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RESEARCH ARTICLE

NUTRITIONAL ANALYSIS RESULTS OF COMMERCIALLY AVAILABLE AND CULTIVATED CLOUD EAR MUSHROOMS - FOOD DEVELOPMENT FOR DISASTER AND SPACE FOOD APPLICATIONS: FIRST REPORT

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ABSTRACT

The 2025 edition of the Dietary Reference Intakes for Japanese has raised the recommended vitamin D intake from 5.5 micrograms to 9.0 micrograms. The reason for this is that more and more people are taking measured to protect themselves from the sun on a daily basis, and also to prevent osteoporosis. Therefore, the goal of this study was to develop a new food product (disaster food or space food) using wood ear mushrooms, which are known to be high in vitamin D. First, we began by analyzing how much vitamin D and calcium wood ear mushrooms contain, and we report on this. We requested the Japan Food Research Laboratories, Nagoya branch. To measure the vitamin D and calcium contents of commercially available Chinese wood ear mushrooms and wood ear mushrooms cultivated using commercially available Japanese mushroom beds. As a result, the vitamin D content of commercially available wood ear mushrooms was 83.5 μg/100g, and the calcium content was 108mg/100g. The vitamin D content of cultivated wood ear mushrooms was below the detection limit (0.7 μg/100g or less), and the calcium content was 49.5mg/100g. 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. In the development of future disaster and space food, it is necessary to clarify the nutritional analysis values of the wood ear mushrooms to be used before processing them into food.

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INTRODUCTION

The 2015 Dietary Reference Intakes for Japanese people stated that the recommended intake of vitamin D was 5.5μg, but the 2025 edition raised it to 9.0μg. The rationale for this increase is that "vitamin D is important for maintaining bone health, and it is synthesized in the body not only through dietary intake but also through exposure to sunlight. However, in recent years, opportunities for sun exposure have decreased due to sunburn prevention measures and indoor living, leading to a tendency for vitamin D deficiency." Therefore, the emphasis is on proactive dietary intake. Therefore, this study focuses on "kukurage" (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 nutritional analysis of commercially available and home-grown wood ear mushrooms.

MATERIALS AND METHODS

We purchased commercially available wood ear mushrooms (TOPVALU) at the AION supermarket. As it is a mass retailer and a large supermarket chain with stores nationwide, we 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 ingredients were white-backed mushrooms, and 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. The cultivated wood ear mushrooms were purchased as a mushroom bed from Mori Sangyo Co., Ltd. The product name was Mori No. 97 (Arage-Kikurage), the production area was Gunma Prefecture, the weight was 1.5 kg, there was no chemical control, there was no presence of toxic fungi, and the main raw material was domestic broadleaf tree nuts, with secondary materials being Edible grain white rice, sample grains, and inorganic salts. The results were obtained by submitting analyzes of the vitamin D and calcium contents of commercially available products (products from China, no vitamin D labeling) and cultivated wood ear mushrooms (Gunma Prefecture-grown mushroom bed: Mori No. 97 Arage-Kikurage) to the Nagoya branch of the Japan Food Research Laboratories. Calcium was analyzed by inductively coupled plasma (ICP) emission spectrometry.Vitamin D content was measured using high performance liquid chromatography. The cultivated wood mushroom ears were grown for two months, and immediately dried in the sun over a window harvest after. Analysis was requested to the

Japan Food Research Laboratories once they reached a dry weight of 100g.The analysis took three weeks.In addition, we also requested that the cultivated wood ear mushrooms be analyzed for the five major nutrients (energy, lipids, proteins, carbohydrates, and salt equivalents).

RESULTS

The wood ear mushrooms were grown at room temperature of 35-25C and humidity of 60-40%. They were sprayed with water three times a day with a spray bottle and covered with a plastic bag. The first harvest was carried out around 20days after cultivation, and after harvesting, the crop was dried in the sun. After the harvest on the 58th day was dry (dry weight exceeded 100g), analysis was submitted to the Nagoya branch of the Japan Food Analysis Center (See Table 1).

Table 1. Total harvest of cultivated wood ear mushrooms (From the start of cultivation to 58 days later)

	Harvest amount	Dry weight	Moisture percentage
No.1	185.5	21.9	88.19
No.2	264.5	27.5	89.60
No.3	315.5	33.4	89.41
No.4	205.9	19	90.77
Total	971.4	101.8	89.50

After that, we continued to cultivate wood ear mushrooms and dried them in the sum (See Table2).

Table 2. Total harvest of cultivated wood ear mushrooms (49 days from 58th to 107th day after the start of cultivation)

	Harvest amount	Dry weight	Moisture percentage
No.1	124.7	14.9	88.05
No.2	250.1	27.1	89.16
No.3	317.7	35.5	88.83
No.4	275.8	31.2	88.69
Total	968.3	108.7	88.68

The calcium content was measured by the Japan Food Analysis Center using ICP atomic emission spectrometry, and the vitamin D content was measured using high-performance liquid chromatography. The vitamin D content of commercially available wood ear mushrooms was 83.5 µg/100g, and the calcium content was 108mg/100g. The vitamin D content of cultivated wood ear mushrooms was below the detection limit (0.7 µg/100g or less), and the calcium content was 49.5mg/100g (See Table 3).

Since the vitamin D content was at the limit of quantification, the second cultivated wood ear mushrooms were again sun-dried after harvesting, and when they reached 100g, we requested the Nagoya Branch of the Japan Food Analysis Center to analyze the calcium and vitamin D contents. As a result, the calcium content was 103mg and the vitamin D content was at the limit of quantification again, per 100g of dried and cultivated wood ear mushroom (See Table 3).

DISCUSSION

The results of this study showed that the first wood ear mushrooms grown using a mushroom bed contained only 59.3% of the calcium of commercially available products, and the analytical value for vitamin D was at the detection limit, making it clear that the nutrients expected from wood ear mushrooms cannot be obtained. The results of this study showed that the second wood ear mushrooms grown using a mushroom bed contained 95.37% of the calcium of commercially available products, and the analytical value for vitamin D was at the detection limit again, making it clear that the nutrients expected from wood ear mushrooms cannot be obtained. The genus *Auricularia*(wood ear mushroom)(Auriculares, Agaricales, Basidiomycota) is a wood-decaying fungus that causes white-rot disease [1] and is an important decomposer in forest ecosystems. Some species are cultivated primarily in Asia and are widely used as edible mushrooms in Japan.

The Asian *A. auricula-judae*population includes several new species, including *A. heim-uer* (F. Wu, B.K. Cui & Y.C. Dai), A. minutissima (Y.C. Dai, F. Wu &Malysheva), and A. tibetica (Y.C. Dai & F. Wu)[2,3,4].*Auricularia polytricha* (Mont.) Sacc. is considered a common species, distributed widely throughout Asia, including Japan, the Americas, and Oceania [5, 6]. Animal experiments have shown that *Auricularia* (wood ear mushroom) has the effect of suppressing blood sugar levels[7], which has led to research into various cultivation methods[8,9], and the effects of its functionality have also been reported. There have also been reports on the investigation of mass-production methods for *Auricularia* (wood ear mushroom)[10] and shortening the cultivation period[11]. Currently, the market is dominated by Chinese *Auricularia* (wood ear mushroom), and although there are issues with *Auricularia* (wood ear mushroom) production in Japan[12], there are plans to increase domestic *Auricularia* (wood ear mushroom) production. However, based on the results of this study, it is thought that it is necessary to not only focus on the production volume of *Auricularia* (wood ear mushroom)[13], but also to focus on its useful components in research[14]. In the development of future disaster and space food, it is necessary to clarify the nutritional analysis values of the wood ear mushrooms to be used before processing them into food.

Table 3. 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 g	Sodium g	Equivalent amount of salt g
Dried commercially	Product Labeling				6	0		80	0	80	170		0.08
	Drying	108	83.5										
Cultivated wood ear mushroom 1	Drying	49.5	Not detected	15.1	10.1	1.3	3.4	70.1	5.4	64.7	204	15.4	0.0391
Cultivated wood ear mushroom 2	Drying	103	Not detected										
		ICP emission spectroscopy	Hogh performance liquid chromatography 0.7µg/100g detection limit	Normal pressure heating drying method	Burning method	Acid decomposition method	Direct ashing method			Enzymes-gravimetric method		Atomic absorption spectrometry	

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

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 (in this case, vitamin D and calcium), and then determine how much of each they contain before processing them into a food product. In addition, we believe that it is necessary to conduct a re-analysis after food preparation or processing to determine the nutrients that may be lost during cooking or food processing.

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