



Overviews of  
**RARE GINSENOSES**

Guess what?

Neural protection

Cardiovascular protection

Lung protection

Hepatic protection

Renal protection

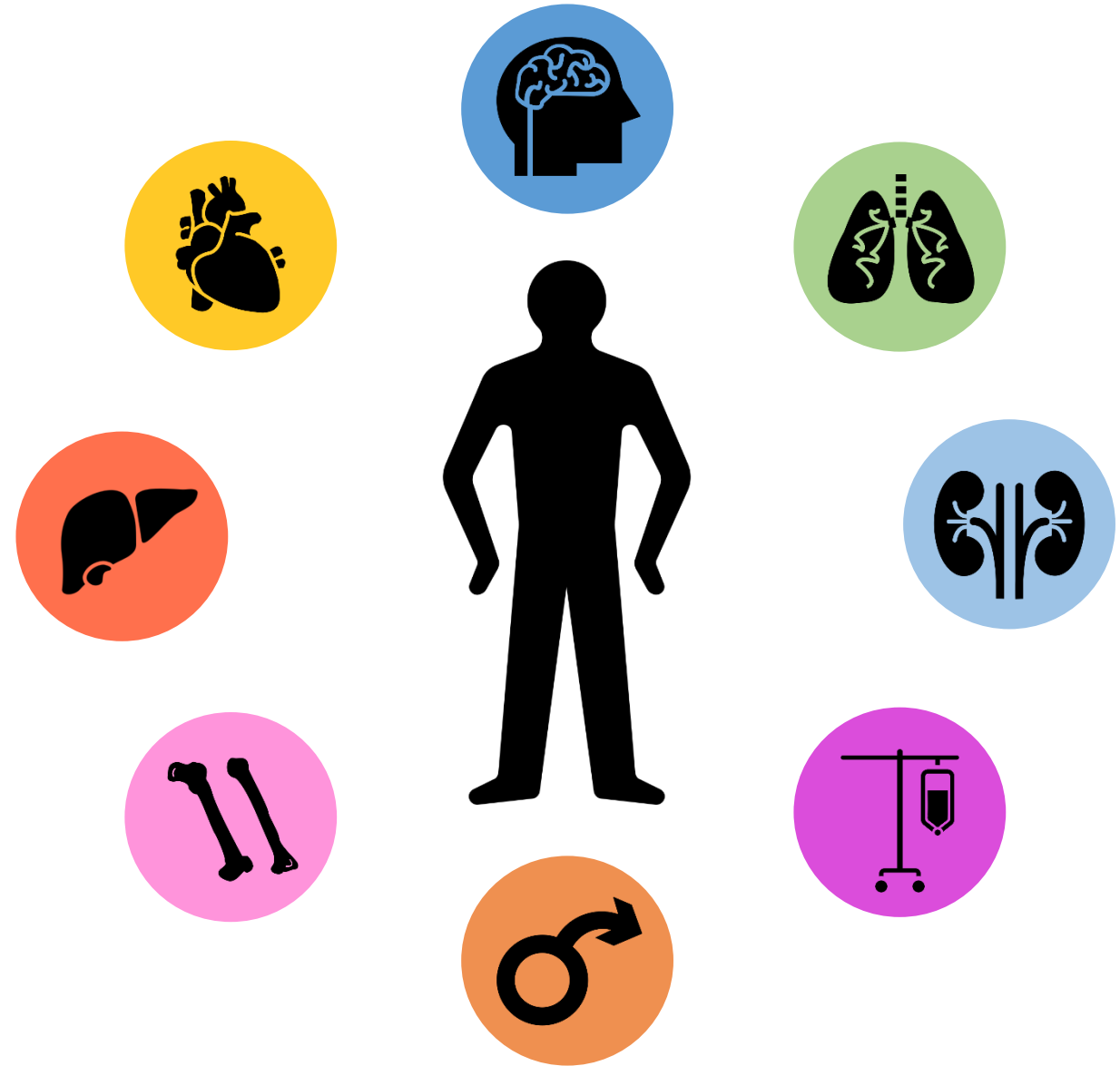
Anti-osteoporosis

Immunomodulators

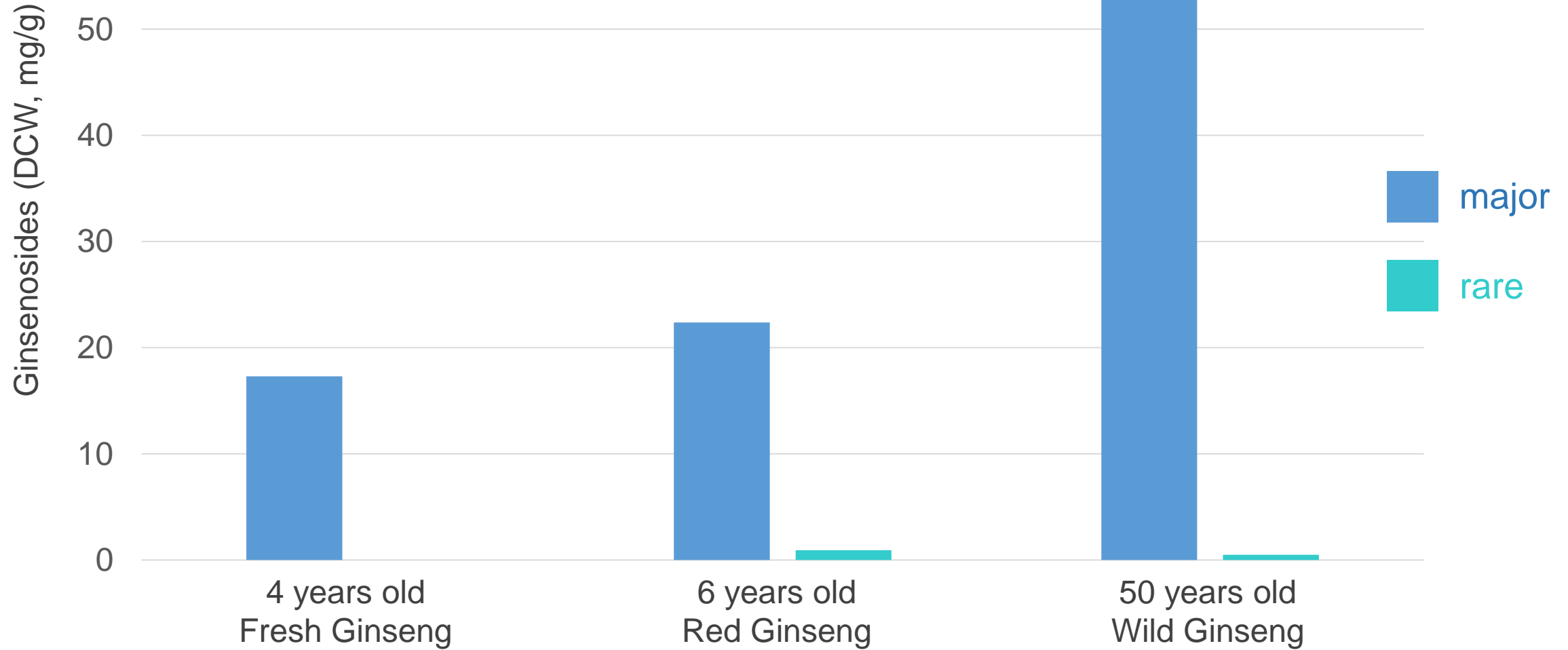
Cancer therapy helper

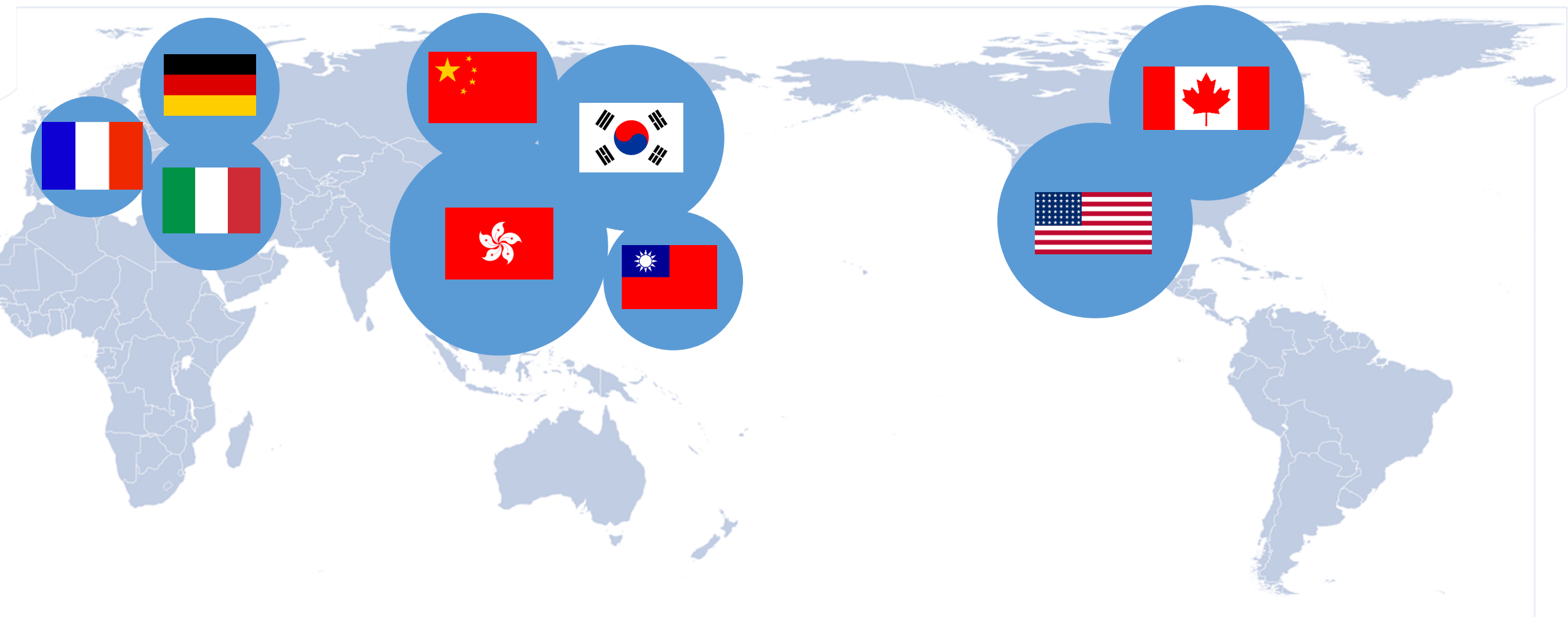
Erectile dysfunction improvement

Others



# Impossible to eat **ENOUGH** rare ginsenosides from ginsengs





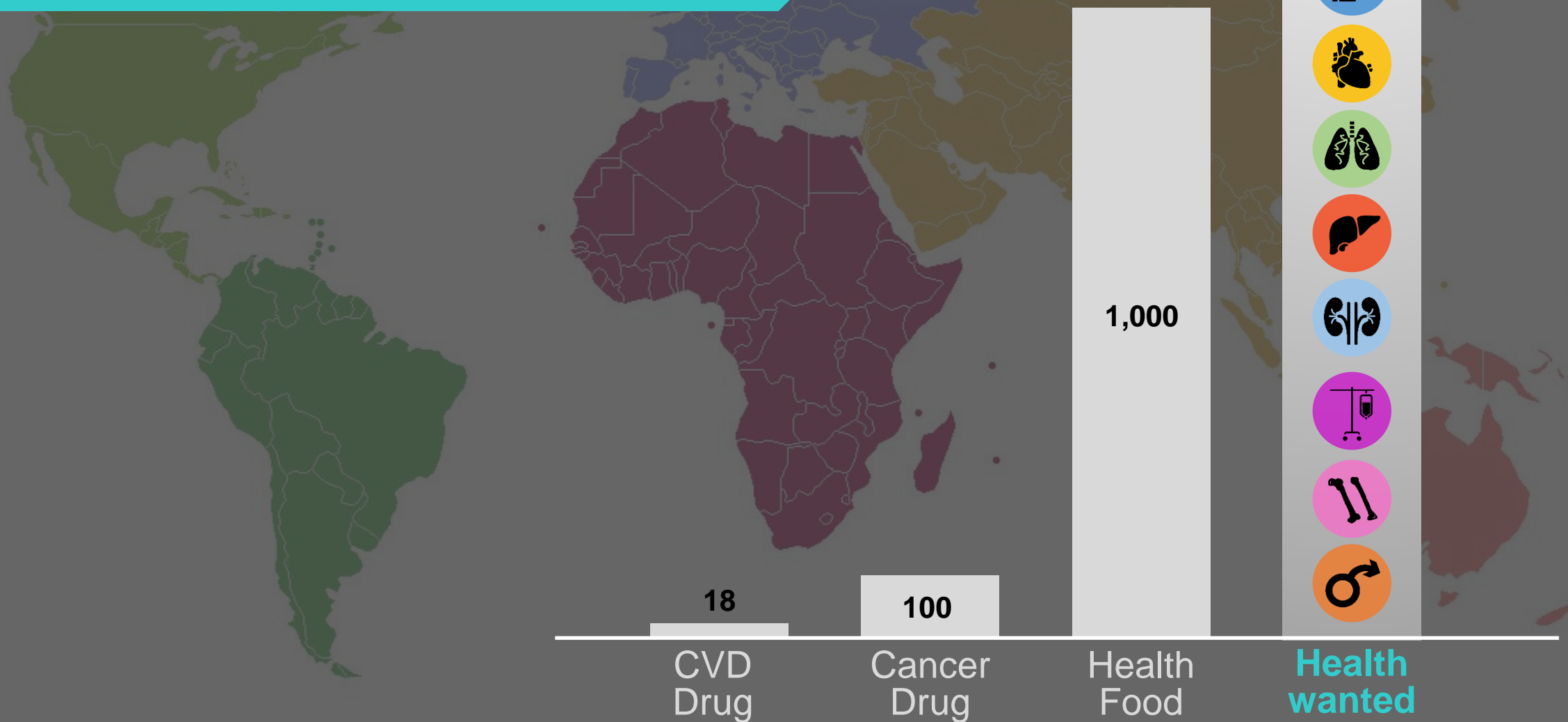
**\$ 217 million** import  
**\$ 217 million** export  
**\$ 1,130 million** distribution

# Ginseng market size

Source: *Journal of ginseng research* 37:1, 1-7 (2013)

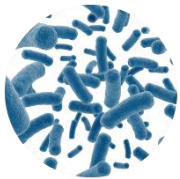
# Rare Ginsenosides market size

(billion USD/year)



- ?
- Brain
- Heart
- Lungs
- Liver
- Kidneys
- IV Drip
- Bones
- Male Symbol

# Fertilization-based method



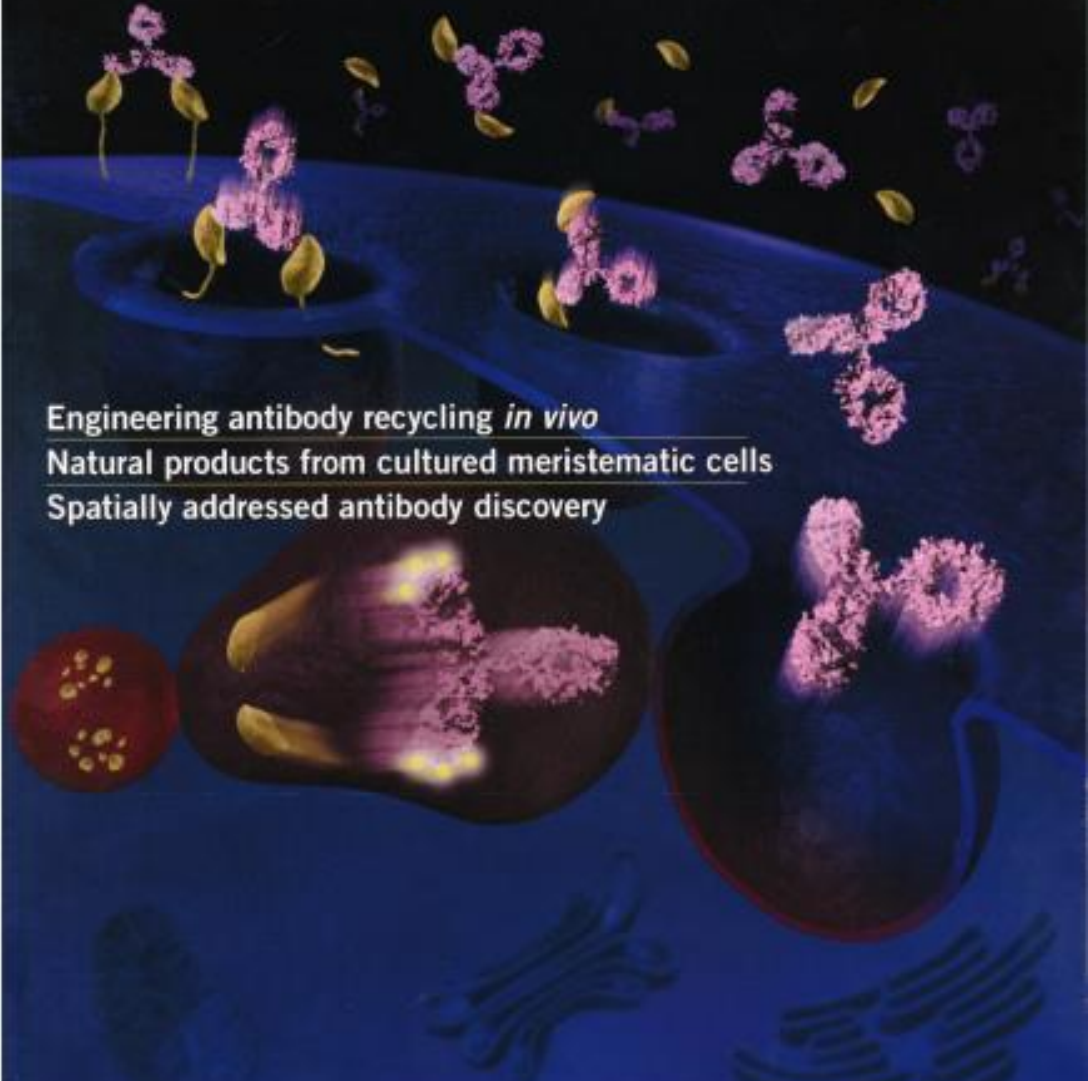
Rg3 content Increases  
**410 times**



**Our solution**



Engineering antibody recycling *in vivo*  
Natural products from cultured meristematic cells  
Spatially addressed antibody discovery



Cultured cambial meristematic cells as a source of plant natural products

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A plethora of important, chemically diverse natural products are derived from plants<sup>1</sup>. In principle, plant cell culture offers an attractive option for producing many of these compounds<sup>2,3</sup>. However, it is often not commercially viable because of

To circumvent this so-called dedifferentiation process, we developed an innately undifferentiated cell line derived from cambium cells, which function as vascular stem cells<sup>4</sup>. Also, paclitaxel biosynthesis in *T. cuspidata* is most conspicuous within the region contain-

cambial meristematic cells

morphology of CMCs, their hypersensitivity to  $\gamma$ -radiation and radiomimetic drugs and their ability to differentiate at high frequency. Suspension culture of CMCs derived from *Taxus cuspidata*, the source of the key anticancer drug, paclitaxel (Taxol)<sup>2,3</sup>, circumvented obstacles routinely associated with the commercial growth of DDCs. These cells may provide a cost-effective and environmentally friendly platform for sustainable production of a variety of important plant natural products.

cells could be gently separated from the DDCs derived from pith, cortex and epidermis (Fig. 1c–e and Supplementary Fig. 3a–e). This mass of proliferating cells was distinct from DDCs derived from a needle or embryo (Fig. 1f,g), and the morphology of these CMCs differed from adjacent cells (Fig. 1h and Supplementary Fig. 3b–e). We also used this technology to produce such cells from a variety of plant species, including ginseng (*Panax ginseng*), ginkgo (*Ginkgo biloba*) and tomato (*Solanum lycopersicon*). This suggests that the procedure has broad utility (Supplementary Fig. 4a–f).

Only plant stem cells, embedded in meristems located at the tips of shoots and roots or contained inside the vascular system, can divide and give rise to cells that ultimately undergo differentiation while simultaneously giving rise to new stem cells<sup>4</sup>. These cells can be considered immortal due to their ability to theoretically divide an unlimited number of times. Consequently, since the beginnings of tissue culture in the 1940s, cell suspension cultures have been routinely generated through what was called the dedifferentiation process<sup>5</sup>. Recent evidence suggests that this process might not entail a simple reverse reprogramming of the mechanism involved, this process results in the generation of specialized cell types within a given cell or multicellular mixture of proliferating cells<sup>6</sup>. Suspensions derived from such cellular assortments often exhibit properties with low and inconsistent yields of natural products owing to deleterious genetic and epigenetic changes during this process<sup>7,8</sup>.

Microscopic analysis of a suspension culture of *T. cuspidata* cells revealed the presence of small, abundant vacuoles within the cultured cells. This characteristic feature of CMCs<sup>11</sup> enables them to withstand the pressure generated by the expanding secondary xylem<sup>12</sup>. In contrast, dedifferentiated *T. cuspidata* cells derived from needles or embryos possessed only one large vacuole, typical of such plant cells (Fig. 11,j). The ability to differentiate into either a tracheary

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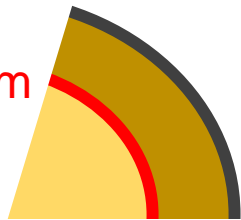
Received 24 August; accepted 27 September; published online 11 October 2010



# CMC technology platform

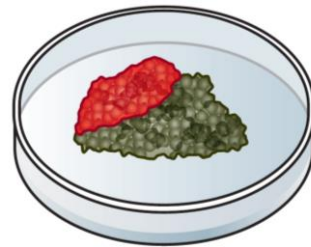
STEP  
1

Cambium



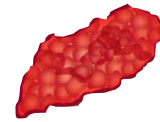
plant tissue  
section

STEP  
2



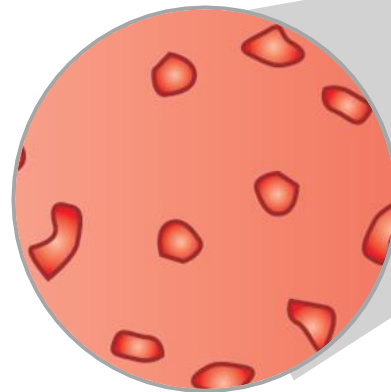
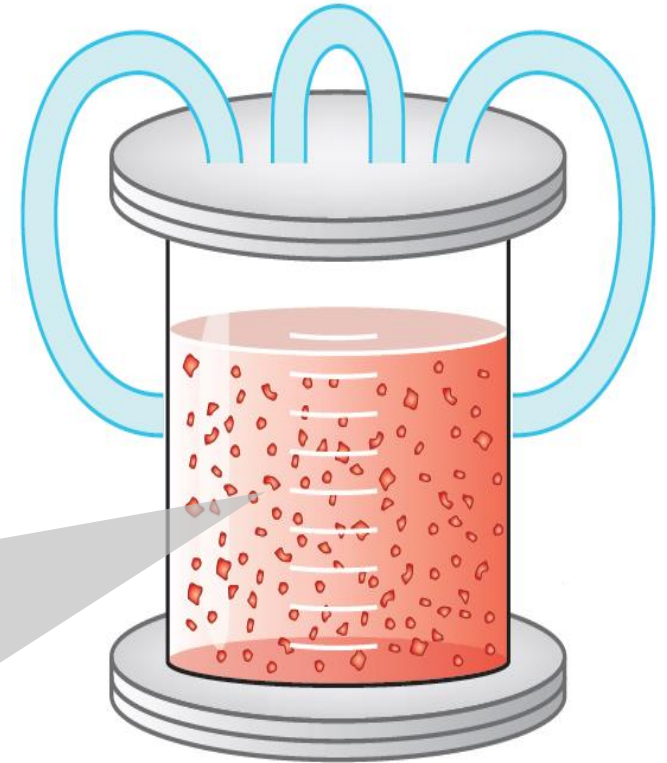
**CMCs** & callus

STEP  
3



**C**ambial  
**M**eristematic **C**ells

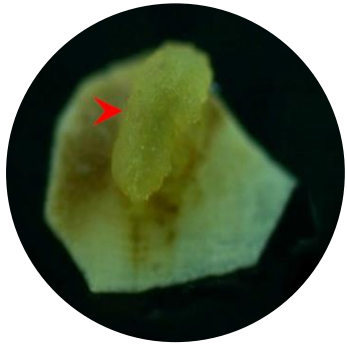
STEP  
4



**CMCs**, contain plant natural products  
**Broth**, contains plant natural products

# CMC-based method

STEP  
1



Wild ginseng  
Cambial Meristematic Cells

STEP  
2



Scale-up

STEP  
3



RGCE process

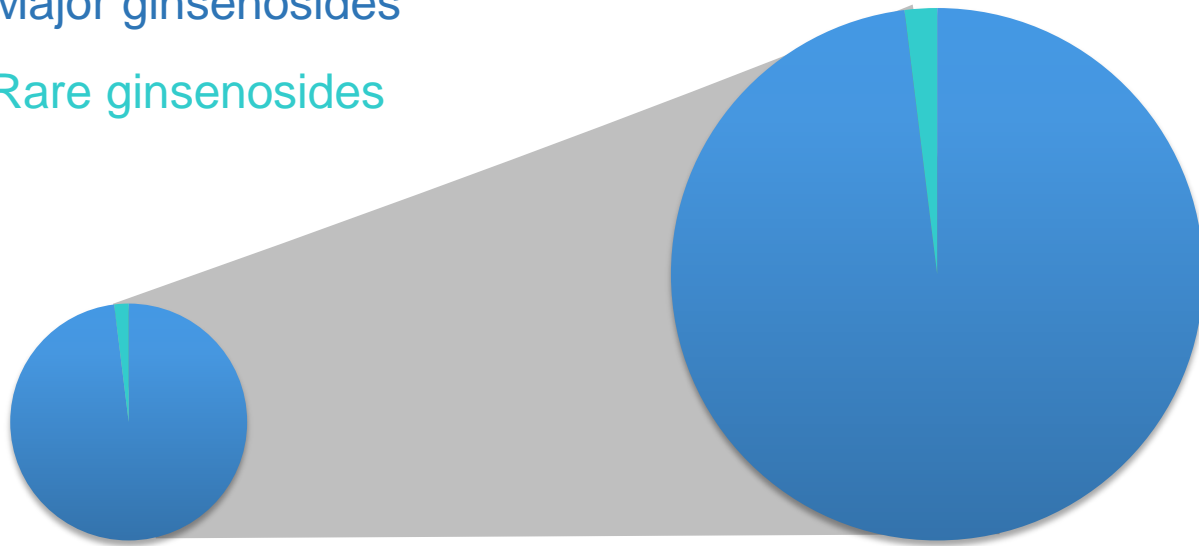
STEP  
4



Package

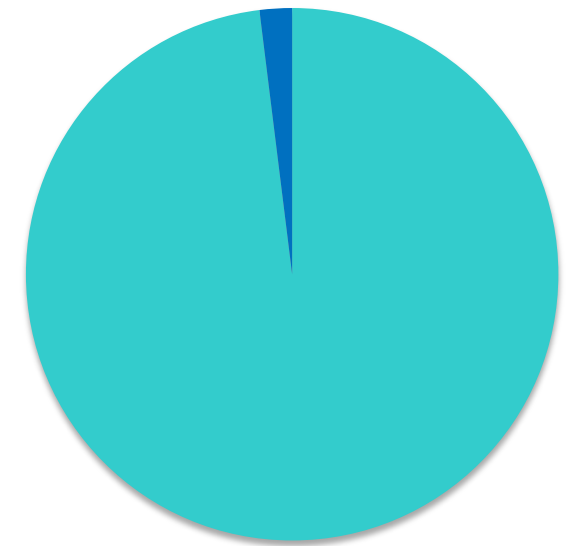
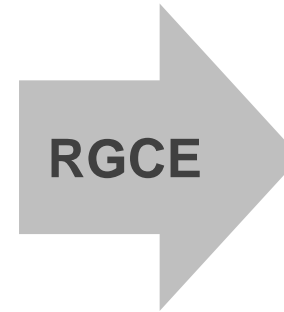
# Rare Ginsenosides Content Enrichment

- Major ginsenosides
- Rare ginsenosides



50 years old  
Wild ginseng

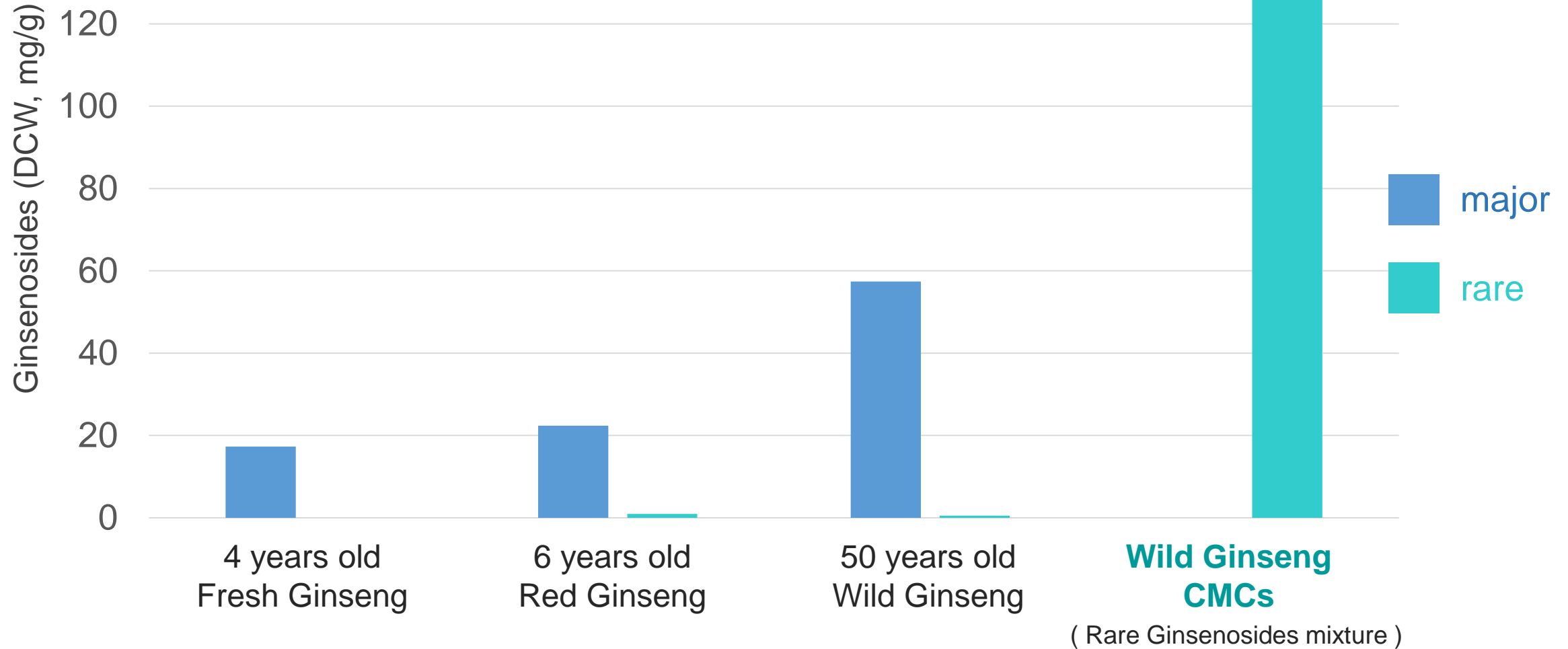
50 years old  
Wild ginseng  
**Cambial Meristematic Cells**



50 years old  
Wild ginseng  
**Cambial Meristematic Cells**

[ Renamed as  
Rare Ginsenosides mixture ]

# Material with **highest RG** content in the market



# Rare Ginsenosides mixture is



**PESTICIDES  
FREE**



**HEAVY METALS  
FREE**



**HORMONE  
FREE**



**STABLE  
SUPPLY**

# Rare Ginsenosides mixture is



**SAFE**




**EFFICIENT**



**BATCH  
CONSISTENT**

# Our achievements - patents



US 20110229443A1

(19) United States  
(12) Patent Application Publication (10) Pub. No.: US 2011/0229443 A1  
Jin et al. (41) Pub. Date: Sep. 22, 2011

(54) COMPOSITION FOR CANCER PREVENTION OR TREATMENT CONTAINING AS ACTIVE INGREDIENT PLANT STEM CELL LINE DERIVED FROM CAMBIUM OF PANAX GINSENG INCLUDING WILD GINSENG OR GINSENG

(75) Inventors: Young Woo Jin, Jeonbuk (KR);  
Eun Kyung Lee, Jeonbuk (KR)

(73) Assignee: Unkwa Corporation, Jeonju, Jeonbuk-si (KR)

(21) Appl. No.: 13/027,750

(22) PCT Filed: Nov. 6, 2009

(86) PCT No.: PCT/KR2009/006523

§ 371 (c)(1), (2), (4) Date: Jun. 10, 2011

(30) Foreign Application Priority Data  
Nov. 6, 2008 (KR) ..... 10-2008-0110086

Publication Classification

(51) Int. Cl. (2006.01)  
A61K 36/258 (2006.01)  
C12N 5/06 (2006.01)  
A61P 35/00 (2006.01)  
A61P 35/02 (2006.01)

(52) U.S. Cl. .... 42493.7; 424720; 435/410; 435/431

(57) ABSTRACT

The present invention relates to a composition for preventing or treating cancer, which contains, as an active ingredient, a *Panax ginseng* cambium-derived cell line including wild ginseng or ginseng; a lysate thereof; an extract thereof; or a culture medium thereof.

The cell line according to the present invention, a lysate thereof, an extract thereof and a culture medium thereof are derived from a natural and have minimized side effects compared to the conventional therapeutic drugs, and thus are safe for the human body. Also, they are involved directly in the growth of cancer to induce cancer cell death effectively, and show anticancer activity of inhibiting or reducing the formation of tumor or the growth of tumor. Accordingly, the cell line, the lysate thereof, the extract thereof and the culture medium thereof are useful for the prevention, treatment and alleviation of cancer.

**PATENT:** US20110229443A1

**TITLE:** Composition for **cancer prevention or treatment** containing as active ingredient plant stem cell line derived from cambium of *panax ginseng* including wild ginseng or ginseng

**PATENT:** US008617621B2

**TITLE:** Composition for **enhancing immunity** containing plant stem cell line derived from cambium of *panax ginseng* including wild ginseng or ginseng as an active ingredient

**PATENT:** US20130202631A1

**TITLE:** Composition for **preventing or treating liver diseases**, containing plant stem cell lines derived from the cambium of *panax ginseng* including mountain ginseng or ginseng as active ingredient

**PATENT:** US20140099285A1

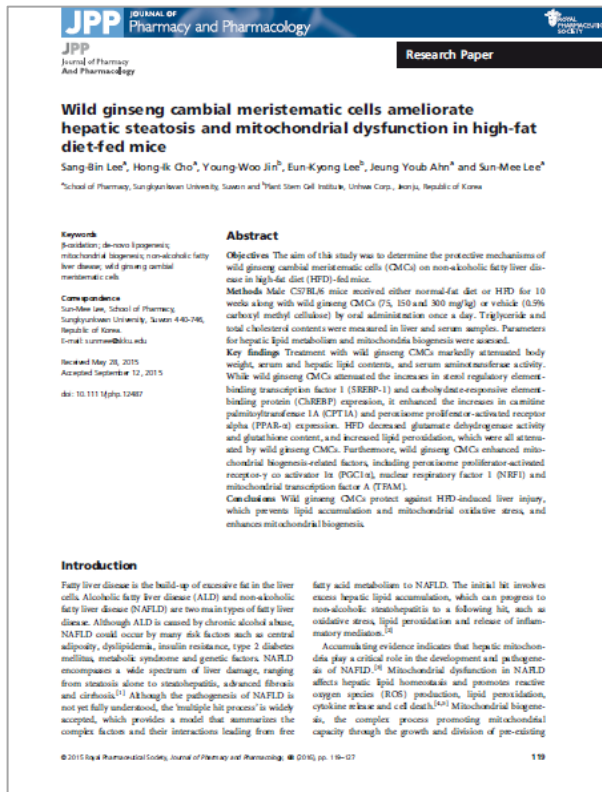
**TITLE:** Composition for **preventing or treating AIDS** containing plant stem cell line derived from cambium of *panax ginseng* including wild ginseng or ginseng as active ingredient

**PATENT:** US9095532B2

**TITLE:** Composition for **anti-aging or anti-oxidant composition** containing plant stem cell line derived from cambium of *panax ginseng* including wild ginseng or ginseng as active ingredient



# Our achievements - publication



**JOURNAL:** *Life sciences* 135(2015) 138-146

**TITLE:** Potentiation of **natural killer (NK) cell** activity by methanol extract of cultured cambial meristematic cells of wild ginseng and its mechanism.

**JOURNAL:** *Journal of ginseng research* 39(2015) 376-383

**TITLE:** Protective effect of wild ginseng cambial meristematic cells on D-galactosamine-induced **hepatotoxicity** in rats

**JOURNAL:** *Journal of pharmacy and pharmacology* 68(2016) 119-127

**TITLE:** Wild ginseng cambial meristematic cells ameliorate **hepatic steatosis** and mitochondrial dysfunction in high-fat diet-fed mice

# Claims



**Immunity** improvement



**Cardiovascular** protection



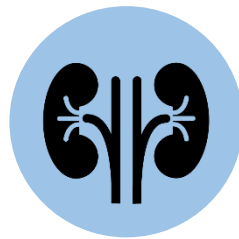
**Hepatic** protection



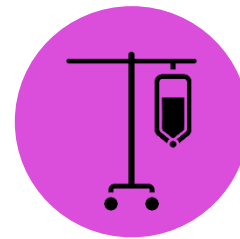
Neural  
protection



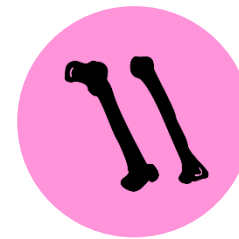
Lung  
protection



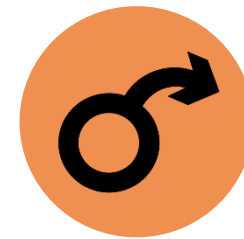
Renal  
protection



Cancer therapy  
helper



Anti-  
osteoporosis



Erectile dysfunction  
improvement



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