



## RESEARCH ARTICLE

### ANALYSIS RESULTS OF VITAMIN D (D2, D3) IN CULTIVATED WOOD EAR MUSHROOMS - AFTER 3 HOURS OF UV IRRADIATION -

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#### ABSTRACT

The 2015 edition of the Japanese Dietary Reference Intakes recommended a daily intake of 5.5g of vitamin D. However, due to the COVID-19 pandemic, people have restricted their outings, spent more time at home, and taken more frequent precautions against ultraviolet (UV) radiation, such as using umbrellas and hats, when going outside. The 2025 edition of the Japanese Dietary Reference Intakes recommends a daily intake of 9µg of vitamin D. To increase vitamin D intake from food, we cultivated wood ear mushrooms, which are thought to have a high vitamin D content, and analyzed their vitamin D content at the National Food Research Institute, but the levels were below the detection limit. Therefore, this study aimed to clarify whether the vitamin D (vitamin D2 and vitamin D3) content of wood ear mushrooms (sun-dried) cultivated in the past would increase by irradiating them with UV light (253.7nm) using an indoor UV irradiation device. As a result of this study, the vitamin D (vitamin D2 and vitamin D3) content of cultivated wood ear mushrooms irradiated with UV light (253.7nm) for 3 hours was 236µg/100g, which is more than double the vitamin D content listed in the Japanese Food Composition Table. In the future, considering the use of domestically produced wood ear mushrooms as disaster food and space food, we aim to enhance their value as a food ingredient by managing factors such as "moisture content," "grinding particle size," and "UV irradiation conditions" to maximize the nutritional value of vitamin D2.

## INTRODUCTION

Vitamin D is an important nutrient that is often deficient in the Japanese diet, with a recommended daily intake of 9 µg. Our research has shown that the amount of vitamin D (vitamin D2 and vitamin D3) in wood ear mushrooms increases with ultraviolet irradiation (253.7 nm). While there was no significant difference between 1 hour and 2 hours of irradiation, 3 hours of irradiation resulted in a vitamin D content of 127 µg/100g, which is approximately 1.5 times the national average of 84 µg/100g for wood ear mushrooms listed in the "Japanese Food Analysis Table" issued by the Japan Food Research Laboratories. Therefore, based on the fact that wood ear mushrooms grown in previous cultivation studies did not contain vitamin D (vitamins D2 and D3) after sun-drying, this study aimed to clarify whether the vitamin D (vitamins D2 and D3) content

increased after ultraviolet irradiation (253.7 nm) using the last cultivated wood ear mushrooms.

## METHODS

Based on the results of the cultivated wood ear mushrooms reported last time, the last harvested cultivated wood ear mushrooms were sun-dried to a total weight of 140g, and these were used to a paper published by the authors, when UV irradiation was performed using a sterilization cabinet (manufactured by Fujimac Co., Ltd.: UV 253.7nm), there was no significant difference between 1 hour and 2 hours of irradiation. However, 3 hours of irradiation resulted in a higher vitamin D2 level compared to 1 hour and 2 hours, we decided to irradiate with UV for 3 hours in this study. The samples were irradiated with ultraviolet light for 3 hours in a sterilization cabinet (manufactured by Fujimac Co., Ltd.: UV 253.7nm), and then the calcium content and vitamin D

(vitamin D2 and vitamin D3) content were sent to the Japan Food Research Laboratories for measurement.

## RESULTS

In the previous report, no vitamin D (vitamin D2 and vitamin D3) was found in sun-dried cultivated wood ear mushrooms. However, in this study, after 3 hours of UV irradiation using a sterilization chamber (manufactured by Fujimac Co., Ltd.: UV 253.7nm), vitamin D3 was at the detection limit, but vitamin D2 was shown to be 2.8 times the amount indicated in the "Food Analysis Table" (see Table 1). The results of the calcium measurement are also shown in Table 2

**Table 1. Analysis results of vitamin D (vitamin D2 and vitamin D3) in cultivated wood ear mushrooms by the Japan Food Research Laboratories**

sample name	vitamin D	vitamin D2	vitamin D3	Analysis method
Cultivated dried wood ear mushrooms(140g) -UV irradiation (253.7 nm) for 3 hours	236 µg/100g	236 µg/100g	Less than 10 µg/100g	high performance liquid chromatography

**Table 2. Calcium analysis results of cultivated wood ear mushrooms by the Japan Food Research Laboratories**

sample name	Calcium amount	Analysis method
Cultivated dried wood ear mushrooms(140g) -UV irradiation (253.7 nm) for 3 hours	136 mg/100g	IPC emission spectrometry

## DISCUSSION

We requested the Japan Food Research Laboratories to measure the vitamin D (vitamin D2 and vitamin D3) and calcium content. As a result, the vitamin D (vitamin D2 and vitamin D3) value was 0µmg when the mushrooms were dried alone<sup>1,2)</sup>, but after 3 hours of ultraviolet (253.7nm) irradiation, the vitamin D (vitamin D2 and vitamin D3) value was 236µg/100g. In the case of mushrooms, they are often sun-dried, but it is not the drying itself that converts ergosterol, which is abundant in mushrooms, into vitamin D2, through ultraviolet irradiation. Therefore, it has been reported that the conversion efficiency varies depending on the control of ultraviolet irradiation, the form such as crushing, and the irradiation conditions<sup>3,4)</sup>. In this study, the vitamin D (vitamin D2 and vitamin D3) levels of wood ear mushrooms grown from substrate and simply dried were below the analytical limit. However, after 3 hours of UV irradiation, they showed a vitamin D2 level of 236 µg/100g. In order to expect the vitamin D2 effect of wood ear mushrooms as a "nutritional value," and to improve and guarantee quality, the purpose of UV irradiation (vitamin D2 production) must be clearly stated, along with the irradiation time and irradiation area.

It is necessary to determine the front and back sides and prepare ultraviolet irradiation equipment<sup>3,4)</sup>. In the future, if we expect vitamin D2 to be a valuable nutrient for disaster relief food or space food, we believe that by controlling the "moisture content" using a drying machine after harvesting the wood ear mushrooms, further controlling the "particle

size" using a pulverizer, and finally controlling the "ultraviolet irradiation conditions" using an ultraviolet irradiation device, we can reduce variations between lots and ensure the supply of wood ear mushrooms of consistent quality<sup>3)</sup>. It is also necessary to consider that the amount of active vitamin D produced in the body changes depending on the absorption rate of vitamin D (vitamin D2 and vitamin D3) in the human body, as well as the intensity and duration of exposure to sunlight (ultraviolet-B) that the skin receives<sup>5,6)</sup>. Furthermore, since fish (such as horse mackerel, sardine, mackerel, saury, and chum salmon) are rich in vitamin D<sup>7,8)</sup>, we believe that by mixing wood ear mushroom powder with fish paste to create fish cakes and kamaboko, it will be possible to create disaster relief food and space food rich in calcium and vitamin D (vitamin D2 and vitamin D3) that can be stored for a long time.

## CONCLUSION

As reported previously, a vitamin D value measurement of a sample of wood ear mushroom cultivated using a substrate (manufactured by MorinoKikurage Farm Co., Ltd.) (indoor cultivation) that was dried indoors was sent to the Japan Food Research Laboratories, and the result was 0 µg/100g. Therefore, in this study, since ergosterol is converted to vitamin D2 by ultraviolet irradiation, a sample of cultivated wood ear mushroom dried indoors was subjected to 3 hours of ultraviolet irradiation in a sterilization cabinet (manufactured by Fujimac Co., Ltd.: ultraviolet 253.7nm), and then the vitamin D value was measured again at the Japan Food Research Laboratories. As a result, the vitamin D (vitamin D2 and vitamin D3) value was 236 µg/100g. In the future, if the nutritional value of vitamin D2 is expected in disaster food or space food, it is considered necessary to control the "moisture content," "crushed particle size," and "ultraviolet irradiation conditions." Furthermore, considering that the amount of active vitamin D produced in the body changes depending on the absorption rate of vitamin D (vitamin D2 and vitamin D3) in the human body, as well as the intensity and duration of exposure to sunlight (ultraviolet-B) received by the skin, we believe it is necessary to develop new products using fish, which are rich in vitamin D3, and wood ear mushrooms, which are rich in vitamin D2.

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