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ACS Scholar Adunoluwa Obisesan
BS, Massachusetts Institute of Technology, June 2021
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ROBERT BEELMAN, PhD
Professor Emeritus of Food Science and Director, Center for Plant and Mushroom Foods for Health, Penn State University

BRIAN GUTHRIE, PhD
Corporate Research Fellow, Cargill

This ACS Webinar® is co-produced with the ACS Division of Agricultural & Food Chemistry.
Is Ergothioneine Made by Fungi a Key to Healthy Aging?

Robert Beelman
Emeritus Professor of Food Science
Penn State University

L-ergothioneine (ERGO)

- Discovered in 1909 in Ergot fungus
- Amino acid (m.w. 229)
- Colorless, odorless, water soluble
- Very stable antioxidant

\[
\text{2-mercaptoimidazole} \quad \text{1-methyl-2-mercaptoimidazole (methionine)}
\]
L-ergothioneine (ERGO)

- In 1950’s ERGO found in high concentrations in animal and then human blood
  - Traced to feed and food
- Not produced by animals or plants
  - Must be obtained from the diet
- Only produced by fungi, cyanobacteria and some bacteria
- Concentrated in mushrooms
- Discovery of Ergothioneine transporter (ETT)
  - ETT is highly expressed in tissues that pull ERGO from food and distribute to areas of oxidative stress

Uptake of ERGO from the diet

- Highly bioavailable from mushrooms
Concentration of ERGO in various mushrooms. Data is expressed as means. Bars on the columns represent standard deviation. Graphics with different letters differ significantly (p= 0.05).


Ergothioneine and Glutathione Content of Mushrooms (mg/g d.w)

Ergo is “a very effective antioxidant. The body clearly wants it, and it doesn’t make it itself. I think it’s pretty clear that it is some kind of “vitamin” that affects aging.”

Triage Theory
(Longevity Vitamin)
Dr. Barry Halliwell
Centennial Professor
National University of Singapore

World authority on free radicals, antioxidants and aging


(a) Plasma ergothioneine (nM) levels in healthy individuals compared to patients with age-related disorders (unhealthy individuals)

(b) Plasma ergothioneine (nM) levels in patients with age-related disorders (# unhealthy group)

(AMD) Age-related macular degeneration; (PD) Parkinson’s disease; (MCI) Mild cognitive impairment; (AD) Alzheimer’s disease; (VaD) Vascular dementia

Ergothioneine is associated with reduced mortality and decreased risk of cardiovascular disease

Einar Smith, Filip Ottosson, Sophie Hellstrand, Ulrika Ericson, Marju Orho-Melander, Céline Fernandez, Olle Melander

- 112 plasma metabolites were measured in 3236 participants without cardiovascular disease (CVD) and diabetes mellitus
- Identified that higher ergothioneine was an independent marker of lower risk of cardiometabolic disease and mortality


Decline of ergothioneine in frailty and cognition impairment

Hiroshi Kondoh, Takayuki Teruya, Masahiro Kameda and Mitsuhiro Yanagida

Estimated Avg Ergothioneine Consumption (mg/day)*

- Italy: 4.6
- Ireland: 3.6
- France: 2.2
- Finland: 1.3
- U.S.: 1.1


Life expectancy vs. estimated ERGO consumption

Parkinson’s Disease Death Rate

Estimated Ergothioneine consumption (mg/day)


Alzheimer’s/Dementia Death Rate

Estimated Ergothioneine consumption (mg/day)

L-Ergothioneine (ERGO) is a natural antioxidant capable of scavenging reactive oxygen species and transition metals. This work reports the robust synthesis of a novel [11C]ERGO PET radioligand to visualize ERGO in action. Here, using the preclinical animal models, we show that the probe could report the threshold levels of oxidative stress in Alzheimer’s disease.

- Treating 5XFAD mice with ERGO reduced amyloid plaques, oxidative stress and reduced glucose metabolism
- ERGO has potential to prevent AD
Is Ergothioneine, a “longevity vitamin” limited in the American Diet?


Is ERGO a link between Soil Health and Human Health?

Dr. Sjoerd Duiker

Professor of Soil Management and Applied Soil Physics

Figure 1. ERGO content of crops (a) maize (2018), (b) soybean (2019), and (c) oats (2020) grown using different tillage methods; different letters above the bars indicate significant differences (p > 0.05) within each crop type, error bars represent the standard deviation of each tillage type.
Reducing tillage increases fungal colonization of roots
Increased crop ERGO

Regenerative Agriculture

**Involves**
- Minimal tillage
- Cover cropping
- Multiple crop rotations
- Reduced pesticides
- Reduced chemical fertilizers

**Results**
- More fungi
- More ERGO
- Reduced inputs
- Improved environment
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Vanderbilt University: Wellington Pham, Fiona Harrison
USDA / ARS: Wade Heller; University of Delaware: Harsh Bais

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Sam Jones, PhD
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Deboki Chakravarti, PhD
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