National Centre for the Replacement Refinement & Reduction of Animals in Research

The ARRIVE Guidelines Checklist

Animal Research: Reporting In Vivo Experiments

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	ITEM	RECOMMENDATION	Section/Paragraph
Title	1	Provide as accurate and concise a description of the content of the article as possible.	The gene expression profile and physiological data of mice feeding the resveratrol-enriched rice DJ526 (Chung et al., 2016)
Abstract	2	Provide an accurate summary of the background, research objectives, including details of the species or strain of animal used, key methods, principal findings and conclusions of the study.	BACKGROUND AND PURPOSE: The resveratrol-enriched rice DJ526 accumulating 1.4-1.9 μg/g of resveratrol in its grain showed the unexpectedly high beneficial health effects on anti-aging. Mouse-feeding experiments showed that the resveratrol-enriched rice DJ526 ameliorates age-related deterioration as exhibited by preventing the aging of cutaneous tissue and by boosting motor coordination and physical strength during aging compared to controls. Here we present these valuable raw data sets of microarray and physiological data of mice feeding the resveratrol-enriched rice DJ526, Dongjin rice, or resveratrol deposited in public repositories, as well as how to analyze blood serum in micro-scale. These datasets may help other researchers find new clues for the etiology of anti-aging process and the signaling pathways induced by resveratrol, rice, or the resveratrol-enriched rice DJ526 as well as analyze experimental mice. EXPERIMENTAL APPROACH: C57BL/6N female mice (17.5 ± 1.5 g) were purchased from Joongang Experimental Animal Co. (Seoul, Korea) at six weeks of age (n = 80). The mice were housed 10 animals per cage, with food (10% kcal as fat; D12450B; Research Diets Inc., New Brunswick, NJ, USA) and water available ad libitum unless otherwise stated. Cages of mice were randomly assigned to each of the four groups (n = 20 per group). They were maintained under a 12 h light/12 h dark cycle with lights on at 8:30 pm in a temperature (22 ± 1°C) and humidity (55 ± 5%) controlled room until the time of sacrifice. After 2 weeks of acclimation, a total of 80 mice were randomly divided into the following groups: Normal Formula Diet (Ctrl), NFD supplemented with resveratrol (RS), NFD in which the corn starch and sucrose were replaced with Dongjin rice (DJ), NFD in which the corn starch and sucrose were replaced with the resveratrol-enriched rice DJ526 (DJ526). The food consumption of each mouse group was monitored on a daily basis. In experiments for blood profiling and behavioral assay, animals were randomly picked into each treatment groups. In particular, we declare that blinding was employed during animal allocation and data collection.

			KEY RESULTS: We present these valuable raw data sets of microarray and physiological data of mice feeding the resveratrol-enriched rice DJ526, Dongjin rice, or resveratrol deposited in public repositories, as well as how to analyze blood serum in micro-scale. These datasets may help other researchers find new clues for the etiology of anti-aging process and the signaling pathways induced by resveratrol, rice, or the resveratrol-enriched rice DJ526 as well as analyze experimental mice. CONCLUSIONS AND IMPLICATIONS: Blood collections from mice are routinely required for a wide variety of in vivo experiment. Although a number of efficient methods have been developed, current methods typically require sacrificing mice or result in mice being much stressed. It is well known that the outcomes of research data were affected if mice were stressed during blood collection. Here we also described a method to analyze mouse blood in micro-scale. In this method, tiny amount of bloods were collected in a short period of time and analyzed accurately in micro-scale so that the mice were not stressed. (Hoff et al., 2000 and Teilmann et al., 2014).
INTRODUCTION			
Background	3	a. Include sufficient scientific background (including relevant references to previous work) to understand the motivation and context for the study, and explain the experimental approach and rationale.	Resveratrol has gained widespread attention due to its ability to extend the lifespan of yeast, worms, and flies, and its ability to protect against age-related diseases such as cancer, Alzheimer's, and diabetes in mammals1. Despite various health-beneficial effects of resveratrol, the efficacy of resveratrol on expanding lifespan is drawing the most attention. However, the efficacy of resveratrol on expanding lifespan was limited to yeast, worms, fruit flies, and fish2-8. The effect of resveratrol on lifespan in rodent models has not been reproduced, and clinical studies on resveratrol also seemed that resveratrol has no effect on expanding life span9-14. The beneficial effect of resveratrol in higher animals including human were limited only in mimicking dietary restriction to delay the physiological deterioration associated with aging but not expanding lifespan9-14. Previously, We created the resveratrol-enriched rice DJ526 by transferring the resveratrol biosynthesis gene, stilbene synthase, from the peanut Arachis hypogaea variety Palkwang into the rice Oryza sativa japonica variety Dongjin which has health-beneficial effects on metabolic syndrome and obesity15, 16. It was believed that the resveratrol-enriched rice DJ526 accumulating 1.4-1.9 μg/g of resveratrol in its grain could show the health-beneficial effects as much as crops containing the similar levels of resveratrol. However, the innate trait of the resveratrol-enriched rice DJ526 acts synergistically with the transgenic trait of resveratrol in mice to confer unexpectedly higher health benefits than expected from either Dongjin rice or resveratrol15, 16. Although Dongjin rice or resveratrol themselves have insignificant effects on metabolic syndrome and obesity, the genetically modified resveratrol-enriched rice DJ526 shows unexpectedly high efficacy for treating metabolic syndrome and obesity in animal studies15, 16. The efficacy levels of the resveratrol-enriched rice DJ526 on metabolic syndrome and obesity were as much as the typical pharmaceutical drugs aiming to treat metabolic syndrome and obesity15, 16. We further studied the health-beneficial effects on aging process as well as the mechanism behind the resveratrol-enriched rice DJ52617. Again, the resveratrol-enriched rice DJ526 ameliorated age-related deteriorations in mice, as exhibited by preventing cutaneous aging and by boosting motor coordination and physical strength during aging, while Dongjin rice or resveratrol themselves have insignificant effects on age-related deteriorations in mice17. That work proved also that the resveratrol-enriched rice DJ526 has unexpectedly high beneficial health effects on delaying aging process surpassing the introduced genetic characteristic of resveratrol synthetic ability. In the current study we performed whole-genome microarrays and pathway analyses on the liver samples of mice fed with the resveratrol-enriched rice DJ526, Dongjin rice, resveratrol alone, and control as well as physiological analyses. The results of these data analyses were published in a manuscript in Scientific Reports that focused on the interpretation of the data from this study as well as elucidating the biological impact of feeding the resveratrol-enriched rice DJ526, Dongjin rice, or resveratrol (Chung et al., 2016).
		b. Explain how and why the animal species and model being used can address the scientific objectives and, where appropriate, the study's relevance to human biology.	Here, we describe these valuable microarray raw data sets deposited in public repositories and re-interpreted the data. At the same time, resveratrol is one of the most debated compounds for their health-beneficial effects. Considering these characteristics of the resveratrol-enriched rice DJ526 and resveratrol, we believe that these microarray data could be a valuable resource in studying aging process and elucidating the biological mechanism on how resveratrol confers various health-beneficial effects.
Objectives	4	Clearly describe the primary and any secondary objectives of the study, or specific hypotheses being tested.	Blood collections from mice are routinely required for a wide variety of in vivo experiment. Although a number of efficient methods have been developed, current methods typically require sacrificing mice or result in mice being much stressed. It is well known that the outcomes of research data were affected if mice were stressed during blood collection. Here we also described a method to analyze mouse blood in micro-scale. In this method, tiny amount of bloods were collected in a short period of time and analyzed accurately in micro-scale so that the mice were not stressed (Hoff et al., 2000 and Teilmann et al., 2014).

METHODS

Ethical statement	5	Indicate the nature of the ethical review permissions, relevant licences (e.g. Animal [Scientific Procedures] Act 1986), and national or institutional guidelines for the care and use of animals, that cover the research.	All procedures involving animals were performed in an accredited with approval of an Institutional Animal Care and Use Committee (IACUC), in compliance with the Ethics Committee of Chonbuk National University Laboratory Animal Center Guidelines on the Care and Use of Animals for Scientific Purposes. Every animal related procedural change during the course of the study was communicated, discussed and approved by the IACUC committee.
Study design	6	For each experiment, give brief details of the study design including: a. The number of experimental and control groups. b. Any steps taken to minimise the effects of subjective bias when allocating animals to treatment (e.g. randomisation procedure) and when assessing results (e.g. if done, describe who was blinded and when). c. The experimental unit (e.g. a single animal, group or cage of animals). d. A time-line diagram or flow chart can be useful to illustrate how complex study designs were carried out.	The study design included four groups of female C57BL/6N mice (n = 20): (1) Ctrl (The control mice fed a NFD in which the carbohydrate source was corn starch and sucrose), (2) RS (resveratrol mice fed a NFD in which the carbohydrate source was corn starch and sucrose except containing resveratrol), (3) DJ (Dongjin mice fed a NFD in which the corn starch and sucrose were replaced with Dongjin rice), and (4) DJ526 (DJ526 mice fed a NFD in which the corn starch and sucrose were replaced with the resveratrol-enriched rice DJ526). In experiments for blood profiling and behavioral assay, animals were randomly picked into each treatment groups. In particular, we declare that blinding was employed during animal allocation and data collection. In the study, n refers to number of animals, the mice were housed 10 animals per cage, with food (10% kcal as fat; D12450B; Research Diets Inc., New Brunswick, NJ, USA) and water available ad libitum unless otherwise stated. Cages of mice were randomly assigned to each of the four groups (n = 20 per group).

a Study design

Group	Exposure duration: 0 Month	3 Month	6 Month	Number of mice per group: Blood profile	Behavioural test	Liver Isolation
Ctrl				20	20	-
				20	20	-
				20	20	3
RS				20	20	-
				20	20	-
				20	20	3
DJ				20	20	-
				20	20	-
				20	20	3
DJ526				20	20	-
				20	20	-
				20	20	3

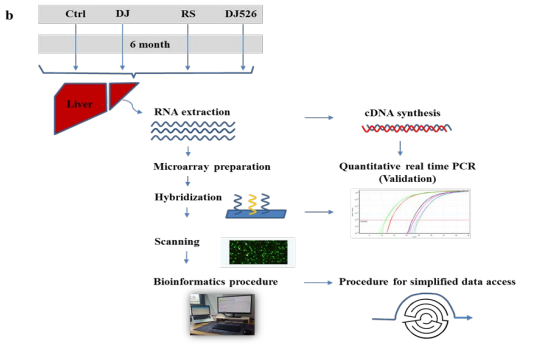
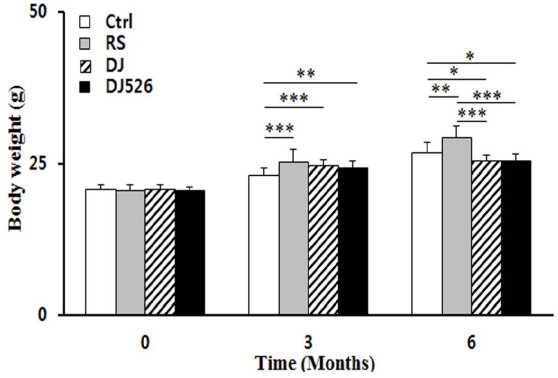


Figure 1. Experimental design. (a) The study design entailed 4 different exposure groups, 3 time points (0, 3 and 6 months), where mice were allocated for each category. The number of mice planned in the study per exposure group for each time point and design are summarized. (b) Schematic illustration of microarray analysis process. For the gene expression patterns of four groups, we performed whole-genome microarrays and pathway analyses on the liver samples of mice fed with the resveratrol-enriched rice DJ526 (DJ526), Dongjin rice (DJ), resveratrol alone (RS), and control (Ctrl).

Experimental procedures	7	For each experiment and each experimental group, including controls, provide precise details of all procedures carried out. For example:	
		a. How (e.g. drug formulation and dose, site and route of administration, anaesthesia and analgesia used [including monitoring], surgical procedure, method of euthanasia). Provide details of any specialist equipment used, including supplier(s).	The mice were housed 10 animals per cage, with food (10% kcal as fat; D12450B; Research Diets Inc., New Brunswick, NJ, USA) and water available ad libitum unless otherwise stated. Cages of mice were randomly assigned to each of the four groups (n = 20 per group). They were maintained under a 12 h light/12 h dark cycle with lights on at 8:30 pm in a temperature (22 ± 1°C) and humidity (55 ± 5%) controlled room until the time of sacrifice.
		b. When (e.g. time of day).	Blood collection in mice and mouse behavioral test were conducted in the light phase.
		c. Where (e.g. home cage, laboratory, water maze).	The mice were trained to swim from one end of a water-filled glass tank to a visible escape platform at the opposite end. An escape platform was located 0.5 cm below the surface of the water at one end of the tank. The glass tank (40 25 16 cm3) was filled to a depth of 20 cm with water maintained at a temperature of 23 °C. After training mice, mice were released from one end on each test trial, and were allowed to swim freely for up to 120 sec. No spatial cues were provided within the tank environment. The rotarod apparatus (ROTA ROD, Haryana, India) was used to assess motor coordination, strength and balance. The apparatus consisted of a base platform and a rotating rod with a diameter of 3 cm and a non-slippery surface. The rod was placed at a height of 15 cm from the base. The rod, 30 cm in length, was divided into four equal sections by three fiber plates. Thus, up to four mice were tested simultaneously on the apparatus, with the same rod rotating speed.
		d. Why (e.g. rationale for choice of specific anaesthetic, route of administration, drug dose used).	Blood samples were drawn from the tail by cutting precisely the vein of tail after 5 h of fasting, and blood drops were collected in 1.5 mL Eppendorf micro-centrifuge tube. If the quantity of serum was too small even in micro-scale, the reading result of the assay could not be accurate. Therefore, the two mouse serum samples within a same group were randomly combined each to get an enough serum volume for analyses.
Experimental animals	8	a. Provide details of the animals used, including species, strain, sex, developmental stage (e.g. mean or median age plus age range) and weight (e.g. mean or median weight plus weight range).	C57BL/6N female mice (17.5 ± 1.5 g) were purchased from Joongang Experimental Animal Co. (Seoul, Korea) at six weeks of age (n = 80).
		b. Provide further relevant information such as the source of animals, international strain nomenclature, genetic modification status (e.g. knock-out or transgenic), genotype, health/immune status, drug or test naïve, previous procedures, etc.	The mice were housed 10 animals per cage, with food (10% kcal as fat; D12450B; Research Diets Inc., New Brunswick, NJ, USA) and water available ad libitum unless otherwise stated. Cages of mice were randomly assigned to each of the four groups (n = 20 per group). They were maintained under a 12 h light/12 h dark cycle with lights on at 8:30 pm in a temperature (22 ± 1°C) and humidity (55 ± 5%) controlled room until the time of sacrifice.

Housing and husbandry	9	Provide details of:	
		a. Housing (type of facility e.g. specific pathogen free [SPF]; type of cage or housing; bedding material; number of cage companions; tank shape and material etc. for fish).	The mice were housed 10 animals per cage, with food (10% kcal as fat; D12450B; Research Diets Inc., New Brunswick, NJ, USA) and water available ad libitum unless otherwise stated. Cages of mice were randomly assigned to each of the four groups (n = 20 per group). They were maintained under a 12 h light/12 h dark cycle with lights on at 8:30 pm in a temperature (22 ± 1°C) and humidity (55 ± 5%) controlled room until the time of sacrifice.
		b. Husbandry conditions (e.g. breeding programme, light/dark cycle, temperature, quality of water etc for fish, type of food, access to food and water, environmental enrichment).	The mice were housed 10 animals per cage, with food (10% kcal as fat; D12450B; Research Diets Inc., New Brunswick, NJ, USA) and water available ad libitum unless otherwise stated. Cages of mice were randomly assigned to each of the four groups (n = 20 per group). They were maintained under a 12 h light/12 h dark cycle with lights on at 8:30 pm in a temperature (22 ± 1°C) and humidity (55 ± 5%) controlled room until the time of sacrifice.
		c. Welfare-related assessments and interventions that were carried out prior to, during, or after the experiment.	The mice were housed 10 animals per cage, with food (10% kcal as fat; D12450B; Research Diets Inc., New Brunswick, NJ, USA) and water available ad libitum unless otherwise stated. Cages of mice were randomly assigned to each of the four groups (n = 20 per group). They were maintained under a 12 h light/12 h dark cycle with lights on at 8:30 pm in a temperature (22 ± 1°C) and humidity (55 ± 5%) controlled room until the time of sacrifice.
Sample size	10	a. Specify the total number of animals used in each experiment, and the number of animals in each experimental group.	The study design included four groups of female C57BL/6N mice (n = 20): (1) Ctrl (The control mice fed a NFD in which the carbohydrate source was corn starch and sucrose), (2) RS (resveratrol mice fed a NFD in which the carbohydrate source was corn starch and sucrose except containing resveratrol), (3) DJ (Dongjin mice fed a NFD in which the corn starch and sucrose were replaced with Dongjin rice), and (4) DJ526 (DJ526 mice fed a NFD in which the corn starch and sucrose were replaced with the resveratrol-enriched rice DJ526)
		b. Explain how the number of animals was arrived at. Provide details of any sample size calculation used.	Sample size calculations were the reference paper (Chung et al., 2016)
		c. Indicate the number of independent replications of each experiment, if relevant	The experiment was repeated, and data were pooled.
Allocating animals to experimental groups	11	a. Give full details of how animals were allocated to experimental groups, including randomisation or matching if done.	For experiments using animals, cages of mice were randomly assigned to each of the four groups (n = 20 per group).

		b. Describe the order in which the animals in the different experimental groups were treated and assessed.	In experiments for blood profiling and behavioral assay, animals were randomly picked into each treatment groups. In particular, we declare that blinding was employed during animal allocation and data collection.
Experimental outcomes	12	Clearly define the primary and secondary experimental outcomes assessed (e.g. cell death, molecular markers, behavioural changes).	The mice were trained to swim from one end of a water-filled glass tank to a visible escape platform at the opposite end. An escape platform was located 0.5 cm below the surface of the water at one end of the tank. The glass tank (40 25 16 cm3) was filled to a depth of 20 cm with water maintained at a temperature of 23 °C. After training mice, mice were released from one end on each test trial, and were allowed to swim freely for up to 120 sec. No spatial cues were provided within the tank environment. The rotarod apparatus (ROTA ROD, Haryana, India) was used to assess motor coordination, strength and balance. The apparatus consisted of a base platform and a rotating rod with a diameter of 3 cm and a non-slippery surface. The rod was placed at a height of 15 cm from the base. The rod, 30 cm in length, was divided into four equal sections by three fiber plates. Thus, up to four mice were tested simultaneously on the apparatus, with the same rod rotating speed. Blood samples were drawn from the tail by cutting precisely the vein of tail after 5 h of fasting, and blood drops were collected in 1.5 mL Eppendorf micro-centrifuge tube. If the quantity of serum was too small even in micro-scale, the reading result of the assay could not be accurate. Therefore, the two mouse serum samples within a same group were randomly combined each to get an enough serum volume for analyses.
Statistical methods	13	a. Provide details of the statistical methods used for each analysis.	All data were expressed as the mean ± s. d., as indicated. The statistical comparisons were analyzed using an unpaired Student's t-test. All differences were considered statistically significant if $p < 0.05$. Statistical significance is shown as $*p < 0.05$, $**p < 0.01$ and $***p < 0.001$
		b. Specify the unit of analysis for each dataset (e.g. single animal, group of animals, single neuron).	For behavioral test, the experimental unit was an individual animal.
		c. Describe any methods used to assess whether the data met the assumptions of the statistical approach.	The statistical comparisons were analyzed using an unpaired Student's t-test.
RESULTS			
Baseline data	14	For each experimental group, report relevant characteristics and health status of animals (e.g. weight, microbiological status, and drug or test naïve) prior to treatment or testing. (This information can often be tabulated).	All procedures involving animals were performed in an accredited with approval of an Institutional Animal Care and Use Committee (IACUC), in compliance with the Ethics Committee of Chonbuk National University Laboratory Animal Center Guidelines on the Care and Use of Animals for Scientific Purposes. Every animal related procedural change during the course of the study was communicated, discussed and approved by the IACUC committee. The mice were free of all viral, bacterial, and parasitic pathogens listed in the IACUC recommendations.
Numbers analysed	15	a. Report the number of animals in each group included in each analysis. Report absolute numbers (e.g. 10/20, not 50%[2]).	The study design included four groups of female C57BL/6N mice. (n = 20) C57BL/6N female mice (17.5 ± 1.5 g) were purchased from Joongang Experimental Animal Co. (Seoul, Korea) at six weeks of age (n = 80). The mice were housed 10 animals per cage, with food (10% kcal as fat; D12450B; Research Diets Inc., New Brunswick, NJ, USA) and water available ad libitum unless otherwise stated. Cages of mice were randomly assigned to each of the four groups (n = 20 per group). All mice were utilized for this study and 20 per group were included and completed.

		b. If any animals or data were not included in the analysis, explain why.	All mice were utilized for this study and 20 per group were included and completed.
Outcomes and estimation	16	Report the results for each analysis carried out, with a measure of precision (e.g. standard error or confidence interval).	In accordance with the ARRIVE guidelines (Kilkenny et al. 2010), we have reported measures of precision, confidence, and n to provide an indication of significance. Cages of mice were randomly assigned to each of the four groups (n = 20 per group). **Fig. 2 The effects of the resveratrol-enriched rice DJ526 on changes in body weight with age progression.** Changes in the body weight of four experimental groups mice at 0, 3 and 6 months of the experiment. The values represent the mean ± s.d. (n=20). The control (Ctrl) mice fed a NFD in which the carbohydrate source was corn starch and sucrose; resveratrol (RS) mice fed a NFD in which the carbohydrate source was corn starch and sucrose except containing resveratrol; Dongjin (DJ) mice fed a NFD in which the corn starch and sucrose were replaced with Dongjin rice; DJ526 mice fed a NFD in which the corn starch and sucrose were replaced with the resveratrol-enriched rice DJ526.  Values in the figure with a superscripted letter indicate statistical significance as analyzed by an unpaired Student's t-test; $p < 0.05$, $p < 0.01$, $p < 0.001$.
Adverse events	17	a. Give details of all important adverse events in each experimental group. b. Describe any modifications to the experimental protocols made to reduce adverse events.	The blood glucose and lipid levels were measured at 0, 3 and 6 months during treatment. The food consumption of each mouse group was regularly monitored. Blood samples were drawn from the tail by cutting precisely the vein of tail after 5 h of fasting, and blood drops were collected in 1.5 mL Eppendorf micro-centrifuge tube. The serum was separated by centrifuging at 13,000 rpm for 10 min and immediately stored at 22 °C until assayed. If the quantity of serum was too small even in micro-scale, the reading result of the assay could not be accurate. Therefore, the two mouse serum samples within a same group were randomly combined each to get an enough serum volume for analyses. Blood collections from mice are routinely required for a wide variety of in vivo experiment. Although a number of efficient methods have been developed, current methods typically require sacrificing mice or result in mice being much stressed18. It is well known that the outcomes of research data were affected if mice were stressed during blood collection19. Here we also described a method to analyze mouse blood in micro-scale. In this method, tiny amount of bloods were collected in a short period of time and analyzed accurately in micro-scale so that the mice were not stressed.

DISCUSSION			
Interpretation/ scientific implications	18	a. Interpret the results, taking into account the study objectives and hypotheses, current theory and other relevant studies in the literature.	In the current study we performed whole-genome microarrays and pathway analyses on the liver samples of mice fed with the resveratrol-enriched rice DJ526, Dongjin rice, resveratrol alone, and control as well as physiological analyses. The results of these data analyses were published in a manuscript in Scientific Reports that focused on the interpretation of the data from this study as well as elucidating the biological impact of feeding the resveratrol-enriched rice DJ526, Dongjin rice, or resveratrol17. Here, we describe these valuable microarray raw data sets deposited in public repositories and re-interpreted the data. At the same time, resveratrol is one of the most debated compounds for their health-beneficial effects. Considering these characteristics of the resveratrol-enriched rice DJ526 and resveratrol, we believe that these microarray data could be a valuable resource in studying aging process and elucidating the biological mechanism on how resveratrol confers various health-beneficial effects.
		b. Comment on the study limitations including any potential sources of bias, any limitations of the animal model, and the imprecision associated with the results[2].	Blood collections from mice are routinely required for a wide variety of in vivo experiment. Although a number of efficient methods have been developed, current methods typically require sacrificing mice or result in mice being much stressed18. It is well known that the outcomes of research data were affected if mice were stressed during blood collection19. Here we also described a method to analyze mouse blood in micro-scale. In this method, tiny amount of bloods were collected in a short period of time and analyzed accurately in micro-scale so that the mice were not stressed.
		c. Describe any implications of your experimental methods or findings for the replacement, refinement or reduction (the 3Rs) of the use of animals in research.	Here we also described a method to analyze mouse blood in micro-scale. In this method, tiny amount of bloods were collected in a short period of time and analyzed accurately in micro-scale so that the mice were not stressed.
Generalisability/ translation	19	Comment on whether, and how, the findings of this study are likely to translate to other species or systems, including any relevance to human biology.	In the current study we performed whole-genome microarrays and pathway analyses on the liver samples of mice fed with the resveratrol-enriched rice DJ526, Dongjin rice, resveratrol alone, and control as well as physiological analyses. The results of these data analyses were published in a manuscript in Scientific Reports that focused on the interpretation of the data from this study as well as elucidating the biological impact of feeding the resveratrol-enriched rice DJ526, Dongjin rice, or resveratrol17. Here, we describe these valuable microarray raw data sets deposited in public repositories and re-interpreted the data. At the same time, resveratrol is one of the most debated compounds for their health-beneficial effects. Considering these characteristics of the resveratrol-enriched rice DJ526 and resveratrol, we believe that these microarray data could be a valuable resource in studying aging process and elucidating the biological mechanism on how resveratrol confers various health-beneficial effects.
Funding	20	List all funding sources (including grant number) and the role of the funder(s) in the study.	This work was supported by a grant from the Next-Generation BioGreen 21 program, Rural Development Administration (No. PJ011188). This research was also supported by the Technology Development Program for Agriculture and Forestry No. 313040-3, Ministry for Food, Agriculture, Forestry and Fisheries, Republic of Korea.

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