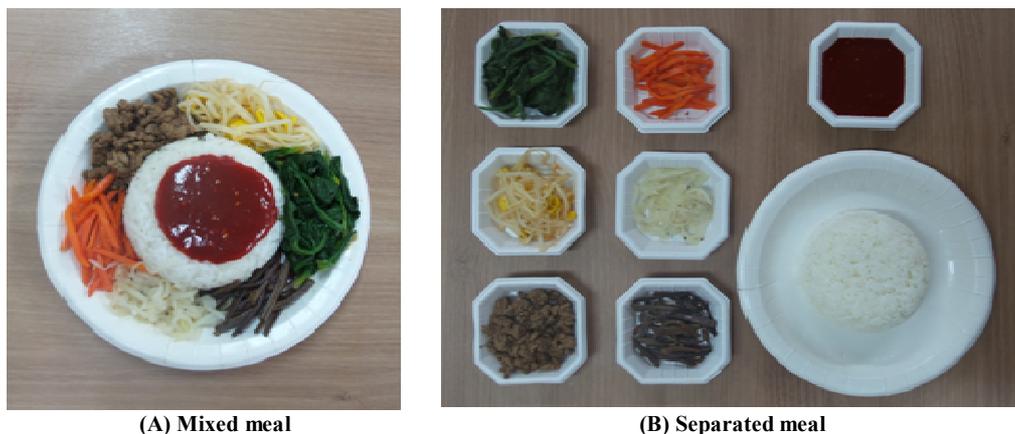


Figure 1. Pictures of test meals served as mixed and separated forms.

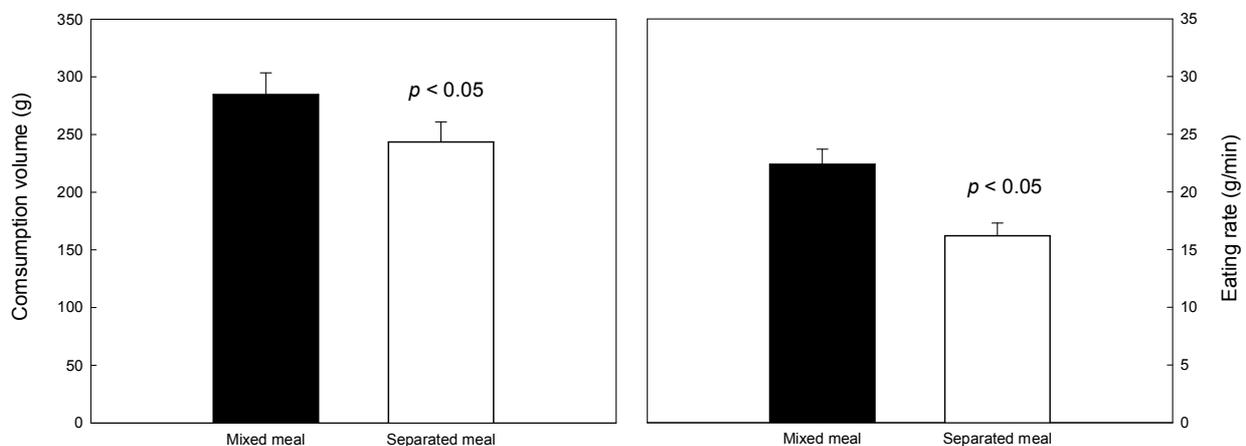


Figure 2. Consumption volume and eating rate for test meals served as a mixed form and separated form. Values are mean \pm standard error of the mean (SEM) for 29 subjects. Data were analyzed with a repeated measure ANOVA with one within-subject factor followed by Bonferroni-adjusted pair-wise comparisons.

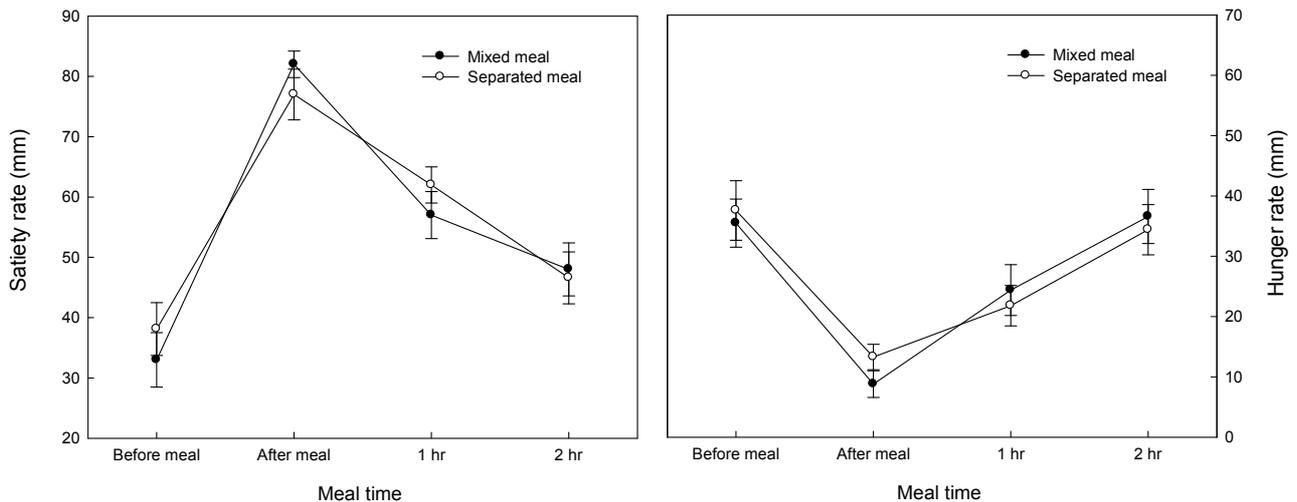


Figure 3. Hunger rating on test meals served as mixed and separated forms. Values are mean \pm standard error of the mean (SEM) for 29 subjects. Data were analyzed with a repeated measure ANOVA with one within-subject factor, followed by Bonferroni-adjusted pair-wise comparisons.

taking in it. Since the late 20th century, this mixed meal has become widespread in different countries. Recently, it has emerged as a healthy food, gaining attention around the world.⁹ However, a mixed meal might decrease meal time due to its convenience, similar to fast foods. A mixed meal might induce an increase in energy intake because energy intake is increased significantly with an increase in the eating rate.³ Previous research has tested the hypothesis that a reduction in the eating rate decreases food intake; moreover, it has been suggested that this intervention therefore can be used to treat obesity.^{3,4} Sakata and Yoshimatsu suggested, from their study of obese rats, that an eating rate abnormality might be the result of a defect in hypothalamic neuronal histamine.¹⁰ Due to the lack of satiety, a rapid eating rate may cause overeating before the stomach senses fullness. This is consistent with the positive association between eating rate and energy intake observed in our study.

In this study, we found that the form in which food was served had a significant effect on energy intake via eating rate; subjects ate significantly more and faster when a test meal was served as a mixed compared to separated form. Moreover, we also observed that despite consuming more when a test meal was served as a mixed form, subjects felt similar satiety and hunger from test meals served in the 2 different forms. In conclusion, we confirmed that meals served in a separated form might lower the eating rate, and moreover, that slower eating might be associated with less energy intake, without compromising satiety.

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AUTHOR DISCLOSURES

No conflict of interest in this study.

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¹*Department of Food and Nutrition, Korea University, Seoul, Republic of Korea*

²*Department of Home Economic Education, Jeonju University, Jeonju, Republic of Korea*

食物提供的形式对食用率的影响：餐食分开提供形式可能会降低食用率

在这项研究中，我们调查食物形式（混合或分开）和食用率之间的关系。该实验使用了受试者设计（n=29，年轻健康体重正常的女性）。具有相同内容和重量的测试餐（白米饭和小菜）以混合或分开的形式提供。食物提供的形式显著影响消费量和进食速度：当测试餐以混合形式提供（285 g，575 kcal）的时候，受试者吃的显著多于测试餐以分开形式提供（244 g，492 kcal）。此外，当测试餐以混合形式提供时受试者吃的也显著快（22.4 g/min）于以分开形式提供（16.2 g/min）。尽管当测试餐以混合的形式提供比以分开形式提供受试者消费更多，但受试者并没有感到更显著的饱腹感。总之，我们证实食物以分开形式提供可能降低食用率，而且更慢的进食速度与较少的能量摄入相关，而不影响饱腹感。

关键词：饮食习惯、进食速度、能量摄入、食物混合、肥胖