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Taste education reduces food neophobia and increases willingness to try novel foods in school children

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BACKGROUND/OBJECTIVES: This study measured the effects of a taste education program developed in Korea on food neophobia and willingness to try novel foods in school children.
SUBJECTS/METHODS: One-hundred and twenty school children (aged 7-9 years) residing in Seoul participated in 12 sessions of a taste education program for 3 months. The Korean taste education program was adapted from "Les classes du goût" by J. Puisais and modified to suit a Korean education environment. The study subjected school children to pre- and post-programs on food neophobia and willingness to try novel foods (WTNF), in addition to children's food neophobia in their parents. A total of 101 survey data were analyzed using SPSS 18.0.
RESULTS: Regarding the effects of taste education, scores of food neophobia significantly decreased ($P < 0.01$) in the posttest, mean (m) score (4.10 ± 1.19) decreased compared to the pretest (4.39 ± 1.00), and WTNF significantly increased ($P < 0.001$) in the pretest (m) score (0.48 ± 0.33) compared to the pretest (0.32 ± 0.34). This result indicates verification of the study hypothesis.
CONCLUSIONS: Food neophobia scale (FNS), an index that measures personal food preference [1,2], showed a very weak correlation with behavioral willingness to taste novel foods (WTNF). Therefore, it is expected that the two scales measure different things. However, considering that the traits of food neophobia are not easily changed, the taste education program was administered in a remarkably effective manner.

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INTRODUCTION

Food neophobia, a phenomenon of refusing novel foods, is regarded as a physiologically significant mechanism that protects humans and animals from harmful foods. The terminology is derived from the concept of the "Omnivore's dilemma" proposed by Rozin and Vollmecke [3], which explained the tendency to select familiar and safe foods rather than novel and unfamiliar ones.

Food neophobia appears in all age groups with individual differences in severity. Pliner & Salvy, Carruth *et al*., and Cashdan [4-6] have reported that participants' food neophobic tendency gradually increases from early childhood (2-years-old) and decreases by late childhood and adolescence. Previous studies have reported that food neophobia decreases most frequently between 4- and 22-years-old [7,8]. In school children, the preference for novel foods is expected to change after one-time exposure to food ingredients, and exposure to unfamiliar ingredients is known to have significant effects on the preference and willingness for re-intake [9]. Further, a strong food neophobic tendency in school children could be due to their lack of experiences with novel foods in early childhood.

Children's time in school is an important period of physical and mental growth and development. Recently, sound dietary habit formation in school children has become more important, necessitating development of education programs on balanced diets at home and in schools. Along with this, taste improvement education has been newly introduced in advanced countries.

The first taste education program for children (Les classes du goût) was developed in France in 1987 [10]. Since then, European countries such as Italy and Finland have recognized the importance of taste education for children, and studies on taste education programs for children are actively performed [11-13]. Russell and Worsley [14] showed that children's everyday food preferences are closely associated with food neophobia. They also suggested that effective taste education programs are needed to reduce food neophobia, which has direct influences on children's food preferences, and to promote formation of healthy dietary habits. In particular, taste education was suggested to be effective for short-term food neophobia reduction [11]. For the formation of dietary habits in school children, taste education with repeated taste and culinary practice experience education, rather than short-term taste education, is essential.

In Korea, studies are emerging regarding taste education programs and their effectiveness as part of children's dietary education, but taste programs for children introduced in Korea

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are still inadequate. Most dietary education programs developed in Korea for children consist primarily of simple nutritional education and culinary activities. In one study, parents and teachers of participating children aged 4-7 years who took five lessons of the taste education program observed a positive change in children's dietary habits; however, the study indicated a need to develop tools to measure effectiveness suitable for the age of the participating children as well as programs with long-term effects [15]. Therefore, there is an urgent need to provide measures that can promote taste education by highlighting the effects of dietary habit improvement for children in order to improve their long-term physical and mental health and facilitate the development of independent dietary habits.

This study aimed to verify whether or not children's food neophobia can be reduced through taste education as well as whether or not willingness to try novel foods increases. The objectives were to improve curiosity about taste, to perform a taste education program as a long-term preventative measure applicable to actual dietary habits, and to verify its effects, focusing on Korea's healthy food culture along with taste formation and development for school children. Therefore, in this study, we aimed to verify the effects of taste education through formation of dietary habits by reducing children's food neophobia and through effective new education methods to increase willingness to try novel foods.

SUBJECTS AND METHODS

Subjects

The institutional review board at Ewha Womans University approved the study (2012-08-09). The subject of this study was selected by a simple random sampling from a population of school children aged 7-9 years. A class of 20 children of the same age and gender distribution was used in preliminary experiments to test the procedures and to verify the equivalence of the subtest. A total of 120 subjects (aged 7-9 years) with no experience in taste education agreed to attend the program present in the pretest and the posttest. Only 101 subjects were present (72 girls, 29 boys, mean age 7 years, 9 months ± 5 months) in the posttest. The general characteristics of the school children who participated in the survey are shown in Table 1. Permission to execute the experiments in school children was obtained from the participants and the parents of all participating children gave their written consent based on a full understanding of the purpose and the procedure of this study.

Table 1. The study population

Grade / Age	Boys / Girls N (%)
1st / 7 yrs	9 (25.7) / 26 (74.3)
2nd / 8 yrs	8 (22.2) / 28 (77.8)
3rd / 9 yrs	12 (40.0) / 18 (60.0)
Total	29 (28.7) / 72 (71.3)

Questionnaire

Food neophobia scale (FNS)

The FNS was adapted from the French original version developed by Pliner and Hobden [16] and later reduced by Nicklaus, Boggio, Chababnet, and Issanchou [8]. This scale was modified to AFNS, a seven-point Likert scale measuring food neophilia in children and developed by Reverdy, Chesnel, Schlich, Koster, and Lange [11], and provided good internal consistency (Cronbach's alpha: 0.74, n = 180). The same scale was employed in this study (1 = very unlikely - 7 = very likely). Ten items in questionnaires were translated and revised to suit the level of 1st-3rd grade school children. These questionnaires were distributed both to parents and children in the same manner before (pretest) and just after (posttest) the education program. Reverse coding was applied for some questionnaires. FNS questionnaires used in this study consisted of 10 questionnaires as described in Table 2. In the FNS that the children evaluated, Cronbach's alpha was very low (0.573), indicating very low confidence, so the scale was deleted. This result can be explained by the children lacking capability to evaluate their food neophobia characteristics. On the other hand, Cronbach's alpha for the FNS that the parents evaluated, consisting of the same questionnaires, was greater than 0.6, representing a confident result due to the absence of items that disrupted the confidence level (Cronbach's alpha 0.83, n = 101 in pretest). Based on these results, children's FNS evaluated by parents was utilized in the analyses.

Table 2. Description of items of the food neophobia scale (FNS)

No.	Item of the AFNS	Item of the FNS
1	I am very particular about the foods I will eat.[R]	I am very particular about the foods I will eat.
2	I like foods from different countries.	I like foods from different countries.[R]
3	I don't trust new foods.[R]	I don't trust the foods I never tried before.
4	I like to try unusual foods.	I like to try unusual foods.[R]
5	If, for a food, I have the choice between different flavors (for example: an ice-cream, a sweet,…), I like to choose a flavor that I do not know.	If, for a food, I have the choice between different flavors (for example: an ice-cream, a candy,…), I like to choose a flavor that I do not know.[R]
6	I will try a dish, even if I do not know what is in it.	I will try a dish, even if I do not know what is in it.[R]
7	The foods I know are sufficient for me.[R]	I am good with the foods I already know.
8	I am willing to eat everything that one offers to me.	I am willing to eat everything that one offers to me.[R]
9	I am afraid to eat things I have never had before.[R]	I am afraid to eat things I have never had before.
10	I will not taste a food when I do not know what it is.[R]	I will not taste a food when I do not know what it is.

[R] Reversed scoring

Willingness to Try Novel Foods (WTNF)

This scale was adapted from the French version of the WTNF developed by Reverdy, Chesnel, Schlich, Koster, and Lange [11] and evaluated behavioral neophobia upon exposure to novel foods. In this study, the same scale was modified to suit the purpose of the study and applied to participating school children. The test consisted of three parts and a total of 18 questionnaire items.

Acceptance of novel food

In the second part of the test, subjects received six dishes with each containing a novel food. Subjects were allowed to touch and smell the foods and were surveyed on their desire to eat it based on a five-point Likert scale (1 = I never want to eat it, 5 = I really want to eat it).

Familiarity of novel food

In the first part of the test, subjects were presented with six dishes with each containing a novel food and asked to observe the appearance. Subjects were then asked the question 'Do you know this food?' to evaluate familiarity with the novel food by choosing one of the following answers:

(1) I do not know it, and it is not similar to any of food that I know.
(2) I do not know it, but it is slightly similar to a food that I know.
(3) I do not know it, but it is very similar to a food that I know.
(4) I know it, but I never ate it before.
(5) I know it, and I occasionally eat it.
(6) I know it, and I often eat it.

The higher the score, the more familiar the subject is with the novel food.

Preference for novel foods

In the last part of the test, subjects were asked to taste the novel food and answer the question "Do you like this food?" to evaluate preference for the novel food based on a five-point Likert scale (1 = I do not like it very much, 5 = I like it very much).

In the three test stages, a total of 12 novel foods were divided into three equivalent sets of six foods. Each was the basis of a preliminary experiment with a group of 20 children of the same age and sex involved as the experimental subjects. Each of the three subsets contained the same six categories and shared similar characteristics of foods (e.g. vegetables, fruits, grains, nuts, dairy products and seafood; see Table 3).

The WTNF scores were computed by dividing the number of unknown foods (answers 1, 2, or 3 in the first test) that the subject was willing to eat by the total number of items that were unfamiliar to the subjects. A higher proportion means that the subject is more neophilic.

Taste education program

The taste education program of this study was refined in accordance with the environment and current status of Korean elementary schools in line with the concept of the taste education program "Les classes du goût" first developed in France [10]. The taste education program consisted of integrated educational intervention of taste education and culinary practice programs and was based on the 'Yin & Yang and five elements of the universe' theory. This theory is characteristic of Korean traditional dietary culture and consists of five colors resembling vegetables, fruits, and grains as well as five tastes using sauces of traditional fermented foods. This program included food color coding based on traditional Korean foods, thereby highly recommending ingestion of various foods rich in nutrients. This was used to strengthen internal organs, spread sound dietary attitudes based on Korean foods, and inspire a return to well-being foods from high-caloric foods such as meat, fat, fish-like conventional fast foods, processed foods, and semi-cooked foods. Formation of balanced dietary habits based on Korean foods would contribute to the prevention or treatment of representative diseases in children such as unbalanced dietary habits, obesity, allergies, and atopy. The content of the taste education program is shown in Table 4. The taste education program was performed for 100 minutes for each session once a week for 3 months.

The introduction focused on understanding the program and building rapport through self-introduction. This step consisted of activities identifying participants' own dietary problems through self-reporting of preferred and non-preferred foods using daily dietary records, thereby recognizing the need for education through understanding of taste education. Based on taste experience education using five tastes, repeated culinary practice, and group activities, activity subjects were provided sequentially to apply such elements in each session.

In the last step, the 12th session, the parents and children as a group made foods representing the five tastes based on provided cooking methods, prepared table settings, and evaluated the taste. Using the activities learned up to that point, they presented explanations and impressions of the completed foods along with what the children experienced and felt. In addition, the learning activities summarized by each session were made into a book and given to the children so that they

Table 3. The six novel foods presented in each of the two different sessions (pretest and posttest)

Food groups	Pretest	Posttest	Close association
Vegetables	Deodeok	Yam	Root vegetables, color, price
Fruits	Dragon fruit	Rambutan	Tropical fruits, unusual appearance
Grains[1)]	Mung beans	Glutinous millet	cooking method applied, Usual typed of grains consumed
Nuts	Pistachio	Sunflower seeds	Presence of shells
Dairy products	Feta cheese	Cottage cheese	color and appearance
Seafood[2)]	Capelin	Sailfin sandfish	cooking method applied, appearance

[1)] Presented as both uncooked and cooked
[2)] Presented as both fresh and grilled

Table 4. The taste education program

Stage	Title of the session	Aim of the class	Class activity
Start up	Class 1. The five senses	Understanding the five senses related to tasting procedures (before, during, and after)	- Exploring the five senses to describe a food - Making five senses Salad
Taste with the five senses	Class 2. Taste	Discovering own sense of taste perception	- Knowing the basic four tastes - Making five tastes Gimbap
	Class 3. Vision	Understanding the five colors of foods and how they affect perception of food tastes	- Knowing that colors have an impact on sensory perceptions - Making my own colorful rice balls
	Class 4. Olfaction	Identifying the relationship between aroma and flavor	- Using odor bottles to identify aroma and flavor - Making rice cake skewers with aromatic sauces
	Class 5. Touch and Hearing	- Understanding that foods may come in different textures - Understanding that hearing and touching complement each other	- Linking food textures and hearing - Making crunchy tofu cookies
	Class 6. Flavor	Understanding the relationships among functions of olfaction, flavor, and taste.	- Identifying different flavors and tastes presented in foods - Making shaved iced dessert with flavorful fruits
Rediscovery of the taste	Class 7. Traditional Korean food	- Discovering traditional Korean food, and eating habits of pupils - Understanding the seasonal ingredients used in Korean food	- Experiencing the flavor of Korean traditional cooking - Making Bibimbap with seasonal vegetables
	Class 8. International food	Discovering different food cultures	- Comparing the differences between the cultures of Korean and Japanese food - Making Japanese pancake
	Class 9. Food preferences	Discovering food preferences	- Tasting unfamiliar foods and expressing food preferences - Making Rice pancake with unfamiliar food ingredients
	Class 10. Understanding the five senses	Remembering knowledge built up during previous classes	- Tasting five tastes utilized with the five senses - Making Five tastes fruit punch
Becoming familiar with foods	Class 11. Table manners	Understanding the culture of Korean table manners Discovering the method of using chopsticks	- Comparing the Korean table setting with Western table settings - Making 3-sides Korean traditional dishes
Wrap up	Class 12. Table settings	Wrapping up session Setting up the 'Five tastes tables' by groups Evaluation of the program	- Experiencing pleasure of eating together - Evaluate the tastes of each meal made by groups

could promote willingness to practice independent healthy dietary habits in the future.

Procedure

A questionnaire was completed by 20 children of the same age and gender distribution as well as 15 parents of school children in preliminary experiments. Prior to the taste education, the experimenter, including two other instructors and two assistants, demonstrated a training session on the survey questionnaires and measurements of scales. All school children and their parents answered the questionnaire before the education (pretest), and the subjects received 12 sessions of the taste education program. The follow-up data were collected over 3 months, with the following schedule for completion of the questionnaire (Fig. 1): April 2012 (baseline: pretest) and July 2012 (Follow-up: posttest).

Statistical analysis

In this study, the final data from 101 questionnaires were analyzed using SPSS 18.0 (SPSS, Inc. Chicago, IL, USA). Statistical analysis of a paired-sample t-test was used to investigate changes in food neophobia and WTNF induced by the taste education program. Descriptive analysis was conducted based on the mean and standard deviation to determine changes with familiarity, preference, and acceptance of novel foods marked on a five-point Likert scale. In addition, correlation between FNS and WTNF scores were also calculated.

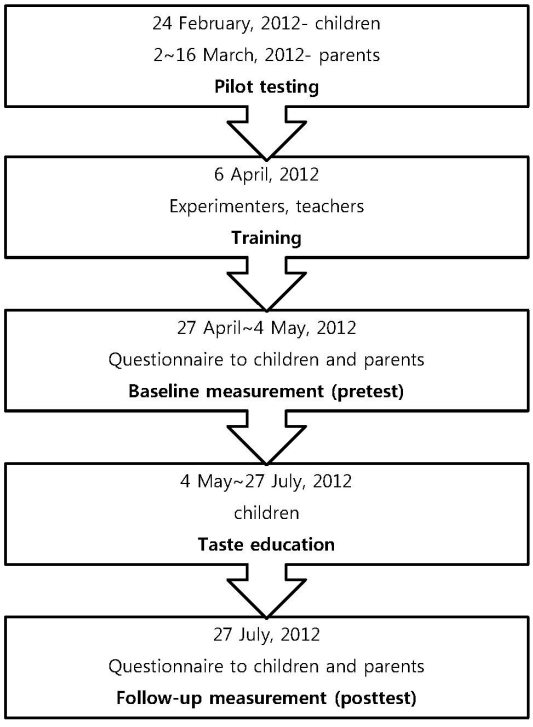

Fig. 1. Flow chart of the experimental procedure of the study

RESULTS

Declarative food neophobia score

Fig. 2 illustrates changes (posttest-pretest) in scores of the mean and standard deviation for food neophobia. The scores of the FNS significantly decreased ($P < 0.01$) in the posttest (m) score (4.10 ± 1.19) compared to the pretest (4.39 ± 1.00), and this result reveals that the taste education program effectively reduced the characteristics of neophobia behaviors. This result shows that the taste education programs reduced AFNS in the experimental group (F(1, 179)-4.10; $P = 0.044$).

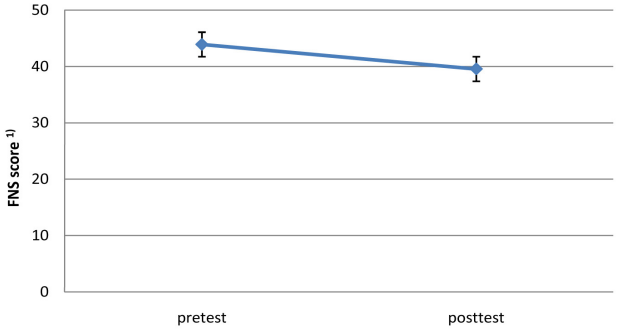

Fig. 2. Mean scores and standard errors of the mean obtained for food neophobia in pretest and posttest periods (after 12 lessons) (means and their 95% confidence intervals). 1) FNS score: food neophobia score

Behavioral food neophobia

Familiarity with novel foods

Fig. 3 shows changes (posttest-pretest) in scores of familiarity with novel foods.

Novel foods were classified by the food groups selected in this study. Familiarity with novel fruits (dragon fruit and rambutan) ($P < 0.01$), nuts (pistachio/sunflower seeds) ($P < 0.05$), dairy products (feta cheese/cottage cheese) $P < 0.001$), and seafood (capelin/sailfin sandfish) ($P < 0.05$) significantly increased in the posttest period compared to the pretest. On the other hand, there was no significant change in familiarity with novel vegetables (deodeok/wild yam) and grains (mung beans/glutinous millet) in the posttest period compared to the pretest. Such results may be because grains have long been eaten as a staple food in Korea, and a dietary culture that enjoys side dishes using various vegetables was established. Therefore, significant differences were not observed in familiarity with grains and vegetables. This suggests that application of the taste education program can have a positive influence on changes in familiarity with novel foods in children.

Preferences for novel foods

Fig. 4 illustrates the difference between the scores of the pretest and posttest based on preferences for novel foods. Preferences for novel vegetables (deodeok/wild yam) ($P < 0.05$),

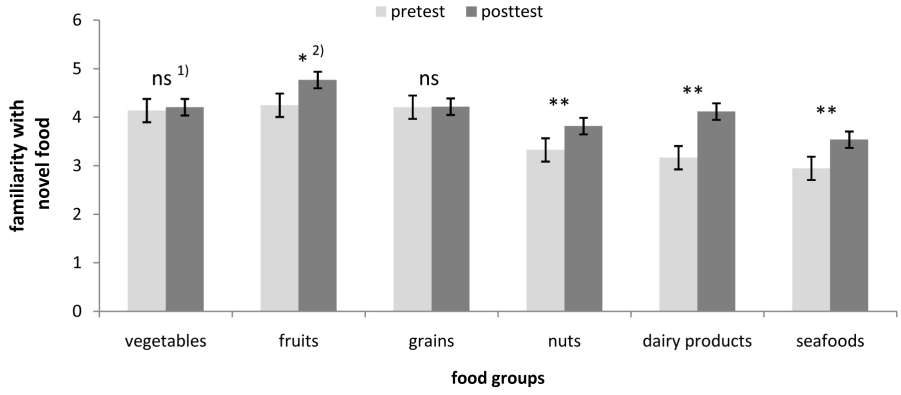

Fig. 3. Familiarity with novel foods in pretest and posttest periods (means and their 95% confidence intervals), 1) ns: non-significant 2) *$P < 0.05$, **$P < 0.01$

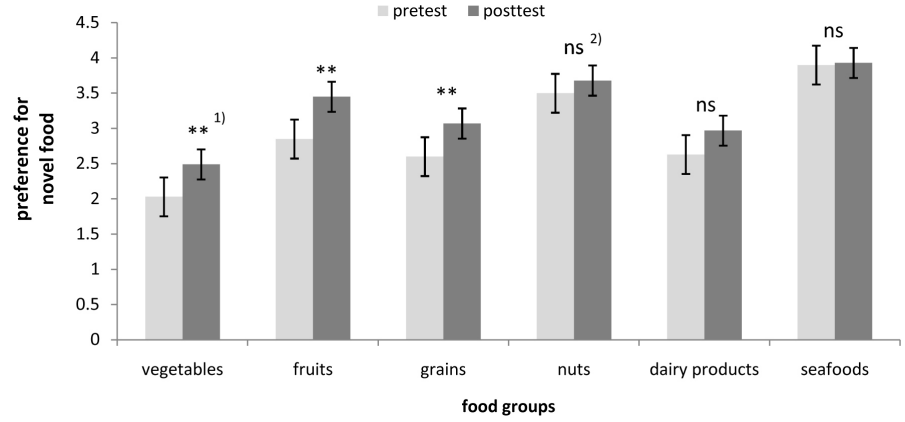

Fig. 4. Preferences for novel foods in pretest and posttest periods (means and their 95% confidence intervals). 1) **$P < 0.01$ 2) ns: non-significant

fruits (dragon fruit and rambutan) ($P < 0.05$), and grains (mung beans/glutinous millet) ($P < 0.05$) significantly increased in the posttest period compared to the preset. On the other hand, preferences for novel nuts (pistachio/sunflower seeds) and dairy products (feta cheese/cottage cheese) increased in the posttest period compared to the pretest but were not statistically significant. However, there was no significant change in the preference for novel seafood (capelin/sailfin sandfish) between the pretest and posttest. Such results indicate effective application of the program utilizing the five colors focused on vegetables, fruits, and grains based on the 'Yin & Yang and five elements of the universe' theory, which is characteristic of Korean traditional dietary culture. However, whereas the program was intended to encourage children to consume healthy foods instead of high-calorie foods, preference for seafood did not significantly increase. This indicates that the taste education program can influence children's preferences for novel foods.

Acceptance of novel foods

Fig. 5 illustrates changes (posttest-pretest) in the scores of the acceptance of novel foods. Acceptance of novel vegetables (deodeok/wild yam) ($P < 0.01$), fruits (dragon fruit and rambutan) ($P < 0.05$), grains (mung beans/glutinous millet) ($P < 0.01$), nuts (pistachio/sunflower seeds) ($P < 0.05$), and dairy products (feta cheese/cottage cheese) ($P < 0.01$) significantly increased in the posttest period compared to the pretest. However, changes in the scores of acceptance of novel seafood (capelin/sailfin sandfish) did not significantly increase. When providing novel foods, seafood was provided in both raw and cooked forms so that acceptance did not increase significantly due to the distinct odor of seafood. Given this result, it can be concluded that the taste education program promoted children's acceptance of novel foods.

Table 5 gives an overview of the changes (posttest-pretest) in the effect of the taste education program on behavioral food neophobia.

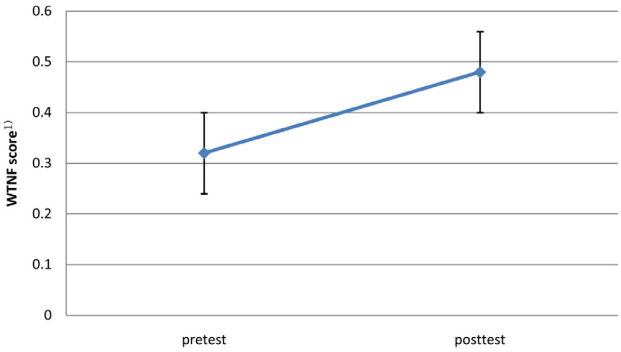

Fig. 6. Mean scores and standard errors of the mean obtained for WTNF score by children in pretest and posttest periods. [1] WTNF: Willingness to taste novel food

Willingness to try novel food

As shown in Fig. 6, changes (posttest-pretest) in the scores of WTNF increased in the posttest period compared to the pretest, and the results of a paired t-test show a significance level of 0.001 ($P = 0.001$). This indicates that the taste education program had significant effects on children's WTNF.

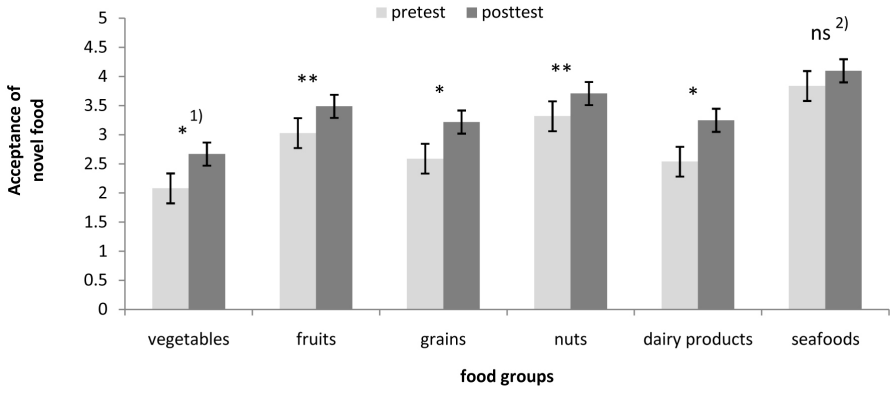

Fig. 5. Acceptance of novel foods in pretest and posttest periods (means and their 95% confidence intervals). [1] $*P < 0.05$, $**P < 0.01$ [2] ns: non-significant

Table 5. Changes in Behavioral Food Neophobia of food groups

Behavioral Food Neophobia	Changes in Means					
	Vegetable	Fruits	Grains	Nuts	Dairy products	Seafood
Familiarity	0.07↔ (t = 0.352)	0.52 ↑ (t = 2,708, $P < 0.01$)	0.01↔ (t = 0.049)	0.49 ↑ (t = 2.209, $P < 0.05$)	0.95 ↑ (t = 4.041, $P < 0.001$)	0.59 ↑ (t = 2.573, $P < 0.05$)
Preference	0.46 ↑ (t = 2.731, $P < 0.05$)	0.6 ↑ (t = 3.162, $P < 0.05$)	0.47 ↑ (t = 2.555, $P < 0.05$)	0.18↔ (t = 0.928)	0.34↔ (t = 1.886)	0.03↔ (t = 0.167)
Acceptability	0.59 ↑ (t = 3.199, $P < 0.01$)	0.46 ↑ (t = 3.162, $P < 0.05$)	0.63 ↑ (t = 3.105, $P < 0.01$)	0.39 ↑ (t = 2.353, $P < 0.05$)	0.71 ↑ (t = 3.519, $P < 0.01$)	0.26↔ (t = 1.439)

↔ Increased non significantly.
↑ Increased significantly.

Table 6. Correlations between the FNS and WTNF in pretest and posttest

	R(N)	*P*-value
Pretest	-.051(101)	< 0.615
Posttest	-.111(101)	< 0.269

Correlations between FNS and WTNF score

Table 6 shows the correlation between pretest-posttest FNS and WTNF scores of taste education.

Pearson's correlation analysis showed a negative correlation between FNS and WTNF in the pretest. However, the effect of taste education on FNS and WTNF was very low (r = -0.051). The correlation of FNS with WTNF after taste education was not statistically significant (r = -0.111), although its value increased due to the effects of taste education. This could mean that the taste education program had an impact on the positive relationship between declarative and behavioral neophobia.

DISCUSSION

Regarding the hypothesis of this study, the effects of taste education were verified to be significant.

Reverdy *et al*. [11] investigated the effects of a taste education program consisting of 12 sessions on the development of food preferences in school children. In their study, children showed increased interest regarding sense of taste, interaction with foods, and rich emotional expression after trying various foods, indicating increased interest in novel foods overall. In a study on the effects of children's taste education on food neophobia performed by Mustonen & Tuorila [13], taste education was found to increase the interaction between children's taste and foods. This is inconsistent with the results of the present study showing that taste education programs resulted in reduced food neophobia in children of lower grades. Such positive effects are believed to be because the taste education with culinary practice activities performed in this study provided opportunities for children to deal with unfamiliar food ingredients by repeated exposure to novel foods.

Taste education was found to have significant effects on reduction of food neophobia in children of lower grades.

In a study on the relationship between the effects of taste education and food neophobia in children, 12 sessions of taste education were performed with 90 children with a mean age of 9 years, and the results showed reduced food neophobia through taste education [11]. This result was based on sense of taste, so it can be effective for short-term taste formation and development. However, development of systematic programs for long-term effects is needed. Stein, Nagai, Nakagawa, and Beauchamp [17] reported that food neophobia is often found for citrus fruits and bitter tasting vegetables like cabbage. They also suggested that neophobia of bitter taste can be improved by repeated exposure and learning, which means that preferences and dietary habits in adulthood are formed through repeated exposure and ingestion of varied foods from early childhood. Therefore, in this study, we performed taste education with repeated culinary practice in school children for total of 12 sessions over 3 months. As previously mentioned, the results showed a positive effect, but the study was performed over a short period of time for proper improvement of continuous development in children. Therefore, further longitudinal studies need to be conducted with regard to the effects of taste education programs. Unlike previous studies regarding the effects of taste education [11,13], this study was performed in a single group with pretest and posttest due to practical difficulties in securing the control group. Absence of a comparison between the control and experimental groups can be considered to be a limitation of this study. Therefore, standardization and generalization of the results would be inappropriate. Through further systematic studies regarding the effects of such programs need to be conducted.

Regarding the acceptance, familiarity, and preference of pretest and posttest novel foods provided in the taste education program, all pretest and posttest means by the three food groups (fruits, nuts, and dairy products) increased significantly. This indicates that the taste education program had partial significant effects on increasing children's willingness to try novel foods, thereby constituting partial significant effect verification of the study hypothesis.

In verification of the difference between pretest and posttest effects, scores of willingness to try novel foods were also significantly improved in the posttest mean score compared to the pretest. This result is in agreement with a study by Reverdy *et al*. [11], who reported that repeated exposure to novel foods and educational experiences has a positive effect on children's acceptance of novel foods. Mustonen & Tuorila [13] modified the French taste education program to make it suitable for a Finish child education environment and performed the program over 15 sessions. They observed favorable changes in acceptance of novel foods in children, which is consistent with this study. Pelchat & Pliner [18] found that increased exposure to foods can result in increased preference for beverages, representing a positive correlation between food preference and exposure to food ingredients. Likewise, in this study, we confirmed that preferences for novel foods increased upon repeated exposure through repeated practice using food ingredients in the taste education. Birch *et al*. [9] reported that children's food preferences show a positive correlation between visual exposure and taste exposure, which emphasizes that taste exposure is critical for changes in children's food preferences. This highlights the importance of education that provides positive experiences of foods in children through repeated visual and taste exposure to various novel foods from early childhood.

In the present study, the correlation between food neophobia (FNS) and willingness to try novel foods (WTNF) in children in pretest exhibited low scores, indicating a very weak relationship between the two tests. On the other hand, the correlation between FNS and WTNF measured after taste education was not significantly high but increased slightly. Such a result conflicts with a study by Reverdy *et al*. [11] in which the experimental group in pretest manifested $r = 0.242$ and $P < 0.03$ and posttest showed $r = 0.180$ and $P < 0.10$. This result is believed to be because the taste education program influences the relationship between declarative and behavioral neophobia; the relationship between FNS and WTNF tends to increase slightly as the taste education progresses.

In this study, we employed the same methods as in the study by Reverdy *et al*. [11] in order to measure changes in WTNF

of children through taste education. Food ingredients provided for measuring pretest and posttest WTNF by taste education in children were selected, and the present study evaluated preferences for food ingredients in each food group in pretest and posttest.

The tool for food neophobia measurement applied in this study was an index that evaluated 8-10-year-old children's food neophobia tendency, as used in studies by Reverdy *et al*. [11] and Pliner [2]. Pliner [2] reported a positive (+) correlation between food neophobia tendency in 8-10-year-old children and behavioral food neophobia. Behavioral food neophobia suggested the possibility of its utilization for evaluating children's willingness to try novel foods.

Based on the results of this study, the food neophobia scales seem to be suitable for parents to evaluate the tendency of food neophobia in their own children. However, there was no statistically significant correlation between FNS and WTNF scores in both pretest and posttest, although FNS and WTNF scores in the posttest slightly increased. This can be explained by the fact that an increase in WTNF score had a positive impact on FNS scores. The FNS, which measures the acceptance of unfamiliar and novel foods, is a single item that investigates personal trends and lacks reliability to determine overall food behavioral trends [19]. On the other hand, the WTNF scale determines the willingness to try unfamiliar and novel foods and measures behavioral food neophobia in practical situations; this scale is also influenced by investigative conditions and status. In this study, the reason that WTNF was more largely affected than the FNS after taste education could be explained in the same manner.

This study showed that the taste education program was effective for reducing food neophobia and increasing willingness to try novel foods in 7-9-year-old Korean school children.

The significance of this study is as follows.

First, there is currently a lack of research on systematic taste education programs in school children and their effects. In other words, the significance of this study lies in applying a suitable taste education program for the education environment of Korean elementary schools with repeated culinary practices in school children of lower grades.

Second, the taste education applied to school children of lower grades resulted in significant changes in food neophobia and partial significant changes in willingness to try novel foods. Of them, food neophobia was observed in all age groups, with some personal differences [4]. Considering that the traits of food neophobia are not easily changed, the taste education program of this study was performed effectively.

Finally, advanced taste experience education comprised of repeated culinary practice was effective for improvement of dietary habits in school children of lower grades. This result indicates that the taste education had considerable positive effects, which could be effectively repeated in children through repeated culinary practices. The taste education resulted in reduced food neophobia and a partial increase in willingness to try novel foods in elementary school students. Therefore, it can be utilized as an education program for improvement of diet and formation of dietary habits in school children.

This study investigated changes in food neophobia and willingness to try novel foods. In the future, systematic and continuous studies and development of taste education programs are needed to promote taste education.

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