Hoodia gordonii: Part II
Separating Science from Speculation

by Stephen Holt, MD, and Thomas V. Taylor, MD

Introduction

Hoodia gordonii is a succulent plant from South Africa that has appetite-suppressant properties.\(^1\)\(^-\)\(^3\) Hoodia has been used as a dietary supplement, derived by drying the aerial parts of the plant,\(^3\) or as a source of extracted steroidal glycosides to induce weight loss in experimental animals and humans.\(^4\)\(^-\)\(^14\) Ethnobotanical studies document the use of whole, fresh, plant material by San Bushmen as a way of suppressing appetite, thirst, and hunger pangs during nomadic hunting expeditions in desert regions of South Africa.\(^1\)\(^-\)\(^3\) Animal and limited human studies have shown that extracts of Hoodia gordonii can reduce body weight in free feeding rats\(^4\)\(^,\)\(^14\) and obese subjects,\(^6\)\(^-\)\(^8\) but full disclosure of this drug development research has not been made in the medical literature.

In Part II of this two-part article, controversial aspects of the development of Hoodia species as a substitute for dietary supplements or drug development are discussed. The current, disclosed evidence-base for the use of Hoodia species as a dietary supplement is reviewed.

The Excitement About Hoodia

Much information about the potential of Hoodia gordonii as a non-stimulant, appetite suppressant has been presented in the media.\(^8\)\(^-\)\(^13\),\(^15\)\(^-\)\(^21\) Hoodia has become one of the best-selling “weight loss supplements” in North America and certain regions of Western Europe.\(^3\) Hoodia is available in many different formulations of branded dietary supplements with variable characteristics and presumed biological activity (see Part I of this article: Townsend Letter; November 2006).

Extracts of Hoodia gordonii are being actively researched by major food and pharmaceutical corporations as potential food-
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Given the importance of calorie control as a means of impacting the global epidemic of obesity, the commercial market for this new technology is estimated to be worth tens of billions of dollars. 

Hoodia gordonii may be considered a “grandfathered” ingredient because of its longstanding presence in food chains, but there may be a “grey area” within the law, concerning whether or not DSHEA (1994) requires that the dietary substance be in the US food chain exclusively.

It has been argued that the food additive provisions of the Federal Food, Drugs and Cosmetic Act (FDCA) have been abused by regulators who may wish to propose legal arguments to harass the dietary supplement industry. Under the FDCA, many food ingredients, most notably herbs, qualify for sale if they were commonly used in food prior to 1958 and considered safe. The allowable measure of safety does not need scientific data if “common use” was present. However, many herbs that are currently popular in the US and qualify for sale in dietary supplements, or perhaps foods, have been in safe “common use” in countries other than the United States.

There have been attempts by the FDA to exclude herbs “in common use” from countries outside the US, by interpreting the “common use” exemption to apply only to the US. This interpretation of rules, involving geographic restrictions, was found to be illegal (see Fmali Herb, Inc. v. Heckler, 715 F.2d 1385, 1390 9th Cir. 1983 with the following rulings: “[I]t is an illogical and, we think, unwarranted constriction of the statute to rule that evidence of long use of a substance in food outside the United States can never provide probative evidence of safety.... The statute provides no basis for a purely ethnocentric distinction of this kind, divorced from demographic considerations.”)

The FDA did not accept readily the rulings from Fmali Herb, Inc. v. Heckler and published subsequent regulations that described specific circumstances under which a food substance could enter the food chain in the US, based upon its common use as food in another country. The regulations, including 21 C.F.R. § 170.30 (c) (2) (1996); and 53 Fed. Reg. 16, 544, 16, 544-45 (1988), received assent with an argument that the revised regulations were consistent with the court’s ruling in Fmali Herb Inc. v. Heckler. These newer regulations published by the FDA are stricter than any earlier regulations imposed on food ingredients “in common use” in the US, prior to 1958.

The FDA took the position that approval by a foreign government prior to 1958 may provide strong evidence of safety (see 50 Fed. Reg. 27, 294, 27, 295 [1985] and 53 Fed. Reg. at 16,545). There have been significant amounts of litigation under the food additive laws that have been directed at herbal products, with “arguable” arguments that the FDA may have extreme definitions of the regulations.

All new, dietary supplement ingredient filings on Hoodia gordonii have been refused in recent times by the FDA on poorly defined, safety grounds (www.fda.org). It is our belief that these ingredient filings on Hoodia were submitted often in an incomplete manner, and the necessity for such filings has been questioned, based upon the long history of the use of Hoodia as a health food in South Africa. Hoodia is accepted as a health food by the South African government. Furthermore, there are descriptions of the use of Hoodia prior to 1994 in the US, at least in the form of tinctures that have been used for hemorrhoid treatment. North American inhabitants are not strangers to the use of edible succulent plants or cacti in their diet.

Given the international popularity of Hoodia as a dietary supplement, there are millions of unit dosages of Hoodia gordonii used as whole plant dried powder in capsules that have been used by consumers without significant reports of side effects. One may argue that there are no formal surveillance programs in these circumstances, but this situation must be considered as supportive evidence of the safety of the use of Hoodia gordonii in the food chain. On balance, a compelling argument may exist that Hoodia gordonii must be considered allowable under DSHEA (1994), but this debate continues.

Adulterated or Misbranded Dietary Supplements Containing Hoodia

The occurrence of intentional adulteration of certain dietary supplements or misbranding of some supplements by the making of illegal treatment claims has haunted the dietary supplement industry and the practice of alternative...
or complementary therapies (integrative medicine). These adverse occurrences have provided fuel for individuals who would like to dismantle the DSHEA (1994). Some marketing predators in the dietary supplement industry have ignored federal rules and regulations that govern the sale of dietary supplements, and the industry has not organized itself to police these problems.

This continuing illegal activity challenges the future of the dietary supplement industry, and these matters are emerging rapidly in the category of the dietary supplement *Hoodia gordonii*. This opinion is supported by contention that exists on the Internet concerning the fidelity of certain Hoodia products and some isolated examples of FDA intervention with supplies of Hoodia in the US (www.fda.org). These matters are of extreme personal distress to the authors, and they precipitated or fuelled a series of research projects to investigate the integrity of bulk samples of *Hoodia gordonii* powder that are used in dietary supplements, together with open-label, clinical observations on the effects of a specific type of Hoodia supplement on weight control (Hoodia Supreme™, Natures Benefit Inc, Little Falls, New Jersey).

### Analyzing Hoodia Gordonii in the Laboratory

The methodology used by commercial laboratories in the dietary supplement industry to check the purity, quality, and consistency of *Hoodia gordonii* has been the subject of debate. In brief, there are four ways of analyzing *Hoodia gordonii* for “fidelity” (www.hoodiaetesting.com). These techniques involve general nutritional analysis (non-specific); light microscopy (semi-specific); infrared spectroscopic analysis; and chemical analysis, using chromatographic techniques, to determine the quantitative measure of steroidal glycoside compounds and related chemical analogues (most specific).

The authors selected sixteen batches of bulk powder, alleged to be *Hoodia gordonii*, and subjected them to examination by infrared spectroscopy (Holt MD Labs, New Jersey, in collaboration with Soma Labs, New Jersey). This was undertaken to define a fingerprint for dried and ground whole Hoodia plant. Drying the aerial part of Hoodia results typically in a 20:1 concentrate. Some dietary supplements containing Hoodia claim that they are extracts, but extracts have not been reported, known, or verified to have been used in any dietary supplements. Extracts of Hoodia that have been prepared for the content of steroidal glycosides have been used in drug development studies, and these preparations form the basis of a use patent that has been licensed to the biotechnology and pharmaceutical industries.

The present studies, using infrared spectroscopic analysis, were performed on a total of sixteen samples of *Hoodia gordonii* powder. Thirteen of these 16 samples of *Hoodia gordonii* powder were received...
Woodchips, implying adulteration or lack of origin from the Hoodia gordonii plant. In addition, the sample from China contained significant amounts of crystalline material. Microscopic analysis of bulk material from Stella Labs – and that said to have been purchased from Eastern Europe – did not have these characteristics.

The purpose of these initial studies was to search for a consistent and reliable bulk supply of Hoodia gordonii for use in the dietary supplement Hoodia Supreme® (Natures Benefit, Inc., Little Falls, New Jersey, USA).

Further testing by standard food analysis showed that six of the 13 batches of Hoodia, with consistent spectroscopic profiles, contained approximate chemical contents of protein 3.7g, carbohydrate 80g, dietary fiber 12g, fat 0.4g, moisture 5.7g, ash 10.5g, calories 335kcl, Vitamin A 85iu, Calcium 800mg, Iron 14mg, Sodium 445mg with negligible fat content per 100g of powder (±20% variation). The tested material was found to be free of significant heavy metal contamination.

Random samples from six of the 13 batches of Hoodia powder, with a consistent spectroscopic profile, were submitted for chemical analysis of their steroidal glycoside and related marker chemical content. Four marker components were measured quantitatively by high performance liquid chromatography (HPLC), including steroidal glycosides, after extracting the compounds with organic solvents (Table 1). The four measured markers included alpha-formyl-pyrrolidone, n-carbamylputracenen, P57-isoberberine alkaloid, and steroidal glycosides. All tested samples revealed measurable amounts of the markers, including P57, a steroidal glycoside molecule that has been used as a principle template for drug research (Figure 2).

The chemical analysis of Hoodia gordonii was performed by IBC Labs, Tucson, Arizona, using methods that were adapted from the Hoodia gordonii analysis described by Tulp.

**Figure 2:** An example of an auto-scaled chromatogram derived from high performance liquid chromatographic studies of Hoodia bulk powder. The graph shows three marker peaks that were measured quantitatively.
Individuals who lead commercial drug development research have commented that supplements containing *Hoodia gordonii* do not contain sufficient amounts of biologically active molecules to suppress appetite. These claims may apply to a number of different brands — but not all brands — of *Hoodia gordonii* sold as dietary supplements. Early research findings contradict these claims, and preliminary research shows that it appears possible to find a source for a Hoodia dietary supplement with appetite-suppressing properties and a satisfactory content of biologically active substances (Hoodia Supreme®).

It is alarming that many products labeled as *Hoodia gordonii* may contain other plant material or may be adulterated. Arguments prevail concerning the acceptance of *Hoodia gordonii* as a safe dietary supplement, but this plant has been in the food chain of South Africa and other countries for centuries.1-3,28-34

### Table 1: Chemical analysis performed by HPLC on six samples of *Hoodia gordonii* powder prepared from whole dried aerial plant (powder used in Hoodia Supreme®, supplied by Stella Labs, LLC).

<table>
<thead>
<tr>
<th>Marker</th>
<th>Sample Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Alpha-formyl-pyrrolidine</td>
<td>0.025</td>
</tr>
<tr>
<td>N-carbamylputracen</td>
<td>0.010</td>
</tr>
<tr>
<td>PS7-isoberberine alkaloid</td>
<td>0.012</td>
</tr>
<tr>
<td>Steroidal glycosides</td>
<td>0.135</td>
</tr>
</tbody>
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### Conclusion

The folklore history of the use of *Hoodia gordonii* as an appetite suppressant has been confirmed in several animal and human observations.1-3,4-21 Preliminary studies show that it is possible to produce a dietary supplement from whole Hoodia plants that appears to have promising adjunctive properties for weight control. However, the outcome of two small clinical studies of Hoodia as a dietary supplement for weight control does not provide sufficient evidence to make disease treatment claims.
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Health care givers, retailers of dietary supplements, and consumers must ask for verification of the authenticity of the Hoodia used in nutritional supplements. The authors believe that Hoodia gordonii is one of the most important ethnobotanical discoveries of the 20th century and, if early observations of the effectiveness of Hoodia as an appetite suppressant are confirmed in better constructed, controlled studies, this plant may prove to be very valuable in the management of obesity or overweight status.

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Disclosure: Dr. Stephen Holt has a financial interest in the commercial sale of Hoodia; Dr. Thomas Taylor does not.

Notes
21. BBC S. African bushmen hail drug deal: South Africa’s indigenous San peoples have signed a deal ensuring they will profit from a diet drug being developed from a plant they have used for generations. BBC Correspondent broadcast. Sunday, 1 June, 2003 at 1915 BST.
31. Mangold T. Correspondent’s Tom Mangold traveled to Africa and sampled the appetite suppressing Hoodia, a plant which may make Kalahari bushmen millionaires, BBC Television Broadcast by Tom Mangold, BBC 2 Correspondent, 2003. Available at: http://news.bbc.co.uk/.
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- The **ONLY** Hoodia as featured in a best selling book “Supreme Properties of Hoodia Gordonii” (Wellness Publishing, Inc., NJ)*
- The **ONLY** disclosed, patent pending formula of a Hoodia supplement*


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- Evidence-Based
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