



## RESEARCH ARTICLE

# NUTRITIONAL ANALYSIS RESULT OF COMMERCIALLY AVAILABLE WOOD EAR MUSHROOMS AFTER COOKING AND ADJUSTMENT-FOOD DEVELOPMENT FOR DISASTER AND SPACE FOOD APPLICATIONS: Part 2-

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### ABSTRACT

Vitamin D is not only required to be taken together with calcium to prevent osteoporosis, but is also an important nutrient because it regulates immune function, inhibits cell proliferation and differentiation, and suppresses inflammation. We would like to add vitamin D and calcium to new food (disaster relief food and space food) to prevent osteoporosis and frailty, but we need to consider the loss of these nutrients during cooking. Therefore, in the study, we decided to use wood ear mushrooms, which are said to have high vitamin D and calcium contents, and measure and compare the vitamin and calcium contents after cooking and crushing them. Analysis of calcium and vitamin content was commissioned to the Nagoya branch of the Japan Food Analysis Center. After boiling commercially available wood ear mushrooms for 2 hours, the vitamin D content was 6.3 µg/100g and the calcium content was 12.1 mg/100g. The vitamin D content of finely powdered commercially available wood ear mushrooms was 93.3 µg/100g and the calcium content was 165 mg/100g. The vitamin D content of coarsely powdered commercially available wood ear mushrooms was 106 µg/100g and the calcium content was 115 mg/100g. Since it has become clear that the vitamin D and calcium contents are lost after cooking, future product development must always include the results of post-cooking food analysis.

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## INTRODUCTION

"Vitamin D is important for maintaining bone health, and in recent years, opportunities for sun exposure have decreased due to sun protection measures and indoor living, leading to a tendency for vitamin D deficiency." Therefore, the 2025 edition of the Dietary Reference Intakes for Japanese people sets the target vitamin D intake at 9.0 kg. Therefore, this study focuses on "kikurage" (wood ear mushroom), which is said to have a high content of vitamin D, which is also related to the prevention of osteoporosis, and reports the results of a nutrient analysis after cooking and adjusting commercially available products.

## MATERIALS AND METHODS

As previously announced, we had requested the Japan Food Research Laboratories Nagoya branch to analyze the "vitamin D content" and "calcium content" of commercially available products (made in China: no vitamin D labeling) that can be purchased at mass retailers (supermarkets). This time, we also requested the Japan Food Research Laboratories to analyze the "vitamin D content" and "calcium content" of the cooked products (analysis of wood ear mushrooms boiled for 2 hours to make tsukudani) and powder (analysis of powder prepared using a 700G Iwatani blender to prepare powder for adding to bread and various sweets).

We purchased commercially available wood ear mushrooms (TOPVALU) at the AEON supermarket. As it is a mass retailer and a large supermarket chain with stores nationwide, I considered that wood ear mushrooms would be readily available in the future. The product was packaged in 30g bags, and the country of origin was China. The raw material was white-backed fungus. The nutritional value per 10g was listed on the surface of the bag as follows: energy 17kcal, protein 0.6g, fat 0g, carbohydrates 8.0g, salt equivalent 0.008g. Previous research has already revealed that the calcium and vitamin D contents of this commercially available product are 108 mg/100 g and 83.5 µg/100 g, respectively.

**Sample preparation:** In order to confirm whether vitamin D and calcium are lost during the boiling process, 120g of commercially available dried wood ear mushrooms were boiled in 2 liters of water in a pot for 2 hours, assuming the preparation of wood ear mushroom tsukudani (simmered food). The mushrooms were then drained and sent to the Nagoya branch of the Japan Food Analysis Center to have their calcium and vitamin D content measured. Similarly, assuming that the wood ear mushroom powder would be mixed with various foods to create products, 120g of dried wood ear mushrooms were powdered using an Iwatani Corporation 700G blender, which was repeated 20 times for 30 seconds. The calcium and vitamin D content of this wood ear mushroom powder was measured by the Japan Food Research Laboratories, Nagoya branch.

**Table 1. Nutritional analysis results for wood ear mushrooms (Food analysis results from the Nagoya branch of the Japan Food Analysis Center)**

	Calcium mg	Vitamin D µg	Moisture g	Protein g	Lipid g	Ash g	Carbohydrates g	Carbohydrate g	Dietary Fiber g	Energy kcal	Sodium g	Equivalent amount of salt g
Product display				6	0		80	0	80	170		0.08
Dried commercially available wood ear mushrooms	108	83.5										
As is	165	93.3										
Fine powder	115	106										
Powder (peel)	12.1	6.3										
After boiling for 2 hours												

Note 1. Nitrogen/protein conversion factor: 6.25

Note 2. Calculation formula according to the Food Labeling Standards (Cabinet Office Ordinance No. 10 of 2015): 100-(moisture+protein+fat+ash)

Note 3. Calculation formula according to the Food Labeling Standards (Cabinet Office Ordinance No. 10 of 2015): 100-(moisture+protein+fat+ash+dietary fiber)

Note 4. Energy conversion factors according to the Food Labeling Standards (Cabinet Office Ordinance No. 10 of 2015): Protein, 4; Fat, 9; Carbohydrate, 4; Dietary fiber, 2

Note 5. Calculation formula: Sodium ×2.54

## RESULTS

The Japan Food Analysis Center was commissioned to measure calcium content using inductively coupled plasma (ICP) atomic emission spectrometry, and vitamin D content using high-performance liquid chromatography. After boiling commercially available wood ear mushrooms for 2 hours, the vitamin D content was 6.3 µg/100g and the calcium content was 12.1 mg/100g. The vitamin D content of finely powdered commercially available wood ear mushrooms was 93.3 µg/100g and the calcium content was 165 mg/100g. The vitamin D content of coarsely powdered commercially available wood ear mushrooms was 106 µg/100g and the calcium content was 115 mg/100g. The commercially available wood ear mushrooms were ground in a blender. The powder produced by grinding 120g for 30 seconds 20 times had a fine powder to coarse powder ratio of 1:2. The fine and coarse powders can be used for different purposes in food preparation.

## DISCUSSION

The results of this study show that there is no problem with commercially available wood ear mushrooms if they are consumed in their entirety in dishes such as soup, but if wood ear mushrooms are stewed and eaten alone, both vitamin D and calcium are lost. In the development of future disaster and space food, it is necessary to clarify the amount of nutritional loss and consider food processing (See Table 1). Furthermore, the results of creating and analyzing the powder showed that the calcium and vitamin D content of commercially available dried wood ear mushrooms may vary significantly depending on when they were purchased (depending on when they were grown or harvested, and the lot number).

The fine powder and coarse combined powder are shown in 100g: Calcium is  $(165+115)/200=140\text{mg}/100\text{g}$  Vitamin D was  $(93.3 + 106)/200 = 99.65\mu\text{g}/100\text{g}$ , so compared to the values of dried wood ear mushrooms, calcium was 129.6% and vitamin D was 119.3%.

There is a discrepancy of about 30% and about 20% (See Table 1). Wood ear mushrooms have the effect of suppressing blood sugar levels<sup>1)</sup>, and there have been reports of research into the effects on various functionalities of wood ear mushrooms by changing the ingredients of the culture medium<sup>2)</sup>. However, much of the research has focused on improving the culture medium to increase cultivation volume<sup>3, 4)</sup> and methods for mass production in a short period of time<sup>5)</sup>.

Most wood ear mushrooms are produced in China rather than Japan<sup>6)</sup>, and the nutritional information for various nutrients is often unclear<sup>7)</sup>. Although there are research reports showing that various nutrients are lost during the cooking process in some foods<sup>8, 9, 10)</sup>, there are few research reports that have analyzed the loss of vitamins and minerals in mushrooms during cooking. In the future, we believe that it is necessary to conduct a more detailed analysis of the nutritional content of foods that use wood ear mushrooms before and after cooking.

## CONCLUSION

Vitamin D is not only required to be taken together with calcium to prevent osteoporosis, but is also an important nutrient because it regulates immune function, inhibits cell proliferation and differentiation, and suppresses inflammation. However, this analysis has revealed that the foods we eat, thinking we are getting vitamin D, may actually contain no vitamin D or only trace amounts. Therefore, first, we need to analyze the wood ear mushrooms to confirm whether they contain the necessary nutrients (vitamin D and calcium in this case), and then analyze them after cooking and processing to determine the final content. Therefore, we believe that nutrients that may be lost during cooking or food processing should be re-analyzed after food is cooked or processed before being labeled.

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