



Research Article

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Evaluation of Taste of Enteral Nutrient Ice Cream and Search for Factors Affecting the Taste

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Abstract

Objectives: Patients' adherence to enteral administration of nutrients is influenced by their feeling during administration. The present study compared the taste of commercially prepared ice cream with that of enteral nutrient ice cream, using a sensory test. Additionally, the factors influencing the comprehensive evaluation of enteral nutrient ice cream and commercially prepared ice cream were identified.

Methods: A sensory test was performed by 30 pharmacists, on commercially prepared ice cream and enteral nutrient ice cream using the Semantic Differential Method. The factors related to comprehensive evaluation were extracted, and those influencing the comprehensive evaluation of ice cream were analyzed by Covariance structure analysis.

Results: No significant differences were observed in the comprehensive evaluation of enteral nutrient ice cream and commercially prepared ice cream ($p=0.08$, 95% CI=-0.78 to 0.04). Covariance structure analysis identified five factors related to Easy-to-intake (i.e., Taste, Ease to ingest, Continuity, Peculiar flavor, and Familiarity), which strongly influenced Comprehensive evaluation (standardized estimated value: 0.88). In addition, four factors related to discomfort factor (i.e., Feeling of heaviness, Concentration of taste, Greasiness, and Milky smell) were found not to influence Comprehensive evaluation directly but were correlated with Ease-to-intake (standardized estimate: 0.64).

Conclusion: It is important for healthcare professionals to understand the factors involved in the comprehensive evaluation of enteral nutrients, and they should provide appropriate information about it.

Keywords

Nutrition; Ice cream; Enteral nutrient; Semantic differential method

Introduction

Currently, Japan is entering an aging society that has never experienced before. And it is estimated that the percentage of the elderly will reach 39.9% with 1 in 2.5 people being 65 years and over in 2060 [1]. Recently, nutritional problems have been identified among

elderly people, including protein/energy malnutrition and poor oral intake of various causes [2]. Adequate nutrition management for elderly people with poor nutrition will promote healing and recovery from disease and prevent postoperative complications [3]. Nutritional therapy relies on the principle "Enteral feeding. If the guts works, use it," [4,5] and the use of enteral nutrients has proved highly useful for nutrition management [6,7]. In addition, enteral nutrients have been used as dietary supplements for various disease conditions, for example, diabetes, cancer patients and so on [8-10].

In Japan, enteral nutrients are available as medical and food products in various flavors and forms, including liquids, mousse, jellies, semi-solids, and solids [11]. Enteral nutrients have distinctive taste and smell, and bad administration feeling has been reported [12,13]. The good or bad feeling in enteral nutrient administration influences patients' adherence, thus affecting their nutritional status and therapeutic effects. It is therefore important for healthcare professionals to understand how enteral nutrients taste [14]. Mukai et al. [13] conducted sensory tests on liquid enteral nutrients using the Semantic Differential Technique [15] (hereinafter abbreviated as SD technique) and reported good taste as well as the factors affecting each nutrient's taste. The form of enteral nutrients is also reported to influence adherence [14]. In particular, ice cream is easy to swallow, and reported to be preferred and beneficial for disease patients [16,17].

Currently, however, few healthcare professionals and patients know the deliciousness of enteric nutrient ice cream, leading it to be underutilized in the medical field. It is therefore important that pharmacists provide adequate information to healthcare professionals and especially to patients and their families.

The present study, therefore, evaluated the relatively good taste of enteral nutrient ice cream, by comparing it with that of commercially prepared ice cream, using a sensory test. Additionally, the factors influencing the comprehensive evaluation of enteral nutrient ice cream and commercially prepared ice cream were also evaluated.

Materials and Methods

Implementation of a sensory test using the SD method

Tasting and sensory tests were conducted on commercially prepared ice cream and enteral nutrient ice cream (Meiji May Balanced[®] Ice) by pharmacists (30 people) of dispensing pharmacies. Flavored ice cream (vanilla, chocolate, and strawberry) produced by Meiji Co., Ltd., was used as both the enteral nutrient ice cream and the commercially prepared ice cream. For the sensory test, a questionnaire sheet was prepared on the basis of the sensory test evaluation table by Mukai et al. SD method was used [13].

The following pairs of expressions were used to evaluate the features of enteral nutrients: "Familiarity"–not familiar/familiar; "Feeling of the medicine"–like the medicine/does not like the medicine; "Feeling of heaviness"–heavy/not heavy; "Continuity"–cannot eat everyday/can eat every day; "Aftertaste"–good aftertaste/bad aftertaste; "Smell"–smells bad/smells good; "Milky smell"–smells milky/does not smell milky; "Greasiness"–greasy/not greasy; "Feeling of melt"–does not melt smoothly/melts smoothly; "Taste"–bad taste/good taste; "Concentration of taste"–strong taste/weak taste; "Easy to

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ingest”–not easy/easy; “Peculiar flavor”–peculiar flavor/not peculiar flavor; “Feeling on the tongue”–not smooth on the tongue/smooth on the tongue; “Sweetness”–not sweet/sweet; “Comprehensive evaluation”–not satisfied/satisfied. A 5-point rating scale was used to evaluate the 16 expression pairs: 1=“Very much,” 2=“Partially,” 3=“Neither,” 4=“Partially,” 5=“Very much” (Table 1).

Data analysis

Taste differences between commercially prepared ice cream and enteral nutrient ice cream were analyzed using the paired *t*-test. Identification of the factors affecting the comprehensive evaluation of taste was performed using factor analysis with 15 items other than the items used in the SD method. The subscale was set with the factors whose eigenvalue was 1 or more by the maximum likelihood method as a common factor. The factor “Sweetness” showed a negative value pattern matrix at the time of varimax rotation and was therefore interpreted after inversion. To interpret how the items obtained in factor analysis contributed to the comprehensive evaluation, confirmatory factor analysis by covariance structure analysis was performed on both the common factors and comprehensive evaluation. R version 3.4.0 was used for paired *t*-test and factor analysis, and IBM® SPSS® Amos 25 was used for covariance structure analysis. A level of $p < 0.05$ was considered as statistically significant.

Ethical considerations

This study was performed in compliance with the “Ethical Guidelines for Medical and Health Research Involving Human Subjects” and approved by the Ethics Committee of Hoshi University (approval number: 30-010).

Results

Item evaluation using the SD method

Results are presented as mean \pm standard deviation of each of the 16 surveyed items (Table 2). Every item was considered relevant to identify the factors influencing the comprehensive evaluation of ice cream taste; thus, all items were analyzed.

Comparison of the comprehensive evaluation of commercially prepared ice cream and enteral nutrient ice cream

The comprehensive evaluation of commercially prepared ice

cream and enteral nutrient ice cream was performed using a paired *t*-test, and no significant difference was found between the two ice creams ($p=0.08$, 95% CI=−0.78 to 0.04) (Figure 1).

The mean \pm standard deviation of the comprehensive evaluation was 4.20 ± 0.95 and 3.83 ± 0.93 for enteral nutrient ice cream and commercially prepared ice cream, respectively.

Extraction of factors related to comprehensive evaluation, using factor analysis

Factor analysis was performed on 15 evaluation items using the maximum likelihood, excluding the comprehensive evaluation among the sensory test items. A two-factor structure was adopted from the attenuation condition of the eigenvalue and the possibility of fact or interpretation, and factor analysis was performed again, using the maximum likelihood method and varimax rotation. As a result, when the standard factor loading was set to 0.40, and items with factor loading below the standard were excluded, three evaluation items (i.e., “Aftertaste”, “Smell”, and “Sweetness”) were excluded from the analysis. In addition, when confirmation factor analysis was carried out, and the “Feeling of melt” was incorporated into the model, it was not possible to obtain a good fitness index. Therefore, “Feeling of melt” was excluded from the analysis. The maximum likelihood method factor analysis was then performed by varimax rotation for the remaining 11 evaluation pairs. Table 3 shows the results of the factor analysis after varimax rotation. The ratio describing the total variance of 11 evaluation pairs with two factors explained after factor extraction was 49.1%.

The first factor was composed of seven familiarity items: “Concentration of taste”, “Pronounced taste”, “Taste”, “Feeling on the tongue”, “Continuity”, “Feeling of medicine”, “Familiarity”. The latter showed a high load and was named as an “Easy-to-intake” factor. The second factor was named “Discomfort factor”, and it comprised four items: “Feeling of heaviness”, “Easy to ingest”, “Milky smell”, “Greasiness”.

Identification of the factors affecting the comprehensive evaluation

To investigate the influence exerted by each of the items extracted by the factor analysis on the comprehensive evaluation, a path analysis was performed using covariance structure analysis. First,

Table 1: Evaluation pairs used in sensory tests based on the SD method.

		Very much	Partially	Neither	Partially	Very much	
Familiarity	Not familiar	1	2	3	4	5	Familiar
Feeling of medicine	Like the medicine	1	2	3	4	5	Does not like the medicine
Feeling of heaviness	Heavy	1	2	3	4	5	Not heavy
Continuity	Cannot eat everyday	1	2	3	4	5	Can eat everyday
Aftertaste	Good aftertaste	1	2	3	4	5	Bad aftertaste
Smell	Smells bad	1	2	3	4	5	Smells good
Milky smell	Smells milky	1	2	3	4	5	Does not smell milky
Greasiness	Greasy	1	2	3	4	5	Not greasy
Felting of melt	Does not melt smoothly	1	2	3	4	5	Melts smoothly
Taste	Bad taste	1	2	3	4	5	Good taste
Concentration of taste	Strong taste	1	2	3	4	5	Weak taste
Easy to ingest	Not easy	1	2	3	4	5	Easy
Peculiar flavor	Peculiar flavor	1	2	3	4	5	Not Peculiar flavor
Felling on the tongue	Not smooth on the tongue	1	2	3	4	5	Smooth on the tongue
Sweetness	Not sweet	1	2	3	4	5	Sweet
Comprehensive evaluation	Not satisfied	1	2	3	4	5	Satisfied

Table 2: Results of item evaluation of commercially prepared ice cream and enteral nutrient ice cream.

	Commercially prepared ice cream	Enteral nutrient ice cream
Familiarity	3.77 ± 1.17	4.17 ± 1.00
Feeling of medicine	4.33 ± 1.25	4.43 ± 0.96
Feeling of heaviness	3.27 ± 1.12	4.03 ± 0.95
Continuity	3.33 ± 1.35	3.57 ± 1.26
Aftertaste	2.93 ± 0.89	3.17 ± 1.04
Smell	3.60 ± 0.88	3.50 ± 0.85
Milky smell	3.70 ± 0.94	3.90 ± 0.87
Greasiness	3.60 ± 0.95	3.77 ± 0.99
Felting of melt	4.03 ± 0.95	4.07 ± 0.81
Taste	3.87 ± 1.02	4.27 ± 0.68
Concentration of taste	2.83 ± 0.58	2.90 ± 0.75
Easy to ingest	3.97 ± 1.05	4.23 ± 0.80
Peculiar flavor	3.83 ± 1.13	3.70 ± 0.86
Felling on the tongue	3.77 ± 0.92	3.97 ± 0.84
Sweetness	3.97 ± 0.84	3.73 ± 0.85
Comprehensive evaluation	3.83 ± 0.93	4.20 ± 0.95

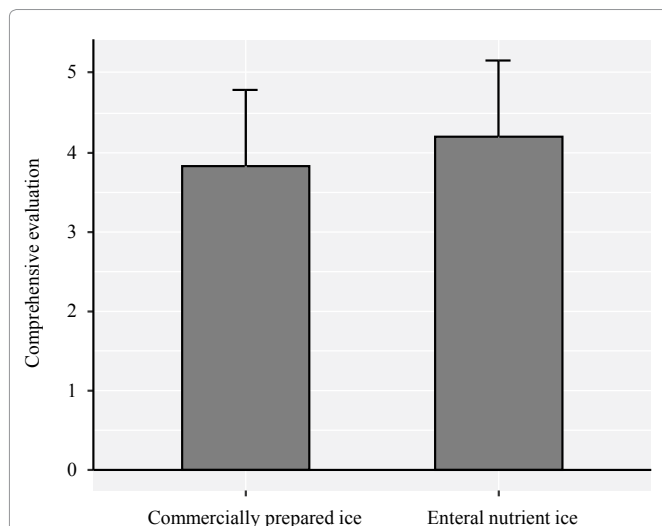


Figure 1: Comparison of comprehensive evaluation of commercially prepared ice cream and enteral nutrient ice cream.

Table 3: Factor analysis of the sensory test evaluation pairs.

	Factor	
	1	2
Concentration of taste	0.898	0.159
Pronounced taste	0.792	0.153
Taste	0.709	0.383
Felling on the tongue	0.631	-0.141
Continuity	0.613	0.37
Feeling of medicine	0.474	0.277
Familiarity	0.44	0.181
Feeling of heaviness	0.321	0.837
Easy to ingest	0.022	0.625
Milky smell	0.06	0.533
Greasy	0.271	0.506
Cronbach α	0.842	0.746

the assumption that all the factors presented in Table 2 influenced the comprehensive evaluation was analyzed. As a result, the path of discomfort was deleted since it showed a low value of 0.11 at the standardized estimate of comprehensive evaluation (best fit index: GFI=0.821, AGFI=0.736, RMSEA=0.106, AIC=138). Therefore, discomfort was considered to be correlated with easy to ingest and analyzed again. However, the goodness of fit index did not become the optimum model (best fit index: GFI=0.872, AGFI=0.809, RMSEA=0.049, AIC=111). Therefore, the path of from “Easy-to-intake” to “Feeling of the medicine” and “Feeling on the tongue”, which were both low in the standardized estimation value, was deleted, and the analysis was re-run, leading to an improvement in the best fit index, and a favorable value was recorded (GFI=0.919, AGFI=0.865, RMSEA=0.000, AIC=72.6). A decline in AIC was also observed. This was then regarded as the final model (Figure 2). Table 4 shows the factor loading of the nine pairs of evaluation items in the final model after factor analysis was re-run. Both the first and second factors showed favorable values of Cronbach α of 0.7 or more. From Figure 2,

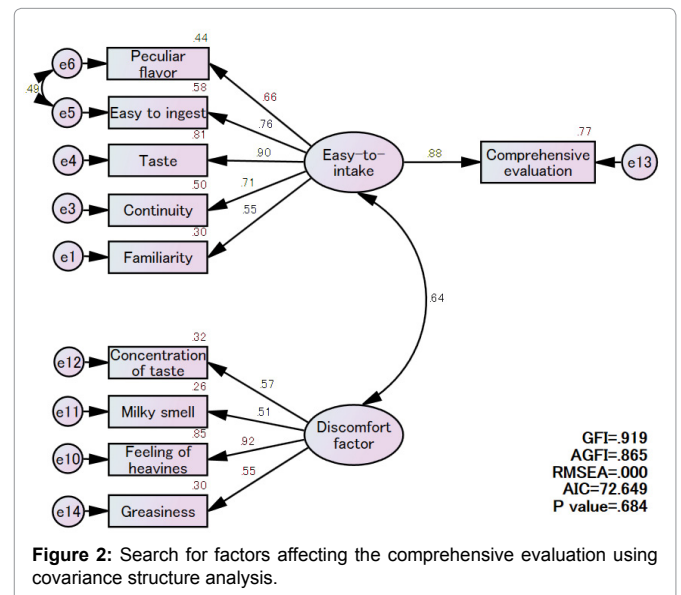


Table 4: Results of the factor analysis of, according to the final model by covariance structure analysis.

	Factor	
	1	2
Easy to ingest	0.988	0.112
Pronounced taste	0.802	0.108
Taste	0.726	0.356
Continuity	0.639	0.342
Familiarity	0.476	0.134
Feeling of heaviness	0.366	0.802
Concentration of taste	0.063	0.618
Milky smell	0.091	0.543
Greasy	0.287	0.499
Cronbach α	0.844	0.746

"Easy-to-intake" had a strong influence on comprehensive evaluation (standardized estimated value: 0.88). "Discomfort factor" showed no correlation with the "Comprehensive evaluation", but correlated with "Easy-to-intake" (standardized estimate: 0.64). In addition, the strength of the five factors comprising the "Ease-to-intake" was in order of Taste>Easy to ingest>Continuity>Peculiar flavor>Familiarity. Similarly, the strength of the four factors constituting the "Discomfort factor" was in order of Feeling heaviness>Concentration of taste>Greasiness>Milky smell.

Discussion

The present study evaluated the taste of enteral nutrient ice cream, by comparing it with commercially prepared ice cream, using a sensory test. Additionally, the factors affecting the comprehensive evaluation of enteral nutrient ice cream and commercially prepared ice cream were evaluated.

No difference was found between the taste of the enteral nutrients ice cream and that of commercially prepared ice cream, which indicates that enteral nutrients may have a delicious taste. A previous study using the same SD methodology reported that the comprehensive evaluation value for enteral nutrients in liquid form was 2.57 in the form (jelly-like substance) with the highest comprehensive evaluation [14]. In this study, the average comprehensive evaluation value of enteral nutritional ice cream was 4.20. Comparing these results indicates that enteral nutrient ice cream has a higher value, thus can be considered equally good. In liquid form, flavor addition has been reported to effectively improve the ingestion feeling. According to the results of this study, recommending administration of enteral nutrient ice cream can be as effective as adding flavor to liquid enteral nutrients for patients complaining of poor ingestion feeling. Factor analysis of 15 evaluation pairs revealed that the comprehensive evaluation of enteral nutrient ice cream consisted of "Easy-to-intake" and "Discomfort". Subsequently, path analysis using covariance structure analysis was performed to determine the degree of factor influence on the comprehensive evaluation. Once the final model was obtained, the easy-to-intake factor affected the comprehensive evaluation and was correlated with the discomfort factor. From this final model, it was considered that during intake, the subjects first felt the items constituting discomfort, and the individual's evaluation of Easy-to-intake factors, which were based on the former evaluation factor, affected the comprehensive evaluation.

The Taste, Ease to ingest and Continuity was shown as important factors for the comprehensive evaluation. The reason why the degree of influence of Easy to ingest and Continuity also increased may have been because the pharmacists knew the background of the patient taking the enteral nutrients. Patients taking enteral nutrients often take nutritional supplements for a long time, instead of a single dose. Therefore, ease of ingestion and continuity become important factors for improving compliance. These results indicate that pharmacists need to gather and provide information concerning the patients' preferences and background.

In this study, the inclusion of the Feeling of melt into the model during the confirmatory factor analysis prevented a good fitness index to be obtained and was therefore excluded from the analysis. Although the Feeling of melt was directly connected to the comprehensive evaluation at the final model, it was removed from the study given its impact on the goodness of fit index. The reason why a good fitness index could not be obtained is that only 30 subjects were included, which insufficient sample size was. Further studies are therefore

required, which include larger sample size and performing the survey of the patients who take the enteral nutrients.

For patients taking enteral nutrient for a long time, it is important to provide nutrients in a good taste and varied form, to ensure compliance, since poor administration feeling decreases adherence. Results from the present study show that enteral nutrient ice cream effectively improves patients' compliance. At present, enteral nutrient ice cream is not fully utilized in the medical front. Therefore, it is necessary that medical professionals, including pharmacists, understand its advantages and provide patients with the appropriate information, recommending their administration.

Conclusion

No clear difference was observed between the comprehensive evaluation of the taste of commercially prepared ice cream and that of enteral nutrient ice cream. Moreover, the Ease-to-intake factor was strongly involved in the comprehensive evaluation. In order to improve the patients' administration adherence to enteral nutrients, it is important that pharmacists and other medical professionals deepen their understanding about the factors involved in the comprehensive evaluation and provide appropriate information about enteral nutrients.

Compliance with Ethical Standards

Conflict of interest

The authors declare that they have no conflict of interest.

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