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Sun-Treated Oyster Mushroom Powder as a Vitamin D Fortificant: Effect of Baking on Vitamin D Retention in Cookies

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Abstract

This study evaluated sun-treated oyster mushroom (Pleurotus ostreatus) powder as a vegetarian source of vitamin D fortification and assessed the effect of baking on vitamin D retention in cookies. Fresh mushrooms were cleaned, cut to a uniform size, sun-dried, converted to powder, incorporated at 10% into a cookie formulation, and baked at 180 °C for 10 min. Vitamin D was quantified by HPLC in untreated mushroom powder, solar-dried mushroom powder, and the baked cookies. The reported vitamin D content increased from 7.73 µg/g in untreated powder to 45.21 µg/g in solar-dried powder, confirming the enhancement associated with sunlight exposure. Cookies prepared with 10% solar-dried mushroom powder contained 5.6 µg/g vitamin D, with a reported retention of 90.20% after baking. These data indicate that solar-dried oyster mushroom powder can be used as a low-cost, vegetarian fortification ingredient for baked products, while retaining most of the measured vitamin D under the baking conditions used in this study.

1. Introduction

Vitamin D is an essential nutrient associated with skeletal health and has also been studied in relation to several chronic diseases. Mushrooms contain ergosterol, a precursor that can be converted to vitamin D when exposed to sunlight. This makes sun-treated mushroom powder a promising vegetarian fortification ingredient for commonly consumed foods.

The present work focuses on oyster mushroom powder exposed to sunlight and its use in cookies. The objective was to quantify vitamin D after sunlight treatment and to assess whether vitamin D is retained after baking in a product format suitable for routine consumption.

2. Materials and Methods

2.1 Sample preparation

Fresh oyster mushrooms (Pleurotus ostreatus) were washed with potable water to remove surface impurities and cut into pieces of approximately 0.5 × 4 cm. A consistent cut size was maintained to support uniform sun drying. The dried samples were ground into a fine powder and used as the vitamin D-enhanced ingredient in cookie formulation.

2.2 Cookie formulation and baking

Cookies were selected as the model product because they are widely consumed and can serve as a convenient carrier for nutrient fortification. The dough was prepared using maida, caramelised sugar, butter, baking powder, salt, vanilla essence, and solar-dried mushroom powder. The mixed dough was proofed for 30 min under refrigeration, rolled into sheets, cut into round pieces of approximately 4 cm diameter, and baked at 180 °C for 10 min.

Table 1. Formulation of mushroom cookies

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Ingredient	Quantity
Maida	65 g
Solar-dried mushroom powder	10 g
Caramelised sugar	30 g
Butter	45 g
Baking powder	0.5 g
Salt	0.7 g
Vanilla essence	5 drops

2.3 Vitamin D quantification

Vitamin D was quantified in solar-dried mushroom powder and in cookies prepared with the same powder to evaluate the effect of baking on retention. The samples were digested and analysed by HPLC. Representative chromatograms for solar-dried mushroom powder and mushroom cookies are shown in Figures 1 and 2.

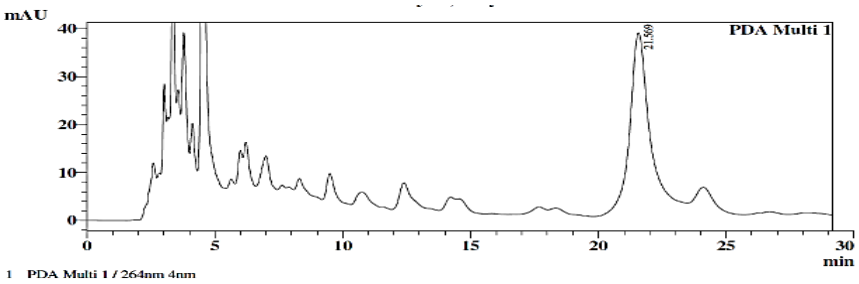

Figure 1. HPLC chromatogram of vitamin D in solar-dried oyster mushroom powder.

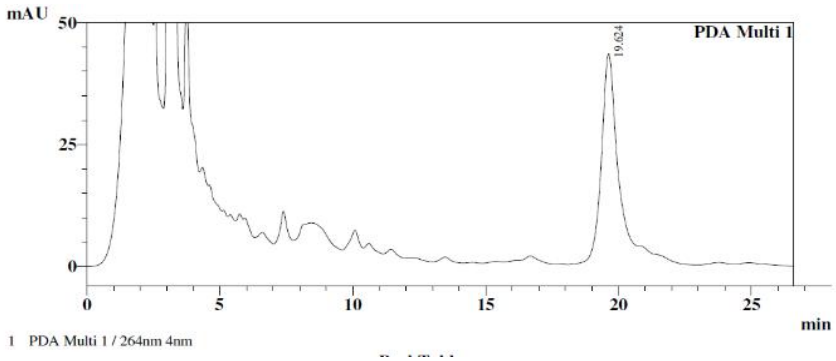

Figure 2. HPLC chromatogram of vitamin D in mushroom cookies prepared with solar-dried mushroom powder.

3. Results and Discussion

3.1 Retention of Vitamin D During Baking

To evaluate the stability of vitamin D during thermal processing, solar-dried mushroom powder was incorporated into cookies at a 10% level and baked at

180 °C for 10 min. The resulting cookies contained 5.60 µg/g vitamin D and exhibited a reported retention of 90.20%. The high retention value indicates that vitamin D remained largely stable throughout the baking process and was only minimally affected by the applied temperature and baking duration.

Vitamin D is generally considered relatively stable under moderate food-processing conditions compared with several water-soluble vitamins. The present findings further justifies household cooking and baking result in limited losses of vitamin D when incorporated into appropriately formulated food matrices. The fat present in the cookie formulation may also have contributed to vitamin D stability by improving its protection during heating and facilitating uniform distribution throughout the product.

3.3 Implications for Food Fortification

The substantial increase in vitamin D content achieved through solar drying, combined with the high retention observed after baking, highlights the potential of oyster mushroom powder as a functional food ingredient for vitamin D fortification. Unlike synthetic fortificants, solar-treated mushroom powder provides a naturally derived, vegetarian source of vitamin D that can be incorporated into commonly consumed bakery products. Cookies are particularly suitable vehicles for fortification because of their widespread acceptance, long shelf life, and ease of consumption across different age groups.

The results further indicate that the conversion of ergosterol to vitamin D during sunlight exposure is sufficiently robust to withstand subsequent food processing operations. Therefore, solar-dried mushroom powder may offer an economically viable strategy for addressing vitamin D insufficiency and deficiency, particularly in populations with limited access to fortified foods or dietary sources of vitamin D.

Table 2. Vitamin D content and reported retention

Treatment	Vitamin D (µg/g)	Retention (%)
Untreated powder	7.73	—
Solar-dried powder	45.21	—
Mushroom cookies (10%)	5.60	90.20

4. Conclusion

The study demonstrates that solar drying substantially increased the measured vitamin D content of oyster mushroom powder and that cookies fortified with 10% solar-dried mushroom powder retained a high proportion of vitamin D after baking. The reported values—45.21 µg/g in solar-dried powder, 5.60 µg/g in baked cookies, and 90.20% retention—support the use of sun-treated oyster mushroom powder as a practical vegetarian fortification ingredient for baked products. Further work with replicated batches, sensory evaluation, and statistical validation would strengthen product-scale recommendations.

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