Rice fermented liquid as an alternative for water that retains skin moisture and its application for cosmetics

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Abstract

Background: Fermentation is a technology that creates new substances or metabolites by conversion using the metabolic pathways of microorganisms and is applied in various fields such as foods and cosmetics. We focused on the combination of rice and yeast as microbial fermentation and developed a rice fermented liquid. The aim of this study is to evaluate the effects of rice fermented liquid on skin moisture and elasticity.

Methods: The double-blind, placebo-controlled, left-right randomized clinical trial was carried out. A lotion formulation including 94.5% rice fermented liquid or a blank was topically applied to the left or right half face in healthy twenty-five volunteers twice daily for 8 weeks. The water content in the stratum corneum (SC), transepidermal water loss (TEWL) and skin elasticity was measured using noninvasive devices at baseline, 4 and 8 weeks. Facial analysis was also performed at the same time.

Results: Application of the lotion containing rice fermented liquid for 8 weeks significantly increased the water content in the SC and the number of skin textures as compared with that of the blank. The lotion tended to decrease TEWL. In an age-stratified analysis, the lotion tended to improve skin elasticity in subjects aged under 50 years.

Conclusion: Rice fermented liquid is useful as a functional water having the ability to retain skin moisture and elasticity.

Keywords: rice fermented liquid; human clinical trial; skin moisture; skin elasticity; skin textures; functional water

Introduction.

Fermentation technology is used in various applications such as foods, detergents, medicines in our lives. In particular, fermented foods have a very long history, and the ingredients produced by fermenting plants with microorganisms are delicious, good for health, and have various effectiveness such as improving storage stability. Among them, it has long been known that the combination of rice and yeast are the best for sake brewing, which is a traditional Japanese fermentation technology. We have tried to develop a rice fermented liquid because it is well compatible with the skin when applying. So far, it has confirmed that 2-ketoglutaric acid (2-KG), which is efficiently produced by yeast fermentation of rice, has promoting effects on proliferation of epidermal keratinocytes and on the expression of mRNA of factors (filaggrin, SPT, involucrin) related to the moisturizing and barrier function in *in vitro* tests (reported at the IFSCC Mexico conference 2021). In this study, we conducted a human clinical trial with continuous use of a lotion containing rice fermented liquid and found that the fermented liquid is a promising cosmetics ingredient with the functions to retain skin moisture and elasticity.

Materials and Methods.

Test sample

The lotion containing 94.5% of rice fermented liquid, 5% of propanediol and 0.5 % of phenoxyethanol or that containing purified water instead of rice fermented liquid as a blank was prepared for this study.

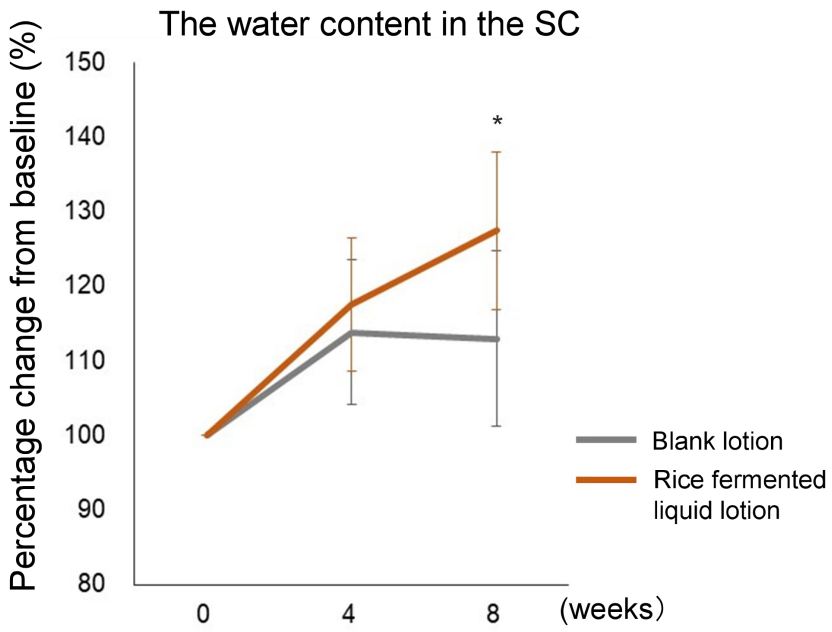
Test method

Twenty-five healthy Japanese female subjects aged between 24 and 57 (Ave. 44) with low water content in the stratum corneum and little difference between the left and right sides of the face who signed the informed consent were selected. The double-blind, placebo-controlled, left-right randomized clinical trial was conducted by topical application of a rice fermented liquid lotion and its blank on each half side of the face twice daily (morning and night) for 8 weeks in these subjects. Subjects were equilibrated for more than 15 minutes in a closed environment with 20 ^{o}C and 50 % relative humidity conditions. The water content in the SC was measured using a corneometer (Model CM825; Courage and Khazaka, Germany). TEWL was measured using a vapometer (Model SWL5001JT; Delfin

Technologies, Finland) . Skin elasticity was measured using a cutometer (Model MPA580; Courage and Khazaka). Facial analysis was also performed using VISIA-Evolution (Integral, Japan). Each measurement was conducted at baseline, 4 and 8 weeks post-application and percentage change from baseline in skin parameters at each time point was used for evaluation. Statistical analyses were conducted using SPSS Statistics (IBM, USA). A statistical significance level of $p < 0.05$ as determined by two-tailed t-test was applied to all analyses.

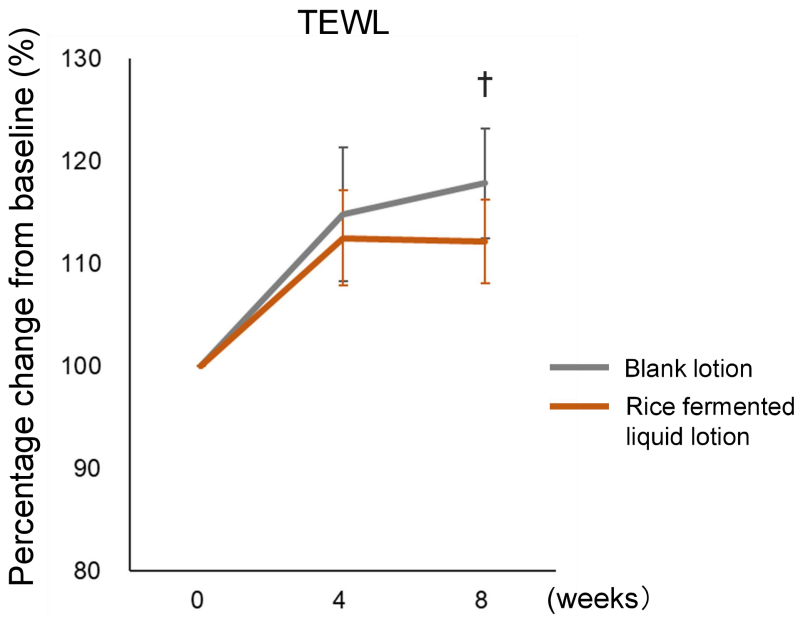
Results.

Application of rice fermented liquid lotion for 8 weeks significantly increased the water content in the SC as compared with the blank lotion (Fig.1) and tended to decrease TEWL (Fig.2). Skin elasticity following the application of rice fermented liquid lotion showed no significant effect (Fig.3). The number of skin textures was significantly increased compared with the blank lotion at 8 weeks (Fig.4). In an age-stratified analysis concerning skin elasticity, an improvement tendency was found by the application of rice fermented liquid lotion in subjects aged under 50 years (Fig.5).



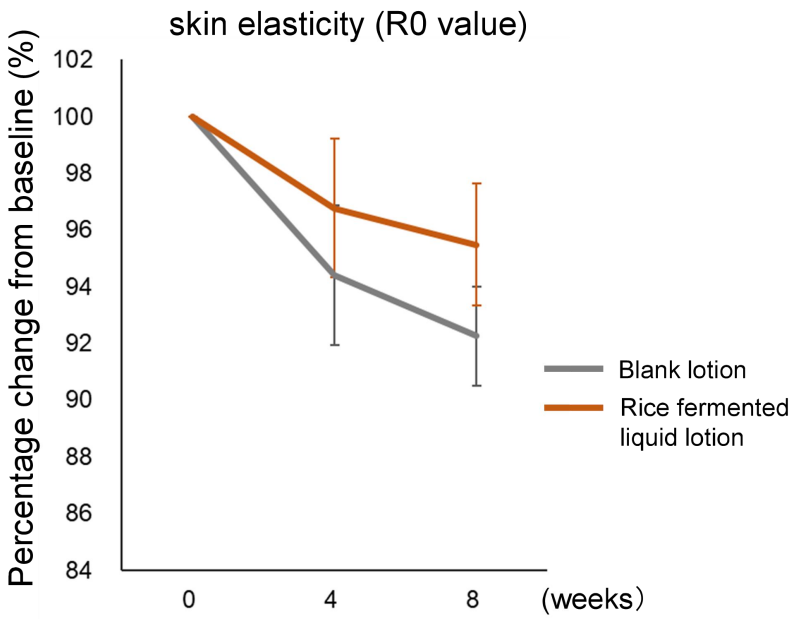
Mean±S.E., n=25 (n=24 at 4 weeks), * : $p<0.05$ (vs. blank lotion)

Fig.1 Effect of a lotion containing rice fermented liquid on the water content in the SC



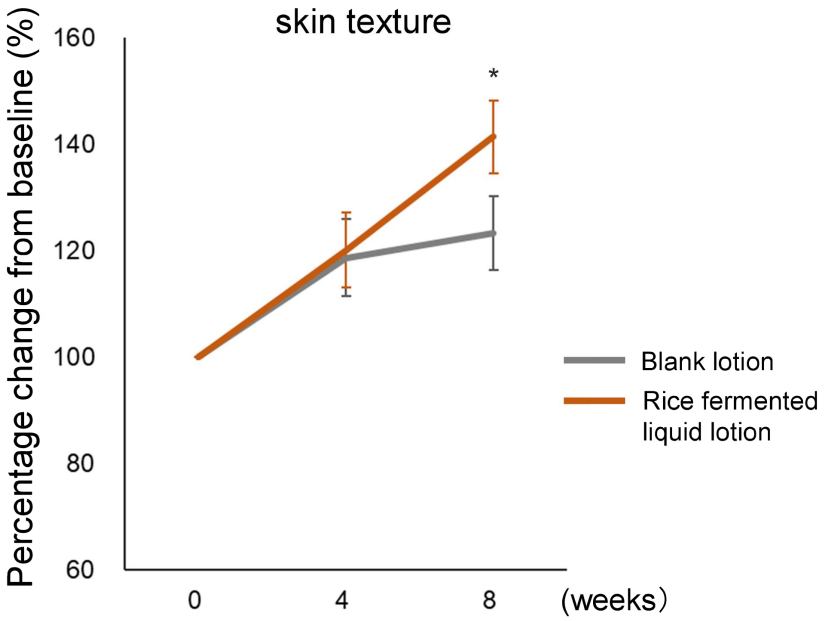
Mean±S.E., n=25 (n=24 at 4 weeks), † : p<0.1 (vs. blank lotion)

Fig.2 Effect of a lotion containing rice fermented liquid on TEWL



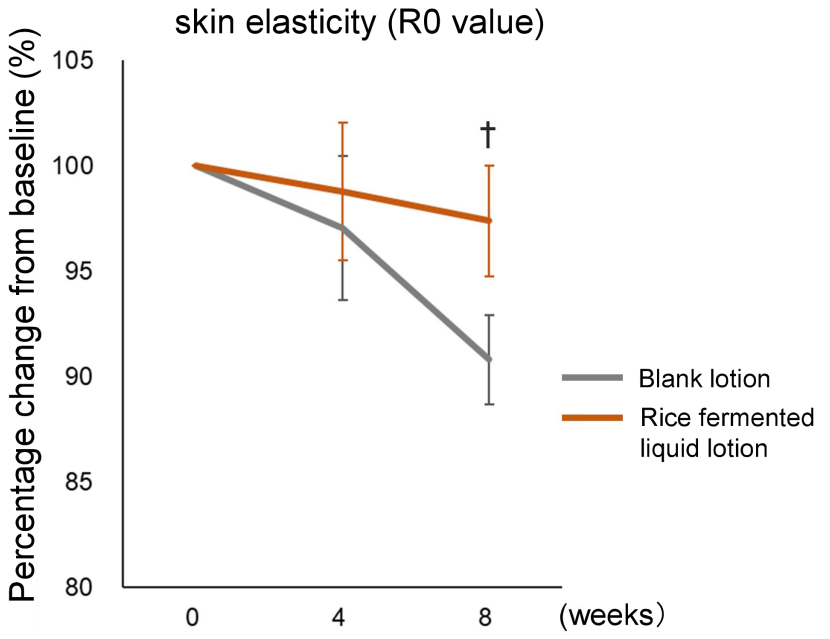
Mean±S.E., n=25 (n=24 at 4 weeks)

Fig.3 Effect of a lotion containing rice fermented liquid on skin elasticity



Mean±S.E., n=25 (n=24 at 4 weeks), * : p<0.05 (vs. blank lotion)

Fig.4 Effect of a lotion containing rice fermented liquid on skin texture



Mean±S.E., n=17 (n=16 at 4 weeks), † : p<0.1 (vs. blank lotion)

Fig.5 Effect of a lotion containing rice fermented liquid on skin elasticity in subjects aged under 50 years

Discussion.

In recent years, cosmetic ingredients produced by microbial fermentation from the perspective of the bioconversion of phytochemicals have been researched and developed [1] [2] [3]. Proteins in raw materials as a substrate are also broken down by the enzymes from microorganisms in the process of fermentation and turned them into amino acids. Free amino acids acount for the largest component of the natural moisturizing factor (NMF) which is indispensable for retaining moisture [4] [5] [6]. Lactates are also one of the main components of NMF [6]. Therefore, we thought that supply of a fermented liquid containing amino acids and lactates to the skin as a sustitute for water, used as a base in the formulation of cosmetics, has a potential to increased skin hydration. We focused on microbial fermentation by the combination of rice and yeast and developed a rice fermented liquid as a cosmetic ingredient with higher compatible with the skin than water. The fermented liquid contains naturally derived substances such as amino acids and lactates. In addition, we have reported that one of the components in the fermented liquid, 2-KG, has promoting effects on the moisturizing and barrier function in *in vitro* tests. As the fermented liquid is expected to be effective by the application on the skin, we conducted a human clinical trial. Eight weeks application of the fermented liquid lotion resulted in a significant increase in the water content in the SC and tended to decrease TEWL as compared with the blank, which means that the fermented liquid has a moisturizing effect compared with water. Furthermore, a significant increase in the number of skin textures by the treatment of this fermented liquid is considered to result from the enhancement of the moisturizing effect. These results suggested that the rice fermented liquid containing amino acids and lactates might not only work more functional than water as a humectant but also improve the epidermal turnover. On the other hand, there was no difference between the fermented liquid lotion and the blank on skin elasticity. However, in an age-stratified analysis, an improvement tendency of skin elasticity by rice fermented liquid lotion was found in subjects aged under 50 years, which means that the rice fermented liquid might be more effective for users under the age of 50. Taken together, it was suggested that the rice fermented liquid is a promising cosmetic ingredient that retains skin moisture and elasticity as an alternative for water.

Conclusion.

It is concluded that the rice fermented liquid is useful as a functional water having the ability to retain skin moisture and elasticity.

Conflict of Interest Statement.

NONE.

References.

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