

# Mushroom Council Nutrition Research Update

---

## ***July – September 2005***

*Quarterly updates provide Mushroom Council members, industry and the Nutrition Research Advisory Panel with the latest information on the status of Mushroom Council funded nutrition research. This update includes a new section that includes references to other mushroom research and mentions of mushroom research in the press. For additional information or clarification, contact Mary Jo Feeney, MS, RD, FADA, Nutrition Consultant, [mj.feeney@earthlink.net](mailto:mj.feeney@earthlink.net).*

## **Chen, Shiuan PhD. Department of Surgical Research, Beckman Research Institute of the City of Hope, Duarte, CA.**

Dr. Chen's 2002-04 study to identify and isolate aromatase and 5 alpha reductase-inhibiting compounds in white button mushrooms and to determine their action in vivo (whether the compounds survive ingestion/metabolism to suppress the growth of aromatase-positive breast cancer cells in an animal model/mice) is completed. A Final Report dated March 2004 was submitted to the Council. A manuscript currently is being prepared for submission to a prestigious research journal (September 2005). The following abstracts of Dr. Chen's work have been published in the Proceedings of the April 2005 meeting of the American Association for Cancer research.

- Chen S, Phung S, Hur G, Kwok S, Ye J, and Oh S. ***Breast cancer prevention with phytochemicals in mushrooms.*** Vol. 46, Abs. 5186.
- Kwok S, Yuan Y-C, Karlsberg K, Smith D, Phung S and Chen S. ***Molecular basis of the chemoprotective effect of white button mushrooms against breast cancer.*** Vol. 46, Abs. 5180.
- Phung S, Ye J, Hur G, Kwok S, Lui L and Chen S. ***White button mushrooms and prostate cancer prevention.*** Vol. 46, Abs. 5174.

The March 2004 Final Report to the Council is confidential. However, Dr. Chen has approved the Council's use of the following statements about his research. These statements refer both to his initial 2002-04 research and research presented at the April 2005 meeting of the American Association for Cancer Research.

### ***Mushrooms' Aromatase Inhibiting Activity in Breast Cancer***

1. Compounds in mushrooms suppress aromatase, an enzyme responsible for the synthesis of estrogen. Abnormal production of aromatase in breast tissue is considered to be a risk factor for breast cancer:
2. Mushroom extracts act by suppressing the formation of estrogen – thus they are thought to be useful in estrogen-responsive breast cancer prevention because they might maintain estrogen at lower levels.
3. Results from animal experiments suggest that mushroom extracts could slow down estrogen-responsive tumor growth in mice, indicating that these mushroom phytochemicals maintain their activity after ingestion.

4. Postmenopausal women might benefit from a diet which includes mushrooms since mushrooms contain phytochemicals shown to be effective aromatase inhibitors.
5. Approximately 100 g of mushrooms per day would provide adequate amounts of active compounds to suppress aromatase made and accumulated in tumors in an average postmenopausal woman.
6. Adding mushrooms to the diet does not have the same effect of pharmacological doses used in cancer therapy. Mushrooms are properly used in the prevention model to potentially lower lifetime exposure to estrogen.

*Mushrooms' 5 alpha-Reductase Inhibiting Activity in Prostate Cancer*

1. Steroid 5alpha-reductase is an enzyme that converts testosterone to dihydrotestosterone (DHT) and plays a role in the development of prostate cancer and enlarged prostate. Over production of DHT also can lead to hair loss.
2. Mushroom extract contains phytochemicals that suppress steroid 5alpha-reductase activity.
3. In cell culture experiments, mushroom extract suppressed the growth of both hormone-dependent and hormone-independent prostate cancer cell lines.
4. In animal studies, mushroom extract decreased tumor size in a dose dependent manner. There was a significant increase in cancer cell death compared to the control as well as a decrease in cell proliferation.
5. A series of in vitro and in vivo experiments demonstrate that white button mushrooms can be a chemopreventing agent against prostate cancer.
6. Diets including mushrooms may have an impact in preventing hair loss and prostate cancers.
7. Approximately 75 to 150 grams of mushrooms is estimated to be the amount to be consumed to have the prostate cancer protective effect.

The compounds in mushrooms that can inhibit aromatase and 5 alpha-reductase include the fatty acid linoleic acid and/or other fatty acid derivatives. The exact compound remains undetermined at this time (September 2005). However, the Council has funded additional analytical work at Ohio State University to identify and quantify a particular fatty acid derivative.

**Cheskin, Lawrence J. MD Johns Hopkins Bloomberg School of Public Health, Baltimore, MD**

*Does Substitution of Meat Products With White Button Mushrooms Have Potential For Weight Reduction? Studies of the Level of Short and Intermediate-Term Caloric Compensation, Satiety, and Dietary Satisfaction Among Lean and Obese Men and Women. Estimated completion early 2006.*

Phase I of this study is completed. Ten test meals with a minimum of 125 calories less than an identical meal using meat have been developed. Recruitment of subjects for Phase 2 to study the palatability, consumer acceptance, and satiating properties of each mushroom-substituted meal using a panel of obese and normal weight men, women, seniors, and teenagers occurred in April.

Dr. Cheskin's research was mentioned at a symposium entitled "Foodservice industry: Solution to America's obesity problems?" during the Institute of Food Technologists (IFT) Annual Meeting in July as a nutrition strategy to help improve the nutrient profile and lower the caloric level of menu offerings.

**Mark Kern, PhD, RD, San Diego State University, San Diego, CA.**

*Role Of Mushrooms Included in a Low Carbohydrate Diet on Weight Loss, Blood Lipids and Satiety. Estimated completion of the 18 month study is mid 2006.*

The clinical trial phase is completed and data are being analyzed. Dr. Kern will attend the Food and Nutrition Conference and Exhibition of the American Dietetic Association (October 22-25, St. Louis) and will be at the Mushroom Council's booth to describe his research objectives. The study was a randomized balanced cross-over study that examined the role of mushrooms incorporated into a 4-week low carbohydrate diet on body weight and fat loss, resting and postprandial blood lipid responses, and blood pressure in overweight men and women. The mushroom-based low carbohydrate (low saturated fat) diet will be compared to a more typical low carbohydrate (higher saturated fat) diet using primarily animal sources of protein and fat and to a diet high in carbohydrate and lower in fat and protein representing usual dietary recommendations.

**David B. Haytowitz, U.S. Department of Agriculture, Beltsville Human Nutrition Research Center, Nutrient Data Laboratory, Beltsville, MD.**

*Nutrient Analysis Of Mushrooms.*

Nutrient information on white button raw, stir-fried and microwaved; oyster raw; shiitake stir-fried; crimini raw; portabella raw and grilled; and enoki raw appear in U.S. Dept. of Agriculture, Agricultural Research Service. 2005. USDA National Nutrient Database for Standard Reference, Release 18. Nutrient Data Laboratory Home Page, <http://www.nal.usda.gov/fnic/foodcomp>. Subsequent revisions will include data on raw maitake and cooked values of some mushroom varieties. Nutrient values in the USDA database represent aggregated values from a variety of data sources.

In addition to the inclusion in this food composition database, used widely by the scientific community to monitor food intake and to conduct nutrition research, the results were used to:

1. **Respond to FDA's request for updated nutrient values for mushrooms as one of the 20 most popular fruits and vegetables.** In May, after review of the USDA data by the Council's nutrition and labeling consultants, and with approval by the President, USDA provided the updated nutrient information to FDA stating that no changes needed to be made for white button mushrooms. Specialty varieties would not be covered by the top 20 list.
2. **Update the Mushroom Council's Nutrition Labeling Toolkit.** Guy Johnson, PhD, used the USDA 2005 nutrient analysis data to supplement FDA data, and data from industry analyses from previous years to provide nutrition labeling on nutrients found in mushrooms that are not part of the typical nutrition label. In addition to the sample labels for whites, ciminis and ports, the industry now can generate sample labels for raw enoki, oyster and maitake mushrooms (maitake label still pending release of some information from USDA).

The updated Nutrition Labeling Toolkit also includes the most recent information on **trans fat labeling**. *Trans* fat labeling will be required for processed foods on January

2006. *Trans* fat labeling will become mandatory for virtually all processed foods (including canned mushrooms) on January 1, 2006. However, the nutrition labeling of fresh mushrooms is regulated under the FDA voluntary system for the nutrition labeling of fresh fruit, vegetables and seafood. This system is currently being updated to reflect newer analytical data for the 20 most popular fruits and vegetables (including mushrooms) and FDA has stated that *trans* fat labeling will not be required on such foods until this revision is finalized. At that time, the new requirements for *trans* fat labeling will be extended to fresh produce.

Therefore, *trans* fat labeling is not technically required for fresh mushrooms at this time, but it is inevitable. The Mushroom Council recommends that Nutrition Facts panels include *trans* fat information at this time in anticipation of the final regulations.

#### New information to be required

All fresh mushrooms are free of *trans* fat. FDA will not require such products to provide *trans* fat information as a separate line in the Nutrition Facts panel, but a footnote that states “not a significant source of *trans* fat” must be included. The revised Nutrition Labeling Toolkit will be posted on the Mushroom Council’s website.

### **Recently Funded Immunity Research**

- “*Effect of mushroom supplementation on innate immune response*,” Dayong Wu, PhD, USDA Human Nutrition Research Center on Aging at Tufts University. Immune cells from mice fed different doses of mushroom powder will be isolated for determination of innate immune responses such as macrophage function, NK cell count and activity and dendritic cell function.
- “*Modulation of biomarkers of inflammation by mushrooms commonly consumed in the United States*” Keith R. Martin, PhD, Penn State University. This study seeks to determine if mushrooms commonly consumed in the U.S. exhibit anti-inflammatory action in an *in vitro* macrophage model; beneficially alter *in vivo* pro-inflammatory status; and affect pro-inflammatory macrophage function.

Dr. Martin is preparing the samples both for his research and Dr. Wu’s so that the samples are consistent. Dr. Martin has begun his *in vitro* studies with monocytes and macrophages. The goal is to have an abstract prepared for presentation at Experimental Biology (April 2006 in San Francisco).

### **Pilot Study on Vitamin D2**

The Council undertook a pilot study to determine the production feasibility of exposing mushrooms to UV light to activate D2 prior proceeding with a proposal from Mona Calvo, PhD, FDA Center for Food Safety and Applied Nutrition to investigate the effect of mushrooms optimized with D2 on increased disease resistance to microorganisms and mammary tumor growth in an animal model.

Drs. Beelman and Beyer, Penn State University, conducted research on the “Influence of UV Light on Mushroom Yield and Fresh Quality.” These samples represented exposure to UV light in the growing room pre-harvest. Monterey Mushrooms prepared samples of white and ports exposed post harvest to UV light for analysis. The D2 content of the samples is being verified.

## Nutrition Research Information Activities

Nutrition research information activities center on attending and participating in various professional symposia, conferences and meetings and preparing Research Report summaries for distribution to health professionals. In July, the Council representatives attended meetings and prepared reports from the Institute for Food Technologists, American Institute for Cancer Research and the Society for Nutrition Education. Quarterly reports similar to this industry report have been prepared for health professionals and sent electronically to a proprietary list developed through surveys and other inquiries. A research report summarizing Mushroom Council research and other citations has been prepared for distribution at the October Food and Nutrition Conference and Exhibition of the American Dietetic Association.

## Other Mushroom Research in the News

In an effort to establish the Mushroom Council as the source of mushroom nutrition research, Council consultants regularly monitor the literature. The following summarizes some mushroom research conducted by others, mainly on medicinal mushrooms or mushrooms not commonly consumed in the US. Names of researchers and/or institutions are added to the Mushroom Council's mailing list for distributing future research proposals. Often contact is made with the researcher/institution to discover if there is any information from the study pertinent to common varieties of mushrooms, and whether it is possible to collaborate in the study. Once a study has been reviewed, funded and gone through the institutional review board process, it is almost impossible to change the study design to include another variable, such as another mushroom variety. It is important, therefore, to establish the Mushroom Council and industry as primary players in mushroom nutrition research.

This list includes scientific citations when the study has been published in a journal or as an abstract and/or news reports of the research.

***Identification and quantification of ergothioneine in cultivated mushrooms by chromatography-mass spectrometry.*** Dubost, NJ, Beelman, RB and Peterson DG. Pennsylvania State University, Food Science Dept. 20 Borland Laboratory, State College, PA 16801. Abstract presented at the Institute of Food Technologists Conference/Exposition July 16-20, New Orleans, LA and August 31 meeting of the American Chemical Society. A press release by Penn State received considerable press coverage which is summarized at the end of this report.

***Isolation of Antitumor Agents from Basidiomycetes (Mushrooms).*** 2001. Nicholas H. Oberlies, PhD, Principal Investigator, Research Triangle Institute (RTI). 3-year \$716,000 grant from American Cancer Society. ***Researchers Hope Mushrooms hold Key to Smallpox*** By Helen Chickering (NBC News) – June 23, 2005. Edited press coverage of Dr. Oberlies antiviral research:

Research Triangle Institute's Dr. Nick Oberlies says over the next five years, researchers will analyze more than 16,000 mushroom samples collected around the country in hopes of finding at least a handful that hold antiviral potential. All of the mushrooms in the study are from North America. The research is funded by a \$5 million grant from the National Institute of Allergy and Infectious Diseases, National Institutes of Health. RTI's website, [www.rti.org](http://www.rti.org), provides additional information.

***Trametes Versicolor-Induced Immunopotentialion***-Developmental Center for Research on CAM (University of Minnesota collaboration, Bastyr subcontractor) Principal Investigator: J Slaton, Co-investigator: C Wenner Project Period: 09/30/04-08/31/05, \$792,000 awarded

by the National Center for Complementary and Alternative Medicine (NCCAM), National Institutes of Health. **Turkey Tail Mushroom May Have Key To Preventing Cancer**

POSTED: 7:49 pm EDT July 15, 2005

UPDATED: 8:00 pm EDT July 15, 2005

Edited press coverage of the research:

New research shows that a powerful fungus could be the latest treatment for cancer. It is called the turkey tail mushroom. It grows in the Pacific Northwest and in many parts of Asia, but you probably won't ever see it. "As far as finding it growing, it's going to be pretty rare to find that," said Jeff Novack, a pharmacologist at Bastyr University in Seattle. It is called the turkey tail mushroom because of its resemblance to the bird. A new study at Bastyr University is looking at whether this mushroom has the power to treat or even prevent cancer. "One of the reasons that we picked it is that preliminary data shows very encouraging evidence that it has very strong effects against cancer cells," said Cynthia Wenner, an immunologist. Researchers are using an extract of the mushroom for their study. *Copyright 2005 by NBC10.com. All rights reserved. This material may not be published, broadcast, rewritten or redistributed*

**Abstract Presentations: American Institute for Cancer Research International Research Conference on Food, Nutrition and Cancer, July 14-15, 2005, Washington, DC**

- ***Ganoderma lucidum inhibits proliferation in human breast cancer cells by estrogen receptor-dependent and estrogen receptor-independent signaling pathways.*** Jiahua Jiang, Veronika Slivova, Jan-Ake Gustafsson, Daniel Silva. Cancer Research Laboratory, Methodist Research Institute, Indianapolis IN; Department of Medical Nutrition, Karolinska Institute, Huddinge, Sweden; Department of Medicine, Indiana University, Indianapolis, IN.
- ***1SY16 isolated from Agaricus blazei Murill K as a Potent Multipotential Chemopreventive Agent .*** Insu P. Lee, Tomihisa Ohta, Sumi Bae, Michael Pereira, Vernon Steele. Graduate faculty of Medicine and Pharmaceutical Science, Kanazawa University, Kanazawa City, Japan; Basic Medical Science Institute, Catholic University, Medical College, Seoul, Korea; Department of Pathology, Medical College of Ohio, Toledo, OH; Chemopreventive Agent Development Research Group, Division of Cancer Prevention, National Cancer Institute, Bethesda, MD.
- ***Chemoprevention of MNU-induced Mammary Tumorigenesis in SD rats by 1SY16 Isolated from Agaricus Blazei Murill K.*** Insu P. Lee, Tomihisa Ohta, Sumi Bae, Woong-Shick Ahn, Vernon E. Steele. Graduate Faculty of Medicine, and Pharmaceutical Science, Kanazawa University, Kanazawa City, Japan; Basic Medical Science Institute, Catholic University Medical College, Seoul, Korea; Chemopreventive Agent Development Research Group, Division of Cancer Prevention, National Cancer Institute, Bethesda, MD.

#### **Other Published Research**

##### **Antioxidant Activity**

Lakshmi B, Tilak JC, Adhikari S, Devasagayam TPA, Janardhanan KK. **Evaluation of antioxidant activity of selected Indian mushrooms.** *Pharmaceutical Biology* 2004. 42: 179-185.

### **Carbohydrate/Dietary Fiber**

Dlkeman, CL, Bauer, LL, Flickinger, EA, Fahey, Jr. GC. **Effects of stage of maturity and cooking on the chemical composition of select mushroom varieties.** Journal of Agricultural and Food Chemistry 2005; 53(4); 1130-38.

Reports of this research:

**Mushrooms offer heart health fibres**

<http://foodnavigator.com/news/ng.asp?id=58078&n=dh46&c=vfgmiacrtydidgb>

**Chemical analysis of mushrooms shows their nutritional benefits**

[http://www.eurekalert.org/pub\\_releases/2005-02/uoia-cao021405.php](http://www.eurekalert.org/pub_releases/2005-02/uoia-cao021405.php)

**The nutritional benefits of mushrooms**

<http://www.medicalnewstoday.com/medicalnews.php?newsid=20070>

**Chemical Analysis of Mushrooms Shows Their Nutritional Benefits**

<http://www.sciencedaily.com/releases/2005/02/050218161310.htm>

### **Vitamin D2**

- Jasinghe VU, Perera CO. **Distribution of ergosterol in different tissues of mushrooms and its effect on the conversion of ergosterol to vitamin D2 by UV irradiation.** 2005. Food Chemistry. 92. 541-546.
- Jasinghe, VJ, Perera CO. **Ultraviolet irradiation: The generator of vitamin D2 in edible mushrooms.** Food Chemistry 2005 in press.
- Jasinghe VJ, Perera CO, Barlow PJ. **Bioavailability of vitamin D2 from irradiated mushrooms: an in vivo study.** British Journal of Nutrition 2005. 93: 951-955.

### **Ergothioneine**

- Deiana M, Rosa A, et al. **L-Ergothioneine modulates oxidative damage in the kidney and liver of rats in vivo: studies upon the profile of polyunsaturated fatty acids.** Clinical Nutrition 2004. 23, 183-193.
- Kumosani TA. **L-ergothioneine level in red blood cells of healthy human males in the Western province of Saudi Arabia.** Experimental and Molecular Medicine, 2001. 33, 20-22.

### **Miscellaneous**

- Gu, Yu-Huan (Bastyr University) and Belury Martha A . **Selective induction of apoptosis in murine skin carcinoma cells (CH72) by an ethanol extract of Lentinula Edodes.** Cancer Letters 220 (2005) 21-28.
- Lindequist U, Niedermeyer TMJ, Julich WD. **The pharmacological potential of mushrooms.** eCAM 2005;2 (3)285-299.
- Meletis CD, Barker JE. **Medicinal mushrooms: a selective overview.** Alternative & Complementary Therapies June 2005. Mary Ann Liebert, Inc. 140 Huguenot St., 3<sup>rd</sup> Fl. New Rochelle NY 10801.
- Nieminen P, Mustonen AM, Kirsi M. **Increased plasma creatine kinase activities triggered by edible wild mushrooms.** Food and Chemical Toxicology 2005. 43: 133-138.
- Ou HT, Shieh CJ, Chen YJ, Chang HM. **The antiproliferative and differentiating effects of human leukemic U937 cells and mediated by cytokines from activated mononuclear cells by dietary mushrooms.** Journal of Agricultural and Food Chemistry. 2005. 53:300-305.

## Mushroom Coverage in the Press

Weekly web reports on health-nutrition related mushroom news is prepared by Stephanie Grunenfelder. Below is a listing of the articles of interest and the initial link to the story. In some cases the links are no longer active but are included to show where the coverage appeared. Stephanie also prepared the separate report on ergothioneine press coverage.

Week	Article/Link
Jan. 10-14	<b>Specialty Mushrooms, TV Spot</b> <a href="http://www.wnbc.com/producepete/4080350/detail.html">http://www.wnbc.com/producepete/4080350/detail.html</a>
Jan. 17-21	<b>Mushrooms 'in' food for chef's favorite low-carb recipes</b> <a href="http://www.wfcourier.com/articles/2005/01/18/features/lifestyles/a274fac81e07663786256f8c0054b8e2.txt">http://www.wfcourier.com/articles/2005/01/18/features/lifestyles/a274fac81e07663786256f8c0054b8e2.txt</a>
Jan 31-Feb 4	<b>Don't be in the dark about mushrooms</b> <a href="http://www.northernlife.ca/lifestyleArticle.asp?32id11-pn=&amp;view=8056">http://www.northernlife.ca/lifestyleArticle.asp?32id11-pn=&amp;view=8056</a>
Feb 14-18	<b>Mushrooms offer heart health fibres</b> <a href="http://foodnavigator.com/news/ng.asp?id=58078&amp;n=dh46&amp;c=vfgmiacrtididgb">http://foodnavigator.com/news/ng.asp?id=58078&amp;n=dh46&amp;c=vfgmiacrtididgb</a> <b>Chemical analysis of mushrooms shows their nutritional benefits</b> <a href="http://www.eurekalert.org/pub_releases/2005-02/uoaia-ca021405.php">http://www.eurekalert.org/pub_releases/2005-02/uoaia-ca021405.php</a> <b>The nutritional benefits of mushrooms</b> <a href="http://www.medicalnewstoday.com/medicalnews.php?newsid=20070">http://www.medicalnewstoday.com/medicalnews.php?newsid=20070</a>
Feb 21-25	<b>Chemical Analysis of Mushrooms Shows Their Nutritional Benefits</b> <a href="http://www.sciencedaily.com/releases/2005/02/050218161310.htm">http://www.sciencedaily.com/releases/2005/02/050218161310.htm</a> <b>Mushrooms are Increasingly Good Money (Page not available)</b> <a href="http://www.nst.com.my/Current_News/NST/Sunday/Features/20050220084215/Article/indexb.html">http://www.nst.com.my/Current_News/NST/Sunday/Features/20050220084215/Article/indexb.html</a> <b>Flower Shitake Mushrooms From China May Contain Dangerous Bacteria</b> <a href="http://www.inspection.gc.ca/english/corpaffr/recarapp/2005/20050218ce.shtml">http://www.inspection.gc.ca/english/corpaffr/recarapp/2005/20050218ce.shtml</a>
Mar. 7-11	<b>Silence of the Mushrooms</b> <a href="http://www.techcentralstation.com/030805D.html">http://www.techcentralstation.com/030805D.html</a> <b>Exotic mushrooms make for indulgent meal (Page not available)</b> <a href="http://www.insidebayarea.com/bayarealiving/ci_2592434">http://www.insidebayarea.com/bayarealiving/ci_2592434</a> <b>Fungus-friendly scientists meet in Tucson</b> <a href="http://www.eurekalert.org/bysubject/agriculture.php">http://www.eurekalert.org/bysubject/agriculture.php</a>
Mar 14-18	<b>Regulating the wild mushroom (Page not available)</b> <a href="http://www.latimes.com/features/food/la-fo-mushrooms16mar16,1,4790141_story?coll=la-headlines-food&amp;ctrack=1&amp;cset=true">http://www.latimes.com/features/food/la-fo-mushrooms16mar16,1,4790141_story?coll=la-headlines-food&amp;ctrack=1&amp;cset=true</a>
	<b>Mushrooms are vegetable of the month at Centers for disease control.</b> <a href="http://www.cdc.gov/nccdphp/dnpa/5aday/month/pdfs/Mushrooms.pdf">http://www.cdc.gov/nccdphp/dnpa/5aday/month/pdfs/Mushrooms.pdf</a>
Mar 21-25	<b>Medicinal Mushrooms from Old-Growth Forests May Counter Smallpox and Similar Viruses</b> <a href="http://home.businesswire.com/portal/site/google/index.jsp?ndmViewId=news_view&amp;newsId=20050325005027&amp;newsLang=en">http://home.businesswire.com/portal/site/google/index.jsp?ndmViewId=news_view&amp;newsId=20050325005027&amp;newsLang=en</a>
	<b>Fun with Fungi: Mushrooms are Healthful</b> <a href="http://www.ediets.com/news/article.cfm/cmi_1029116">http://www.ediets.com/news/article.cfm/cmi_1029116</a>
April 11-15	<b>NCCAM and ODS Co-Fund Five Botanical Research Centers</b> <a href="http://nccam.nih.gov/news/2005/040705.htm">http://nccam.nih.gov/news/2005/040705.htm</a> <b>Medicinal Mushrooms May Help Fight Cancer</b> <a href="http://www.clickondetroit.com/health/4367012/detail.html">http://www.clickondetroit.com/health/4367012/detail.html</a> <b>Medical Mushrooms</b> <a href="http://www.click2houston.com/health/4368364/detail.html">http://www.click2houston.com/health/4368364/detail.html</a> <b>Timesaving Mushrooms</b> <a href="http://washingtontimes.com/food/20050411-111513-8811r.htm">http://washingtontimes.com/food/20050411-111513-8811r.htm</a>
April 18-22	<b>Mushrooms a diet gem</b> <a href="http://www.azcentral.com/arizonarepublic/food/articles/0420lowcarb0420.html#">http://www.azcentral.com/arizonarepublic/food/articles/0420lowcarb0420.html#</a> <b>Product Highlight: Mushrooms</b> <a href="http://www.freshplaza.com/2005/21apr/2_producth_mushroom.htm">http://www.freshplaza.com/2005/21apr/2_producth_mushroom.htm</a>
May 2-6	<b>Mushrooming Anxiety</b> <a href="http://www.newyorkmetro.com/nymetro/news/people/columns/intelligencer/11901/index.html">http://www.newyorkmetro.com/nymetro/news/people/columns/intelligencer/11901/index.html</a>
May 23-27	<b>Make room for mushrooms</b> <a href="http://www.citizensvoice.com/site/news.cfm?BRD=2259&amp;dept_id=457356&amp;newsid=14548415&amp;PAG=461&amp;rfi=9">http://www.citizensvoice.com/site/news.cfm?BRD=2259&amp;dept_id=457356&amp;newsid=14548415&amp;PAG=461&amp;rfi=9</a> <b>Growers right on button with exotic mushrooms</b> <a href="http://www.signonsandiego.com/news/northcounty/20050518-9999-7m18shrooms.html">http://www.signonsandiego.com/news/northcounty/20050518-9999-7m18shrooms.html</a>
June 13-17	<b>How mushrooms enlightened civilization</b> <a href="http://www.freelancenews.com/lifestyles/contentview.asp?c=159995&amp;siteID=33">http://www.freelancenews.com/lifestyles/contentview.asp?c=159995&amp;siteID=33</a>
July 11-15	<b>Skane to develop shiitake-based foods</b> <a href="http://nutraingredients.com/news/ng-nocache.asp?id=61265">http://nutraingredients.com/news/ng-nocache.asp?id=61265</a>
Aug. 1-5	<b>Mushrooms Used to Battle Leukemia</b> <a href="http://www.israelnationalnews.com/news.php3?id=87006">http://www.israelnationalnews.com/news.php3?id=87006</a> <b>Mushrooms Offer Protection from Smallpox</b> <a href="http://www.npr.org/templates/story/story.php?storyId=4783951">http://www.npr.org/templates/story/story.php?storyId=4783951</a>

## Ergothioneine Coverage

Summary of impressions: Based on circulation information available from the publications listed below (discovered in a limited search of the internet), it is estimated that upwards of 3,370,000 consumers saw the press release on mushrooms and ergothioneine in the United States. Publications in Europe also published the report, although the exact number of media impressions there is not available. See publication details below.

1. **Nutraingredients** newsletter – published via web in France, worldwide distribution, September 5, 2005 *Mushrooms beat wheatgerm to top antioxidant slot* <http://www.nutraingredients.com/news/ng.asp?n=62278&m=1NIE905&c=vfgmiacrtydidgb>
2. **Food Navigator** Newsletter – published in Europe – September 5, 2005 <http://www.foodnavigator.com/news/ng.asp?n=62278&m=1FNE905&c=vfgmiacrtydidgb>
3. **Pittsburgh Tribune-Review, September 2, 2005** *Mushrooms source for anti-cancer vitamin, study says* [http://www.pittsburghlive.com/x/tribune-review/national/s\\_370006.html](http://www.pittsburghlive.com/x/tribune-review/national/s_370006.html). About PittsburghLive.com: 35% penetration in Pittsburgh area (Internet users) over 12 million page views every month, over 1 million unique visitors every month
4. **Web MD** online newsletter, August 31, 2005. *Mushrooms: Mother Lode for an Antioxidant* Even the Mushrooms That Top Pizzas Are a Rich Source, Study Shows. <http://my.webmd.com/content/Article/111/109847.htm> This network of public web sites reaches an average of more than 24 million unique users a month. *WebMD the Magazine* is distributed free to consumers in the waiting rooms of approximately 85 percent of doctors across the country. Approximately 1 million copies of the bimonthly publication are distributed.
5. **FDA News**, September 8, 2005. *Mushrooms Source for Anti-Cancer Vitamin, Study Says*. [Pittsburgh Tribune-Review](#) (this article was mentioned in the FDA News). See Pittsburgh tribune-review information in #3 above. FDAnews.com has an ever-increasing number of visitors. On average, the total number of page views per month is over **230,000**, defined as the number of pages viewed, not including supporting graphic files. The number of unique visitors per month now exceeds **37,000**, measured by identifying visitors' IP address, domain name or cookie. Weekly newsletter is read by approximately 3,000 professionals.
6. **Yahoo business news**, September 8, 2005. <http://biz.yahoo.com/prnews/050908/nyth185.html?.v=14>. This press release came through PR Newswire, which serves audiences through satellite delivery, email and fax delivery, and more than 600 television stations through the Pathfire Digital Media Gateway (DMG). More than 79,000 journalists are registered for the media web site, PR Newswire for Journalists, <http://www.prnewswire.com/media>, plus the general public and millions of investment professionals through more than 3,600 websites, online databases and financial networks.
7. **India Times, Health** – September 8, 2005. <http://health.indiatimes.com/articleshow/1218042.cms>
8. **The London Times**, September 9, 2005. <http://www.timesonline.co.uk/article/0,,8124-1770889,00.html>
9. **KLAS TV, Las Vegas, Nevada**, September 1, 2005. *For Antioxidants, Just Add Mushrooms*. <http://www.klastv.com/Global/story.asp?S=3794858>. Estimated reach, "Thousands daily" no specific numbers listed.

10. **Philadelphia Enquirer**, September 5, 2005 – scroll to second headline at this link. *Mushrooms the Best Source of an Antioxidant*.  
<http://www.philly.com/mld/philly/entertainment/12563318.htm>
11. **Medical News Today**, UK, September 2, 2005.  
<http://www.medicalnewstoday.com/medicalnews.php?newsid=29988>
12. **I-newswire.com**, September 9, 2005. <http://i-newswire.com/pr45256.html>. I-newswire is a press release center available to journalists.
13. **Food Consumer**, an industry magazine (IL), in print and online, August 31, 2005 .  
[http://www.foodconsumer.org/777/8/mushrooms\\_a\\_top\\_source\\_for\\_one\\_antioxidant.shtml](http://www.foodconsumer.org/777/8/mushrooms_a_top_source_for_one_antioxidant.shtml). Food Consumer is a non-profit information resource for the food industry.
14. **eMax health**, an online newsletter, September 4, 2005.  
<http://www.emaxhealth.com/74/3063.html><http://www.emaxhealth.com/74/3063.html>. Estimated readership of this new health oriented website is between 5,000 and 10,000 unique visitors daily.
15. **Penn State Live**, online newsletter. September 1, 2005.  
<http://live.psu.edu/story/13294>. Readership not published, part of Penn State's website.
16. **Health Sentinel.com**, online health newsletter, September 2, 2005.  
[http://www.healthsentinel.com/news.php?id=1081&title=Mushrooms+source+for+anti-cancer+vitamin%2C+study+says&event=news\\_print\\_list\\_item](http://www.healthsentinel.com/news.php?id=1081&title=Mushrooms+source+for+anti-cancer+vitamin%2C+study+says&event=news_print_list_item). This information website is free to the public and does not sell advertising. Readership numbers are not available for publication.
17. **Chicago Sun-Times**, Chicago, IL, September 4, 2005.  
<http://www.suntimes.com/output/health/cst-nws-healthnews04.html>. The Chicago Sun Times web site is visited by 2,796,000 unique visitors per month.
18. **Forbes Magazine**, health page, September, 2005.  
<http://www.forbes.com/lifestyle/health/feeds/hscout/2005/09/01/hscout527666.html>. Forbes.com publishes over 1500 stories daily, and is visited by over 13,000,000 unique visitors each month. 84% of these visitors are from North America.
19. **Science Daily** – September 12, 2005.  
<http://www.sciencedaily.com/releases/2005/09/050912080429.htm>. *ScienceDaily's* Web site traffic averages about 45,000 daily visits, generating in excess of 150,000 page views a day, or a total of roughly 1.3 million visits / 4.5 million page views a month.
20. **Red Nova** – September 2, 2005 (Web site with news of science, technology and related interests).  
[http://www.rednova.com/news/health/228309/for\\_antioxidants\\_just\\_add\\_mushrooms/](http://www.rednova.com/news/health/228309/for_antioxidants_just_add_mushrooms/). See circulation and demographics information for Red Nova here:  
<http://www.rednova.com/advertising/>
21. **The Courier Journal**, Louisville, KY. September 15, 2005. Daily circulation newspaper, Louisville, KY. <http://www.courier-journal.com/apps/pbcs.dll/article?AID=/20050915/FEATURES03/509150308/1010/FEATURES>. The Louisville Courier-Journal has an estimated readership of 216,000 per day.
22. **The Sun-Sentinel**, Fort Lauderdale, Florida, September 15, 2005.. [http://www.sun-sentinel.com/features/food/sfl-bites15sep15\\_0\\_3193000.story?coll=sfla-features-food](http://www.sun-sentinel.com/features/food/sfl-bites15sep15_0_3193000.story?coll=sfla-features-food). The Sun-Sentinel has an average daily readership of 664, 000 in the Fort Lauderdale area.

23. **The Seattle Times**, September 1, 2005..  
[http://seattletimes.nwsources.com/html/nationworld/2002463366\\_mdig01.html?syndication=rss&source=health.xml&items=25](http://seattletimes.nwsources.com/html/nationworld/2002463366_mdig01.html?syndication=rss&source=health.xml&items=25). The Seattle Times (both print and online) is read by approximately 1.5 million readers per month.
24. **Arizona Daily Star**, Tucson, Arizona, September 1, 2005..  
<http://www.dailystar.com/dailystar/news/91303.php>
25. **Eureka Alert**, August 31, 2005. [http://www.eurekaalert.org/pub\\_releases/2005-08/ps-nms082405.php](http://www.eurekaalert.org/pub_releases/2005-08/ps-nms082405.php). The general audience for this website is about 600,000 unique visitors each month. Approximately 5,000 reporters use the subscription service.