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File: ■ Thyroid Hormones
■ Dietary Supplement Safety
■ Hyperthyroid

HC 021465-501

Date: July 31, 2014

RE: Study Reveals Possible Adulteration of Thyroid Dietary Supplements; however, Study Contains Flaws that Undermine Its Results

Kang GY, Parks JR, Fileta B, et al. Thyroxine and triiodothyronine content in commercially available thyroid health supplements. *Thyroid*. October 2013;23(10):1233-1237.

Incidences of hyperthyroidism or thyrotoxicosis (toxic level of thyroid hormones) have been found in people consuming dietary supplements marketed to address thyroid problems, increase energy, or promote weight loss. The concentrations of thyroid hormones contained in supplements is a legitimate safety concern, as consumers and their physicians cannot determine the thyroid hormone content based on label information. Thyroid hormone medication is classified as a narrow therapeutic range drug by the Food and Drug Administration (i.e., there is a very narrow margin between therapeutic and toxic doses), and therefore close monitoring of thyroid hormone blood levels is required. This screening study assessed the concentration of the thyroid hormones thyroxine (T_4) and triiodothyronine (T_3) present in ten dietary supplements.

An Internet search using the terms "thyroid health," "thyroid supplements," and "thyroid support" was conducted. The ten products identified as having the most commonly visited websites (the authors did not describe how this was determined) were selected for evaluation. Five of the products were herbal-based supplements (H) that did not have animal thyroid content reported on the label. The other five products were labeled as containing bovine thyroid tissue, concentrate, or powder (B).

The T_4 and T_3 content in the supplements was analyzed at the pharmacy of Walter Reed Army Medical Center in Bethesda, Maryland. The synthetic thyroid replacement hormones levothyroxine and liothyronine were used as positive controls and analytical standards. Three samples of each supplement were assayed, and the personnel conducting the testing were blinded to the identity of the samples. High-performance liquid chromatography coupled with a photodiode array detector (HPLC-PDA) set at 225 nm was used to quantify the hormone content; internal standards were used as a control for accuracy and precision, and five concentrations of standards were used to create external calibration curves, but the method was not properly validated. The identification

of the thyroid hormones was entirely based on the absorption at 225 nm, a wavelength where many natural products absorb UV light, and therefore could be mistaken for the thyroid hormones. Since some of the analyte peaks were so small that they were almost indistinguishable from the background noise, the results of this paper have to be considered speculative.

Based on these speculative results, of the ten supplements tested for thyroid hormone content, nine had T_3 concentrations ranging from 1.3 to 25.4 µg/tablet, and one had no detectable T_3. Taken at the manufacturer's recommended dose, four of the supplements (three H, one B) would provide >15 µg/day of T_3. (The lowest prescription dosage is five µg/day; the maintenance dose for hypothyroidism is 25-75 µg/day.) T_3 is not a plant constituent; it should not have been present in the three "herbal" products. But since the identity of the analyte was not determined, it is doubtful that the compound was truly T_3.

Five of the supplements had no detectable T_4 content; the other five had a T_4 concentration ranging from <0.5 to 22.9 µg/tablet (three H, two B). If taken at the recommended dosage, the maximum daily consumption of T_4 would be as much as >90 µg/day for one H supplement. (The lowest prescription dosage is 25 µg/day; the average dose for hypothyroidism is 100-125 µg/day for a 70-kg adult.) T_4 is not a plant constituent; it should not have been present in the three "herbal" products, which again raises the question if the analyte was indeed T_4.

Five supplements (three H, two B) had detectable concentrations of both T_3 and T_4. Taken at the manufacturer's recommended dose, theoretically, the H product with the greatest T_3 and T_4 content would provide 16.53 and 91.6 µg/day, respectively.

Of the five supplements labeled as containing bovine thyroid tissue, extract, or concentrate, one had no detectable T_3 or T_4, two contained T_3 only, and two had detectable concentrations of both T_3 and T_4. Taken in order, these findings indicate that one product was falsely labeled (did not contain bovine thyroid), two products were adulterated with synthetic T_3 (authentic animal material would contain both T_3 and T_4), and two products actually contained T_3 and T_4 (synthetic hormones or thyroid tissue/extract/concentrate).

In the five supplements that were described as containing botanical ingredients but no animal thyroid content, 150-1000 mg of L-tyrosine (recommended daily allowance [RDA] 231 mg/day) and 100-240 µg of iodine (RDA 150 µg/day) were detected. Taken as recommended, these supplements would provide two to four times the RDA.

All five of the "herbal" supplements that had no animal thyroid ingredients listed on their label contained T_3, and two also contained T_4. The authors state, "The presence of T_3 alone in some of the samples would appear to implicate selective addition of this hormone to the product, as those containing a desiccated animal source would be expected to have both T_4 and T_3 present." Again, since the detection method was non-specific for the thyroid hormones, the identity of the peaks eluting at the same time as the T_3 and T_4 standards remains unknown. Most likely, these compounds were components of the botanical extracts present in the products rather than T_3 and T_4.

The evidence from this study focuses attention on two important public health issues. If present, clinically significant amounts of T_3 and T_4 in these readily available dietary supplements would constitute a potential medical hazard that may cause

hyperthyroidism in unwitting consumers. The authors call for more widespread education on the potential risks of these supplements and more rigorous regulation.

The second fact is that the chemical analysis indicated that most of the products assessed in this study were adulterated or had false label claims. Only two of the five products purporting to contain "bovine thyroid" actually contained both T_3 and T_4, and all five of the purported "herbal" products contained T_3.

The third fact is that all the results were based on inadequate science. It is unfortunate that the authors used a method that carries a high risk of providing erroneous results and therefore are making conclusions that will misinform health care professionals and the dietary supplement industry. The authors' attempts to raise awareness of a possibly serious problem in this case have failed due to the use of an inappropriate analytical method.

This study was limited in that the sample size was small and potentially biased, and most importantly, the identity of the products analyzed (manufacturer, lot, batch number) was not reported so it cannot be reproduced.

—Amy C. Keller, PhD

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