

DESCRIPTION

Title of Invention: RECOMMENDATION DEVICE, RECOMMENDATION METHOD, RECOMMENDATION PROGRAM, AND RECORDING MEDIUM FOR RECOMMENDING MEALS

FIELD OF THE INVENTION

[0001]

The present invention relates to a recommendation device, recommendation method, and recommendation program for recommending meals beneficial to user's health.

BACKGROUND OF THE INVENTION

[0002]

When blood glucose levels rise, the risk of diabetes increases along with the risk of many other diseases. This is because glucose in the blood penetrates the endothelial cells in the vascular walls, and the active oxygen generated therein can damage blood vessels. Furthermore, Non-Patent Literature 1 discusses the relationship between diet and blood glucose levels, emphasizing that maintaining a normal postprandial blood glucose response is essential for preventing various metabolic disorders, including diabetes. It also mentions that individual differences, such as those in gut microbiota, can influence the

postprandial blood glucose response.

[0003]

In contrast, the Gut Intelligent service introduced in Non-Patent Document 1 recommends diets that are beneficial or harmful to health by examining the user's gut microbiota. It also recommends meals that either adversely affect blood glucose levels or do not have such negative impacts.

Related Arts, Non-Patent Documents

[0004]

Non-Patent Document 1: "Factors Affecting Postprandial Blood Glucose Changes Include Gut Microbiota," Mykinso Lab, Internet <URL: <https://lab.mykinso.com/kenkyu/190409>>

Non-Patent Document 2: "Gut Intelligent Service," Viome Inc., USA, Internet <URL: <https://www.viome.com>>

SUMMARY OF THE INVENTION

Technical Problem

[0005]

However, the service described in Non-Patent Document 2 recommends meals based on academic knowledge, and therefore, it does not necessarily continue to provide meal

recommendations that are suitable for individual users.

[0006]

The present invention has been made in view of the above problems, and its objective is to continuously provide meals that are suitable for the user.

Solution to Problem

[0007]

To solve the aforementioned problem, the present invention includes the following embodiments.

Clause 1. A recommendation device for recommending meals beneficial to user's health, comprising:

- a biological information acquisition unit configured to obtain biological information of a user;

- a health index acquisition unit configured to obtain a health index of the user;

- a food ingredient evaluation unit configured to evaluate food ingredients based on the biological information;

- a meal recommendation unit configured to recommend the meals beneficial to health based on the evaluation results of the food ingredients; and

- a history creation unit configured to create a history of the correspondence relation between the meals

recommended by the meal recommendation unit and the health index.

Clause 2. The recommendation device according to clause 1, wherein the meal recommendation unit recommends the meals beneficial to health based on the history.

Clause 3. The recommendation device according to clause 1 or 2, wherein the meal recommendation unit recommends meals beneficial to health by comprehensively evaluating the evaluation results of the food ingredients and the history.

Clause 4. The recommendation device according to any one of clauses 1 to 3, further comprising a similar history search unit that searches for similar history, which is a record of the correspondence relation between meals recommended by the meal recommendation unit and the health index, for other users whose biological information is similar to that of the user,

wherein the meal recommendation unit further recommends the meals beneficial to health based on the similar history.

Clause 5. The recommendation device according to any one of clauses 1 to 4, wherein the biological information is gut microbiota information.

Clause 6. The recommended device according to any one of clauses 1 to 5, wherein the health index includes a blood

glucose level.

Clause 7. A recommendation method for recommending meals beneficial to user's health, comprising:

- a biological information acquisition step for obtaining biological information of a user;

- a health index acquisition step for obtaining the health index of the user;

- a food ingredient evaluation step for evaluating food ingredients based on the biological information;

- a meal recommendation step for recommending the meals beneficial to health based on the evaluation results of the food ingredients; and

- a history creation step for creating a history of the correspondence relation between the meals recommended in the meal recommendation step and the health index.

Clause 8. A recommendation program for recommending meals beneficial to user's health, the program causing a computer to function as:

- a biological information acquisition unit configured to obtain biological information of a user;

- a health index acquisition unit configured to obtain health index of the user;

- a food ingredient evaluation unit configured to evaluate food ingredients based on the biological

information;

a meal recommendation unit configured to recommend the meals beneficial to health based on the evaluation results of the food ingredients; and

a history creation unit configured to create a history of the correspondence relation between the meals recommended by the meal recommendation unit and the health index.

Clause 9. A non-transitory computer-readable recording medium storing a recommendation program for recommending meals beneficial to user's health, wherein the recommendation program causes a computer to function as:

a biological information acquisition unit configured to obtain biological information of a user;

a health index acquisition unit configured to obtain health index of the user;

a food ingredient evaluation unit configured to evaluate food ingredients based on the biological information;

a meal recommendation unit configured to recommend meals beneficial to health based on the food ingredient evaluation results; and

a history creation unit configured to create a history of the correspondence relation between the meals

recommended by the meal recommendation unit and the health index.

Effect of the Invention

[0008]

According to the present invention, it is possible to continuously provide meals that are suitable for a user.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]

FIG. 1 is a block diagram illustrating the schematic configuration of a recommendation system according to Embodiment 1 of the present invention.

FIG. 2 is a flowchart showing the overall processing procedure executed by the recommendation system.

FIG. 3 is a flowchart detailing the steps executed by the recommendation server.

FIG. 4 is an example of the evaluation results of food ingredients based on the impact on blood glucose levels.

FIG. 5 is an example of data recorded in the meal/recipe database.

FIG. 6 is a diagram illustrating the impact on blood glucose levels based on the evaluation results of each food

ingredient included in the recipe of a food and drink set.

FIG. 7 is an example of a meal (food and drink set) recommended by the meal recommendation unit.

FIG. 8 is an example of the history of the correspondence relation between meals recommended by the meal recommendation unit and health index.

FIG. 9 is a block diagram illustrating the schematic configuration of a recommendation system according to Embodiment 2 of the present invention.

FIG. 10(a) to FIG. 10(c) are diagrams showing the gut microbiota scores of user A, another user P, and another user Q, respectively.

FIG. 11 (a) and (b) respectively illustrate examples of the histories of user A and user P.

FIG. 12 (a) depicts an example of a food and drink set extracted by the meal recommendation unit, and (b) shows the conversion of the differences indicated in FIG. 12 (a) into positive values for scoring.

FIG. 13 presents an example of a meal (food and drink set) recommended by the meal recommendation unit.

FIG. 14 is a graph displaying the recommendation level and purchase frequency over a specified past period for each food and drink set.

FIG. 15 provides an example of a screen where factors

to be considered for meal recommendations can be selected.

FIG. 16 shows another example of a meal (food and drink set) recommended by the meal recommendation unit.

FIG. 17 is a graph indicating the recommendation level for each food and drink set.

Description of Embodiments

[0010]

The following describes an embodiment of the present invention with reference to the accompanying drawings. It should be noted that the present invention is not limited to the embodiment described below, and various modifications may be made without departing from the scope and spirit of the invention.

[0011]

Embodiment 1

Figure 1 is a block diagram illustrating the schematic structure of a recommendation system according to Embodiment 1 of the present invention. The recommendation system 1 is designed to recommend meals beneficial to user's health, and it comprises a gut microbiota examination device 2, a gut microbiota analysis server 3, health index measuring means 4, a user terminal 5, and a recommendation server (recommendation device) 6.

[0012]

The gut microbiota examination device 2 is an apparatus designed to analyze the gut microbiota from human feces. The gut microbiota examination device 2 is managed by a service provider that offers examination services. Users collect their feces in a gut microbiota test kit and send it to the service provider for analysis.

[0013]

The gut microbiota analysis server 3 analyzes the type of gut bacteria and the proportions of individual bacteria based on the test results from the gut microbiota examination device 2. The analysis results of the gut microbiota are transmitted to the recommendation server 6. Additionally, the gut microbiota analysis server 3 may further analyze aspects such as the diversity score of the gut bacteria and the risk of diseases, based on the user's biological information, including age, gender, the presence of chronic diseases, health examination results, and genetic analysis results.

[0014]

The health index measuring means 4 is designed to measure user's health index, such as blood glucose levels, abdominal condition, skin condition, nail condition, hair color, and vascular age. When the health index is the blood glucose level, the health index measuring means 4 may be in

the form of a stationary device or a wearable device. It may also measure blood glucose levels based on blood test results or subjective questionnaires (for example, questionnaires relating to alternative indexes associated with blood glucose level fluctuations such as postprandial drowsiness, concentration, etc.). If the health index is the abdominal condition, the health index measuring means 4 may include a bowel movement sensor, or it may measure the abdominal condition based on questionnaires regarding the situation during bowel movements and the state of the feces. When the health index is the skin condition, the health index measuring means 4 may consist of a skin sensor; alternatively, it may assess the skin condition based on subjective questionnaires regarding the skin, and similarly, nail condition and hair color can also serve as health indexes. Additionally, if the health index pertains to anti-aging, it is conceivable to measure vascular age. The measurement results of the health indexes are transmitted to the recommendation server 6.

[0015]

The user terminal 5 is a device used by users, such as a smartphone or a personal computer. The user terminal 5 is capable of communicating with the recommendation server 6 via a communication network such as the Internet.

[0016]

The recommendation server 6 is a device that recommends meals beneficial to user's health. The recommendation server 6 can be configured using a general-purpose computer, and in terms of hardware configuration, it includes processors such as a CPU and GPU (not shown), main storage devices such as DRAM and SRAM (not shown), as well as auxiliary storage devices such as an HDD or SSD 60. The auxiliary storage device 60 stores programs and data necessary for operating the recommendation server 6, including a recommendation program P1, an information acquisition program P2, a health index database DB1, a meal/recipe database DB2, and a recommendation history database DB3.

[0017]

It is also possible to configure the recommendation server 6 using a plurality of computers. Additionally, the auxiliary storage device 60 may be externally attached to the recommendation server 6.

[0018]

The recommendation server 6 comprises the following functional blocks: a biological information acquisition unit 61, a health index acquisition unit 62, a food ingredient evaluation unit 63, a meal recommendation unit

64, a delivery instruction unit 65, a consumption recording unit 66, and a history creation unit 67. These functional blocks can be implemented in hardware, such as by using logical circuits, or they can be implemented in software by the processor of the recommendation server 6. In the latter case, the processor can realize each of these units by loading and executing the recommendation program P1 and the information acquisition program P2, which are stored in the auxiliary storage device 60, into the main storage device. The recommendation program P1 and information acquisition program P2 can be downloaded to the recommendation server 6 via a communication network such as the Internet, or they can be installed on the recommendation server 6 through a computer-readable, non-transitory storage medium, such as a CD-ROM, that records the recommendation program P1 and information acquisition program P2. It should be noted that the recommendation program P1 may include part or all of the information acquisition program P2.

[0019]

Processing Procedure of the Entire System

Figure 2 is a flowchart illustrating the overall processing procedure executed by the recommendation system 1.

[0020]

In step S1, the gut microbiota examination device 2 examines the user's gut microbiota. Based on the examination results, the gut microbiota analysis server 3 analyzes the gut microbiota information, such as the type of gut bacteria and the proportion of individual bacteria.

[0021]

In step S2, the recommendation server 6 recommends a one-week meal beneficial to user's health based on the gut microbiota information.

[0022]

In step S3, the health index measuring means 4 measures the user's health index. In this embodiment, the health index is the blood glucose level.

[0023]

Step S1 is repeated every three months (YES in Step S4), Step S2 is repeated weekly (YES in Step S5), and Step S3 is repeated daily (YES in Step S6). It should be noted that the periods for these repetitions are not particularly limited.

[0024]

Processing Procedure for Recommendation Server

The functions of the components of the recommendation server 6 will be described below. Figure 3 is a flowchart illustrating the detailed procedure of step S2 executed by

the recommendation server 6.

[0025]

In step S21 (Biological Information Acquisition Step), the biological information acquisition unit 61 obtains the user's biological information. In the present embodiment, the biological information acquisition unit 61 obtains the user's gut microbiota information from the gut microbiota analysis server 3. Step S21 is executed after the user's gut microbiota examination (Step S1).

[0026]

In step S22 (Health Index Acquisition Step), the health index acquisition unit 62 obtains the measurement results of the user's health index from the health index measuring means 4. Step S22 is executed daily, and the health index acquisition unit 62 records the obtained health index in the health index database DB1.

[0027]

In step S23 (Food Ingredient Evaluation Step), the food ingredient evaluation unit 63 evaluates food based on gut microbiota information. Food based on gut microbiota information refers to food that affects the user's blood glucose levels and/or gut environment. In this embodiment, "food" mainly refers to items such as vegetables, meat, fish, and fruits, but it may also include beverages,

seasonings, and supplements.

[0028]

FIG. 4 illustrates an example of the evaluation results for food ingredients based on the impact on blood glucose levels. In this example, a food ingredient with a positive blood glucose impact score is expected to improve blood glucose levels, whereas a food ingredient with a negative blood glucose impact score signifies a potential adverse effect on blood glucose levels. In the above example, the values indicating blood glucose impact scores are represented by two types: +1 and -1. However, other values such as +2 and -3 may also be used.

[0029]

As an example of evaluating food ingredients based on health indexes other than blood glucose levels, the impact on the gut microbiota can be considered. For instance, food ingredients that have a beneficial effect on the gut microbiota can be rated as +2 or +1, while those that have an adverse effect can be rated as -2 or -1. Another example involves obtaining an evaluation of the food ingredients by referencing other information, such as the gut microbiota score or the specific bacteria present, according to predefined rules. For instance, a rule can be set in advance so that if a certain gut microbiota score exceeds a

predetermined threshold, a specific food ingredient is selected.

[0030]

In step S24 (meal recommendation step), the meal recommendation unit 64 refers to the meal/recipe database 2 and recommends meals that promote the user's health, based on the evaluation results of the food ingredients assessed by the food ingredient evaluation unit 63.

[0031]

Figure 5 is an example of data recorded in the meal/recipe database 2. A recipe refers to information such as the food ingredients required for a dish, their quantities, and the cooking method. In Figure 5, recipes 1 to 3 of a single food and drink set are displayed. The term "food and drink set" refers to a collection of items consumed in one sitting, and is synonymous with a meal.

[0032]

Figure 6 illustrates the impact on blood glucose levels based on the food ingredient evaluation results obtained from the food ingredient evaluation unit 63 for each food ingredient included in the meal set recipe. The meal recommendation unit 64 calculates the total impact on blood glucose levels for each food ingredient and determines the meal set score as $(-1 + 1 + 0 + 0 + 0 + 0 +$

$0 + 0 + 0 + 0 = 0$).

[0033]

Note that food ingredients not evaluated by the food ingredient evaluation unit 63 may be treated as zero. In addition, the impact on blood glucose levels depicted in FIG. 6 does not consider the quantity of food ingredients; however, if the food ingredient evaluation results include information on standard quantities, it is possible to consider the amount of each food ingredient when calculating the meal set score. Furthermore, the food ingredient evaluation unit 63 may compute scores on a more granular level, such as by individual nutrients. In this case, a machine-learned artificial intelligence model may be employed for the score calculation. If the health index is something other than blood glucose levels, for example, the impact on the gut microbiota may be used for food ingredient evaluation, and the total impact value may be calculated accordingly.

[0034]

The meal recommendation unit 64 recommends food and drink sets with high food and drink set scores, from those recorded in the food/recipe database 2, as meals beneficial to user's health. Furthermore, the meal recommendation unit 64 records the meals recommended to the user in the

recommendation history database 3 (step S25). The recommendation content from the meal recommendation unit 64 is transmitted to user terminal 5.

[0035]

FIG. 7 illustrates an example of a meal (food and drink set) recommended by the meal recommendation unit 64. In FIG. 7, three meals are shown in order of highest scores, but the number and order of recommended meals are not particularly limited. The user can specify the quantity of desired meals and press the order confirmation button B1 (YES in step S28), whereby the delivery instruction unit 65 directs the delivery of the meals, and the consumption recording unit 66 records the meals consumed by the user along with the date and time (step S29).

[0036]

In FIG. 7, when the history display button B2 is pressed (YES in step S26), the history creation unit 67 creates a history of the correspondence relation between the meals recommended by the meal recommendation unit 64 and the health indexes (step S27, history creation step). The created history is recorded in the recommendation history DB3 of the recommendation server 6 and is also transmitted to the user terminal 5.

[0037]

Figure 8 illustrates an example of the history of correspondence relation between meals (food and drink sets) recommended by the meal recommendation unit 64 and health indexes. In this example, the health index is the blood glucose level, and the correspondence relation between the recommended meals and the blood glucose levels on the days those meals were consumed is displayed as a one-week history. The user can confirm that after consuming food and drink sets 1 and 3, there was no increase in blood glucose levels.

[0038]

As described above, in this embodiment, the historical correspondence relation between recommended meals and health indexes is visualized, allowing the users to verify whether the recommended meals are indeed suitable for them. This enables the users to select meals while considering their dietary history. Therefore, meals that are suitable for the user can be continuously provided.

[0039]

Embodiment Variation

In this embodiment, the health index was blood glucose level, but the present invention is not limited to this. The health index may also include conditions such as stomach health or cosmetic factors (skin condition), nail

condition, hair color, vascular age, among others. Furthermore, in this embodiment, the biological information acquisition unit 61 obtained the user's gut microbiota information as biological information; however, the present invention is not limited to this. The biological information acquisition unit 61 may obtain information such as the user's age, gender, presence of chronic diseases, health examination results, gene analysis results, etc., as biological information, and the food ingredient evaluation unit 63 may evaluate the food ingredients based on this biological information.

[0040]

Furthermore, when there is a plurality of health indexes, in step S23, the food ingredient evaluation unit 63 evaluates meal sets based on each health index. In step S24, the meal recommendation unit 64 provides meal recommendations by comprehensively evaluating the meal sets that have been evaluated for each health index. For instance, if the health indexes include blood glucose level and gut condition (gut microbiota), the food ingredient evaluation unit 63 evaluates the meal sets from the perspective of blood glucose levels to calculate Score 1 for each meal set, and evaluates them from the perspective of gut microbiota to calculate Score 2 for each meal set.

The meal recommendation unit 64 normalizes both Score 1 and Score 2 to a scale between 0 and 1, and then sums these normalized values for each meal set to perform a comprehensive evaluation of the meal sets.

[0041]

Additionally, the nutritional information of each food ingredient is stored in the meal/recipe Database 2. When the meal recommendation unit 64 recommends meals, it may consider the nutritional information of each food and drink set, calculated from the Meal/Recipe Database 2, in relation to the difference from the required standard amounts.

[0042]

Embodiment 2

Figure 9 is a block diagram illustrating the schematic configuration of the recommendation system 1' according to the second embodiment of the present invention. The recommendation system 1' comprises a gut microbiota examination device 2, a gut microbiota analysis server 3, a health index measuring means 4, a user terminal 5, and a recommendation server (recommendation device) 6'. In other words, the recommendation system 1' is configured by replacing the recommendation server 6 with the recommendation server 6' in the recommendation system 1

shown in Figure 1. In this embodiment, components having the same functions as those in the first embodiment are assigned the same reference numerals, and descriptions thereof are omitted.

[0043]

The recommendation server 6' has a hardware configuration similar to that of the recommendation server 6 shown in Figure 1. As functional blocks, the recommendation server 6' comprises a biological information acquisition unit 61, a health index acquisition unit 62, a food ingredient evaluation unit 63, a meal recommendation unit 64, a delivery instruction unit 65, a consumption recording unit 66, a history creation unit 67, and a similar history search unit 68. In other words, the recommendation server 6' is configured as the recommendation server 6, with the addition of the similar history search unit 68.

[0044]

Moreover, the health index database DB1 and the recommendation history database DB3 stored in the auxiliary storage device 60 of the recommendation server 6' include not only the health indexes and recommendation history of the user of the user terminal 5 (hereinafter referred to as user A), but also the health indexes and recommendation

history of users other than user A utilizing the service (hereinafter referred to as other users).

[0045]

The similar history search unit 68 searches for the historical correspondence relation (similar history) between meals recommended by the meal recommendation unit 64 and health indexes of other users who have gut microbiota similar to that of user A. Specifically, the similar history search unit 68 first references the health index database DB1 to search for other users who have gut microbiota similar to that of user A. The similarity of gut microbiota is determined by using the gut microbiota score. FIGS. 10(a) to 10(c) respectively illustrate the gut microbiota scores of user A, another user P, and another user Q. To compare the gut microbiota scores, the scores are considered as vectors, and the distances between these vectors are calculated. The distance between the gut microbiota score of user A and that of User P is calculated as follows: $(0.9 - 0.8)^2 + (0.02 - 0.03)^2 + (0.15 - 0.15)^2 = 0.0101$. Meanwhile, the distance between the gut microbiota score of user A and that of another user Q is calculated as follows: $(0.9 - 0.4)^2 + (0.02 - 0.05)^2 + (0.15 - 0.3)^2 = 0.2734$. These distances are then compared to a predetermined threshold value (e.g., 0.05). If the distance

is less than or equal to the threshold, the gut microbiota of both the users is determined to be similar. In this example, the gut microbiota of user P is determined to be similar to that of user A. Although only one user with a similar gut microbiota was selected in this example, the number of such users can be any number, including zero or more.

[0046]

The similarity of the gut microbiota may be determined not only by the distance between vectors of the gut microbiota score as described above, but also by using other measures, such as the Mahalanobis distance or correlation coefficients.

[0047]

Subsequently, the similar history search unit 68 references the recommendation history database 3 to search for the history of the correspondence relation between recommended meals and health index for the user P, i.e., the similar history search unit 68 searches for similar histories.

[0048]

Figure 11(a) illustrates an example of the history for user A. For user A, meal sets 1 to 3 have been recommended, and the average blood glucose level during

this period is 130 mg/dL. It is preferable to measure the blood glucose level after a certain period following a meal (for example, 60 minutes post-meal). Alternatively, instead of the blood glucose level, scores for HbA1c (hemoglobin A1c) or drowsiness may also be used.

[0049]

Figure 11(b) illustrates an example of user P's history. Meal sets 4-6 have been recommended to user P, and the average blood glucose level during this period is 135 mg/dL. User P's history is similar to user A's history.

[0050]

The meal recommendation unit 64 recommends meals beneficial to user A's health by considering similar history data, such as the history of user P, in addition to user A's own history. In the present embodiment, the meal recommendation unit 64 extracts meal sets from sets 1 to 6, as shown in Figures 11(a) and (b), where the difference from the average value is less than or equal to zero. This difference is then converted into a positive value and scored accordingly.

[0051]

Figure 12(a) illustrates an example of a food and drink set extracted by the meal recommendation unit 64. The difference values in food and drink sets 1 and 2 represent

the variance from user A's average blood glucose level (130 mg/dL), while the difference value in food and drink set 4 corresponds to the variance from user P's average blood glucose level (135 mg/dL). It should be noted that for food and drink sets 1 through 6, the difference with a fixed value (for example, 140 mg/dL) may also be calculated.

[0052]

FIG. 12(b) is a diagram in which the differences shown in FIG. 12(a) have been converted to positive values and scored. The meal recommendation unit 64 selects the meal sets with scores greater than a predetermined value (for example, 1) from those shown in FIG. 12(b) as the meals to recommend to user A. In this example, meal sets 2 and 4 are selected as the meals recommended to user A.

[0053]

Figure 13 illustrates an example of a meal (food and drink set) recommended by the meal recommendation unit 64. In this screen, when the recommendation level display button B3 is pressed, the recommendation level for each food and drink set, along with the purchase frequency over a predetermined past period, is displayed in a graph, as shown in Figure 14.

[0054]

Brief Summary

In this embodiment, as described above, meals beneficial to user A's health are recommended based not only on user A's personal history but also on a comparable history from user P, whose gut microbiota is similar to that of user A. If meals were recommended solely based on user A's history, only those meals that have been previously recommended to user A would be recommended. However, by taking into account similar histories as well, it becomes possible to recommend meals that have not been previously recommended to user A.

[0055]

In FIG. 12(b), the score of the food and drink sets included in the history of user P may be adjusted according to the similarity of the gut microbiota between user A and user P. For example, the similarity can be calculated by subtracting the distance between the gut microbiota score of user A and that of user P (0.0101) from 1, resulting in a value of 0.9899. This similarity value can then be multiplied with the score of the food and drink sets included in the history of user P.

[0056]

Embodiment Variation

In this embodiment, the meal recommendation unit 64 was recommending meals based on history. However, it may

further recommend meals by performing a comprehensive evaluation of the food ingredient evaluation results and history. For example, when the health indexes are blood glucose level and abdominal condition (gut microbiota), the food ingredient evaluation unit 63 evaluates food and drink sets for each health index. Then, the meal recommendation unit 64 may recommend meals beneficial to health by comprehensively evaluating the food and drink sets evaluated for each health index along with those evaluated based on history.

[0057]

In addition, it may be possible for the user to select which health index to consider when displaying the meal recommendation screen. FIG. 15 illustrates an example of a screen for selecting factors to consider in meal recommendations, where the user can choose the factors to consider from the available options. For instance, if the user selects the factors of blood glucose level, gut microbiota, and history, and then presses the recommendation display button B4, the meal recommendation unit 64 evaluates the food and drink sets that are effective for each of blood glucose level and gut microbiota. It calculates scores for each food and drink set and also calculates a score for the food and drink set

based on the user's history. The meal recommendation unit 64 integrates these scores to make an overall assessment of the food and drink sets and recommends the meal with the highest score. Consequently, as illustrated in FIG. 16, a screen displaying meal recommendations that consider the selected factors is shown. In this manner, the meal recommendation unit 64 can automatically recommend meals suitable for the user. Furthermore, in the overall evaluation of food and drink sets, the meal recommendation unit 64 may consider the user's dietary preferences (likes and dislikes) and food allergies.

[0058]

Furthermore, on the screen shown in FIG. 16, when the detailed recommendation level button B5 is pressed, a screen displaying the details of the recommendation level is shown, as illustrated in FIG. 17. In FIG. 17, the recommendation levels for each food and drink set are displayed in a graph based on each factor.

[0059]

Additionally, the meal recommendation unit 64 may employ an artificial intelligence (AI) model to recommend meals based on the user's history. In this scenario, as preparation, an AI model is constructed using machine learning. During the score computation phase, explanatory

variables are input into this AI model, resulting in the output of values related to blood glucose levels, which serve as the objective variable. Examples of explanatory variables include gut microbiota scores, data on food and drink sets (or data decomposed into nutritional components), blood glucose level information, and other health data. Examples of objective variables include values related to blood glucose levels (such as postprandial blood glucose levels measured 30 minutes after a meal) and scores provided as a result of gut microbiota analysis. Machine learning techniques such as neural networks, support vector machines (SVM), and ensemble learning may be used.

[0060]

Additionally, it is contemplated to recommend based on pre-defined rules. An example of a recommendation method based on rules involves pre-defining a rule where, if a certain index value, or an index value calculated from a plurality of values, falls within a specific range, a certain meal is recommended.

[0061]

In addition, an auxiliary storage device 60 is equipped with a behavior database (DB) that records actions and/or lifestyle habits recommended (or that should be recommended) to the user. By referring to this behavior DB,

the meal recommendation unit 64 can determine the degree of improvement in blood glucose levels in relation to combinations of previously recommended food and drink sets, and actions and/or lifestyle habits. Based on this determination, the unit may recommend meals.

[0062]

Additional Notes

The present invention is not limited to the above-described embodiments. Various modifications can be made within the scope indicated by the claims, and forms obtained by appropriately combining the technical means disclosed in each embodiment are also included within the technical scope of the invention.

Description of Reference Numerals

[0063]

1 Recommendation System

1' Recommendation System

2 Gut Microbiota Examination Device

3 Gut Microbiota Analysis Server

4 Health Index Measuring Means

5 User Terminal

6 Recommendation Server (Recommendation Device)

6' Recommendation Server (Recommendation Device)

60 Auxiliary Storage Device
61 Biological Information Acquisition Unit
62 Health Index Acquisition Unit
63 Food Ingredient Evaluation Unit
64 Meal Recommendation Unit
65 Delivery Instruction Unit
66 Consumption Recording Unit
67 History Creation Unit
68 Similar History Search Unit
P1 Recommendation Program

CLAIMS

1. A recommendation device for recommending meals beneficial to user's health, comprising:
 - a biological information acquisition unit configured to obtain biological information of a user;
 - a health index acquisition unit configured to obtain a health index of said user;
 - a food ingredient evaluation unit configured to evaluate food ingredients based on said biological information;
 - a meal recommendation unit configured to recommend meals beneficial to health based on the evaluation results of said food ingredients; and
 - a history creation unit configured to create a history of the correspondence relation between the meals recommended by said meal recommendation unit and said health index.
2. The recommendation device according to claim 1, wherein said meal recommendation unit recommends meals beneficial to health based on said history.
3. The recommendation device according to claim 2, wherein

said meal recommendation unit recommends meals beneficial to health by comprehensively evaluating said history and the evaluation results of said food ingredients.

4. The recommendation device according to claim 2, further comprising a similar history search unit that searches for similar history, which is a record of the correspondence relation between meals recommended by said meal recommendation unit and said health index, for other users whose biological information is similar to that of said user,

wherein said meal recommendation unit further recommends said meals beneficial to health based on said similar history.

5. The recommendation device according to any one of claims 1 to 4, wherein said biological information is gut microbiota information.

6. The recommended device according to any one of claims 1 to 4, wherein said health index includes a blood glucose level.

7. A recommendation method for recommending meals

beneficial to user's health, comprising:

- a biological information acquisition step for obtaining biological information of a user;

- a health index acquisition step for obtaining the health index of said user;

- a food ingredient evaluation step for evaluating food ingredients based on said biological information;

- a meal recommendation step for recommending the meals beneficial to health based on the evaluation results of said food ingredients; and

- a history creation step for creating a history of the correspondence relation between the meals recommended in said meal recommendation step and said health index.

8. A recommendation program for recommending meals beneficial to user's health, the program causing a computer to function as:

- a biological information acquisition unit configured to obtain biological information of a user;

- a health index acquisition unit configured to obtain health index of said user;

- a food ingredient evaluation unit configured to evaluate food ingredients based on said biological information;

a meal recommendation unit configured to recommend said meals beneficial to health based on the evaluation results of said food ingredients; and

a history creation unit configured to create a history of the correspondence relation between the meals recommended by said meal recommendation unit and said health index.

9. A non-transitory computer-readable recording medium storing a recommendation program for recommending meals beneficial to user's health, wherein the recommendation program causes a computer to function as:

a biological information acquisition unit configured to obtain biological information of a user;

a health index acquisition unit configured to obtain health index of said user;

a food ingredient evaluation unit configured to evaluate food ingredients based on said biological information;

a meal recommendation unit configured to recommend meals beneficial to health based on the evaluation results of said food ingredients; and

a history creation unit configured to create a history of the correspondence relation between the meals

recommended by said meal recommendation unit and said health index.