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NOTE

VARIATIONS IN HYPERICIN CONCENTRATIONS IN *HYPERICUM PERFORATUM* L. AND COMMERCIAL PRODUCTS

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ABSTRACT

Twelve samples of Hypericum perforatum *L. (St. John's wort) were collected throughout Oregon and assayed for hypericin concentrations which ranged from 0.03 to 0.38%. Eight commercially available dietary supplements were also assayed using the same methods and the hypericin concentrations varied from 47 to 165% of their labeled concentrations.*

INTRODUCTION

Hypericum perforatum L. (St. John's wort) has become a widely popular herbal remedy based primarily on usage for treating milder forms of neurotic depression (Linde et al., 1996; DeSmet & Mohen, 1996). The plant contains a variety of compounds including the naphthodianthrones hypericin and pseudohypericin, at least eight flavonoids, phloroglucinols, a mixture of volatile oils, and many others (Upton, 1997). Although these constituents, when separated, are being investigated for their biological activities, the analytical method utilized for *Hypericum* identification depends on the presence of the naphthodianthrones as marker compounds.

The concentrations of these marker compounds, as well as the other constituents, can vary depending on the growth environment, quantities of the different plant parts used (leaf, stem and/or flowers), harvest time, drying procedures, storage conditions, etc.

This study was conducted to determine which locations throughout Oregon may provide plants which produce the highest concentrations of the marker compounds. A secondary study was conducted on commercially purchased dietary supplements to determine the amount of marker compounds in those products.

Concentrations were determined from plants collected in twelve (12) different locations and eight (8) consumer products as seen in Tables 1 and 2. This is the first report of an evaluation for products available to consumers. The manufacturers have not been specifically identified since it was not the purpose of the study to criticize marketing and/or quality control strategies. They are listed alphabetically below and each company has been sent the results along with the coding seen on Table 2[1].

Previous literature reports cite hypericin concentrations ranging from 0.021 to 1.8% from Europe (Hölzl & Ostrowski, 1987), 40–2150 ppm from Australia

Keywords: Hypericum perforatum, Hypericaceae, assay, hypericin, naphthoquinone, dietary supplements.

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1 Alphabetical list of manufacturers/distributors:

Corporation	Location
1. Enzymatic Therapy	Green Bay, WI
2. Furturebiotics	Hauppauge, NY
3. Jarrow Formulas	Los Angeles, CA
4. Natrol	Chatsworth, CA
5. Nature's Herbs	American Fork, UT
6. Nature's Way	Springfield, UT
7. Quantum	Eugene, OR
8. Salem Health Food	Salem, OR

TABLE 1. Collected plants and hypericin concentrations.

Code	Location	Plant part	Hypericin concentration (%)
1. Mp 33	Benton County	Leaves, stems, flowers	0.0968
2. Ctt	Benton County	Leaves, stems, flowers	0.0750
3. Mp 33	Benton County	Leaves, stems, flowers	0.0372
4. Philo-1	Benton County	Leaves, stems, flowers	0.0865
5. Philo-2	Benton County	Stems, seed caps	0.0554
6. 10981	Linn County	Leaves, flowers	0.077
7. 10982	Linn County	Leaves, flowers	0.138
8. 10993	All locations (6–12)	Flowers only	0.387
9. 10990	Klamath County	Leaves, flowers	0.0676
10. 10989	Jefferson County	Leaves, flowers	0.122
11. 10986	Linn County	Leaves, flowers	0.0953
12. 10989	Linn County	Leaves, flowers	0.0112

(Southwell & Campbell, 1991) and 155–637 µg g^{-1} d wt from Canada (Jensen et al., 1995). Therefore the values reported herein are within expected ranges. In all reports the flowers have the highest concentrations. Therefore, if further research is to be done on pure hypericin because of its antiviral (Lavie et al., 1995) and protein kinase C inhibitor properties (Hamilton et al., 1996), the most concentrated source would be the flowers of *H. perforatum*.

The reported values for the commercial products (Table 2) are variable, ranging from 47 to 165% of their labeled concentrations. Three of eight products (A, B and E) were significantly below, three were above (D, G and H) and the remaining two (C and F) would be assumed to meet most pharmacopeal standards, i.e., 95–105% of labeled quantities.

EXPERIMENTAL

Plant Collection

Five plant samples were collected in Benton County, Oregon, in late June 1997, air dried, ground and stored in the dark prior to extraction and analysis.

TABLE 2. Dietary supplements and hypericin concentration.

Product	Hypericin (%)	Label claim (%)	Variation (%)
1. Brand A	0.241	0.3	80.3
2. Brand B	0.171	0.3	57.0
3. Brand C	0.302	0.3	100.7
4. Brand D	0.186	0.14	132.9
5. Brand E	0.141	0.3	47.0
6. Brand F	0.284	0.3	94.7
7. Brand G	0.331	0.2	165.0
8. Brand H	0.355	0.3	118.3

An additional seven samples were collected in seven different geographical regions located in three counties in late July and early August 1997 and were similarly dried, ground and stored (see Table 1). Voucher samples are maintained by the OSU Herbarium and portions of each original ground sample have been maintained in closed air-tight containers.

Dietary Supplements

Eight brands of St. John's wort products were purchased at a health food store, randomly coded and not identified as to source during the extraction and assay. Capsules were emptied or tablets were crushed prior to extraction.

Extraction and Analysis

The methodology of Southwell and Campbell (1991) was modified by utilizing larger sample sizes and volumes of solvents. Plant samples 1–5 (Table 1) were 5.0 g each, plants 6–12 (Table 1) were 3.0 g each, and the equivalent of 3.0 g of capsules/tablets were based on the purchased dietary supplements.

$$[\%] = \frac{(\text{absorbtion}/4.16 \times 10^4) \times (\text{volume/l}) \times 504}{\text{g} \times 10^2}$$

Samples were first extracted with ethyl ether (Mallickrodt, A.R.) for at least six hours to remove chlorophyll which interferes with the UV assay. The thimbles were removed and air-dried overnight. The samples were then extracted with 95% ethanol, U.S.P., for six hours. The ethanol extracts were diluted to a standard volume, 400 ml for samples 1–5, 150 ml for samples 7–12, and 150 ml for commercial products. Some samples required further dilution at the time of

UV analysis to obtain absorption maxima between 0.5 and 1.0. Concentrations of hypericin were determined using the extinction coefficient of 4.16×10^4 at 592 nm and the molecular weight of hypericin at 504 Daltons.

All samples were stored in airtight dark bottles and kept at constant temperature. UV analysis was performed on a Shimadzu UV-VIS recording spectrophotometer, model 245 FW.

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