Vitamin D in Mushrooms

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Abstract

Mushrooms are one of the few plant foods which contain ergosterol, a precursor to vitamin D. The two major physiological forms of active vitamin D for humans are ergocalciferol (D_2) and cholecalciferol (D_3). The current recommended intake (AI) for vitamin D for most adults is 5 µg (200 IU). The amount of vitamin D_3 in mushrooms can be significantly increased by exposing mushrooms to ultraviolet (UV) light; UV-treated mushrooms are now entering some retail markets. To provide vitamin D data for the USDA National Nutrient Database for Standard Reference (SR) for mushrooms treated with this new processing method as well as baseline data for untreated mushrooms, a study to analyze white, portabella (treated and untreated), maitake, enoki, shiitake, oyster, crimini, morel, and chanterelle mushrooms was undertaken in cooperation with the Mushroom Council. Samples of commercially available mushrooms were collected in 12 cities according to the sampling plan for USDA’s National Food and Nutrient Analysis Program. Two lots of other mushrooms, including UV-treated mushrooms, were obtained directly from producers. Vitamin D_3 was determined by HPLC with UV-Detection. Treated and untreated mushrooms were collected from 12 retail outlets in 12 cities. The vitamin D_3 content of non-UV-treated white, morel, and chanterelle mushrooms was 0.1 µg (4 IU), 5.1 µg (204 IU), and 5.3 µg (212 IU), respectively. These data are included in Release 22 of SR and add to the body of data available to assess the vitamin D content of the U.S. diet.

Methods

The study used the infrastructure established by USDA’s Nutrient Data Laboratory (NDL) for the National Food and Nutrient Analysis Program (NFPNA). NFPNA incorporates procedures to prioritize foods and nutrients for analysis; develop statistically valid sampling plans; analyze samples at qualified analytical laboratories; and maintain a rigorous quality control program.

Sampling

• Samples of crimini, enoki, oyster, portabella, shiitake, and white mushrooms were collected from 12 retail outlets around the country.
• States where samples were procured were selected proportional to the state population (US Census, 2000).
• Sample counties within states depended over the 48 continental states, were selected proportional to the county population.
• Sample Consolidated Metropolitan Statistical Areas (CMSA)s selected proportional to CMSA populations.
• Retail outlets with over $2M sales were selected in 12 primary locations (Figure 1).

Sample Preparation

• Samples were shipped overnight to the Food Analysis Laboratory Control Center (FALCC) at Virginia Polytechnic Institute and State University in Blacksburg, Virginia, for analysis.
• Samples were homogenized, packed under nitrogen and shipped frozen to a qualified commercial analytical lab under USDA contract, for analysis.
• Composites of both raw and grilled Portabella mushrooms treated with UV light were prepared.
• All samples were analyzed for vitamin D.

Results

• All mushrooms contain varying levels of ergosterol, exposure to incidental UV light during growth and processing causes the conversion of some portion of the ergosterol to ergocalciferol or vitamin D_3.
• Exposure to UV light for 15-20 seconds causes much higher levels of vitamin D_3 in portabella mushrooms (11.2 µg; 446 IU/100 g) than those not exposed (0.2 µg; 10 IU/100 g) (Table 1).
• The sample was spiked with an internal standard (tritiated vitamin D), saponified in methanol with an internal standard (alkali). Vitamin D_3 content was determined by HPLC with UV-Detection. The dose and length of treatment can affect the amount of D_3 synthesized during exposure (Roberts et al., 2008).

Conclusion

• Exposing mushrooms to UV light whether by design or unintentionally causes measurable increases in the vitamin D_3 content.
• As a result, mushrooms can provide appreciable amounts of vitamin D_3 to the diet.
• Amounts will vary depending on the extent of the duration of exposure.

References

