The Science of Telomerase Activation

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Telomeres are the caps at the end of each strand of DNA that protect it, like the plastic tips at the end of shoelaces. They affect how cells age and are essential for maintaining cell integrity.

Telomeres shorten each time a cell divides, which, over time, leaves the genetic DNA unprotected and causes cellular function to be compromised — like a shoelace that loses its plastic end cap and becomes frayed.

**Telomere** – A compound structure of unique DNA repeats (TTAGGG) that acts as a protective cap at the end of each strand of DNA. Shortens over time due to aging and lifestyle factors (poor nutrition, psychological stress, lack of exercise, etc.), leaving the DNA that makes up our genes vulnerable to damage.

**Telomerase** – An enzyme made only inside cells that is responsible for telomere growth. Telomerase stabilizes telomere length by adding DNA repeats (nucleotides) onto the telomeric ends of the chromosomes.

**TA-65®** – A patented, all natural plant-derived compound that animal and *in vitro* studies have indicated may help maintain or rebuild critically short telomeres by activating telomerase.

**TA-65MD® Nutritional Supplements** – the first in a line of products based on the TA-65® compound that *in vitro*, animal, and human studies indicate specifically target Telomerase Activation.

**Hayflick Limit** – A scientific theorem which explains that cells have a finite ability to divide. Cells stop replicating and no longer function properly when they reach the Hayflick Limit. Named for Leonard Hayflick, Ph.D., who determined this limit to be about 50 divisions.
Nobel Prize Winning Research Uncovers a Root Cause of Aging: Telomere Shortening

In the 1980s scientists studying telomeres (caps at the end of each strand of DNA) discovered telomerase (the enzyme that maintains telomere length). The research of these scientists revolutionized our understanding of cellular aging. This pioneering research was so important that the Nobel Prize in Physiology/Medicine was awarded in October 2009 for the discovery of how chromosomes are protected by telomeres and the enzyme telomerase.

In early genetic research, nucleotide molecules found at the ends of the chromosomes were regarded as non-functioning "garbage DNA." We now know that’s hardly the case. Shortening of these DNA sequences, called telomeres, acts as an aging clock and explains the Hayflick Limit — the number of times cells can divide before becoming non-functioning (senescent) or dying (apoptosis).

Effects of Telomere Shortening

There are now more than 10,000 published studies on telomeres. Some important findings include:

- Key scientists now believe that short telomeres are a root cause of cellular aging.
- Apoptosis or cellular senescence is triggered when too many critically short or "uncapped" telomeres accumulate in a cell.¹
- Named by Nobel Prize laureate Elizabeth Blackburn, "Telomere Syndromes" refers to a whole class of problems associated with cellular aging caused by short telomeres.²

Telomeres act as a clock within our cells, representing their age and how well they function. As they shorten, they signal changes in gene expression, changing the cell’s phenotype to that of an older cell. When enough telomeres become critically short the cell may become senescent or die. Senescent cells can crowd out healthy ones and damage neighboring cells and tissues.

Telomere Shortening: The Body’s Cellular Aging Clock

Telomeres protect chromosomes. Over time, repeated cellular replication results in shortening of the telomere end caps. Eventually this leaves the genetic DNA on the chromosomes vulnerable to damage and mutations. In response to telomere shortening, cells are programmed to take one of two paths:

**Apoptosis** – programmed cell death; the cell naturally self-destructs.

**Senescence** – a state where the cell can no longer replicate. Not only does it no longer function properly, it excretes inflammatory cytokines that damage other cells. Generally, apoptosis is better than senescence. The body disposes of dead cells, but senescent cells are still alive, crowding out healthy ones and damaging neighboring cells and tissue.

Both apoptosis and senescence can result in poor cellular function. Compromised cellular function begins to occur before the telomeres are critically short. Think of shortening telomeres as the cellular aging clock; their decreasing length is a countdown to natural cellular death.

Shortening telomeres signal changes in gene expression to an older phenotype. Telomerase Activation can maintain telomere length — and slow down the speed of that cellular aging clock.

**It Only Takes One Weak Link in the Chain**

There are 23 pairs of chromosomes in each cell — that’s 46 DNA strands. Telomeres are located at both ends of these DNA strands. This means there are 92 telomere end caps in every cell. It only takes one critically short telomere to affect the function of that cell. Think of a chain with 91 strong links and only one weak link. It only takes that one weak link to break the chain.
Telomeres can be lengthened.

The body has its own mechanism to protect telomere length: the enzyme telomerase. Telomerase is an enzyme that adds nucleotides to telomeres, extending these DNA end caps, and thereby extending the Hayflick Limit. In germ (reproductive) cells, a protein-coding gene that activates telomerase, Telomerase Reverse Transcriptase (TERT), is permanently switched on. Stem cells and some rapidly dividing cells also have telomerase, but, unlike germ cells, the gene is not turned on permanently and the amount of telomerase declines with age. The vast majority of somatic (body) cells have the TERT gene turned off. As cells lose their ability to make enough telomerase, they cannot replenish worn out cells.

In vitro and animal studies have shown that activating telomerase can increase the length of the shortest telomeres.

T.A. Sciences® has conducted developmental testing on the TA-65® compound for over a decade. TA-65® is a patented, all natural plant-derived compound that animal and in vitro studies have suggested may help maintain or rebuild critically short telomeres through Telomerase Activation.*

In addition, independent researchers have provided dozens of foundational animal and in vitro studies supporting its mechanism of action. Please visit www.tasciences.com for more information on published and unpublished scientific studies.

TA-65MD® nutritional supplements are the first research-based products that in vitro, animal, and human studies indicate specifically target Telomerase Activation. The TA-65MD® formulation is several times more bioavailable than the plant extract itself, which helps ensure that TA-65® is not destroyed during the digestion process when taken orally. No other supplement utilizes this proprietary technology.

As telomere length is only one of the root causes of aging, TA-65MD® should be taken as part of an overall health and wellness regimen.

TA65MD® nutritional supplements are offered in three strength options. The 100 unit, 30 count bottle is the lowest price option. The 250 unit, 90 count is the most popular. The latest addition to the product line is a 500 unit, 60 count tablet. While individual customers dosing should be determined by the customer’s physician, consumers typically take between 250 - 1000 units daily.

*Protected by numerous U.S. and international patents and patents pending. U.S. patent # 7,846,904.
Life Span of Normal Human Cells Extended by the Introduction of Telomerase

This 1998 foundational study in Telomere Biology showed that telomere shortening is the molecular clock that triggers senescence. Two telomerase-negative normal human cell types, retinal pigment epithelial cells and foreskin fibroblasts, were transfected with vectors encoding the human telomerase catalytic subunit. In contrast to telomerase-negative control clones, which exhibited telomere shortening and senescence, the telomerase-expressing clones had elongated telomeres, divided vigorously, and showed reduced straining for beta-galactosidase, a biomarker of senescence.


The First Documented Age Reversal in a Mammal: Harvard University Study shows Telomerase Activation Helps Reverse the Signs of Aging in Mice.

According to a study published in the January 2011 issue of Nature journal, premature aging in mice can be reversed by reactivating telomerase, the enzyme that lengthens telomeres. Researchers studied mice that were artificially aged by switching off the telomerase enzyme. The mice experienced changes in reproductive health, grey hair, changes in skin health, and other age related signs. However, when the telomerase enzyme was switched back on, researchers saw a dramatic reversal in the signs and symptoms of aging. Benefits included increased brain size, improved cognition, restoration of hair to a healthy sheen, improved reproductive health, and better organ health (spleen, liver, intestines).


Telomere Length: Epidemiological Study Tracks 100,000 People

In the largest and most diverse epidemiological study of aging to date, telomere length is being analyzed as a marker for age-related conditions. This genomic project, Genetic Epidemiology Research on Adult Health and Aging (GERA), aims to increase understanding of the genetic basis for a host of age related signs. Funded by the National Institutes of Health, the project includes a wide scale genotyping project incorporating longitudinal clinical and health data. Adjustments were made for demographic and behavioral factors that influence telomere length (age, sex, race, education, physical activity, BMI, smoking and alcohol consumption). Because of its relationship to aging, telomere length was considered an important biomarker.

Automated assay of telomere length measurement and informatics for 100,000 subjects in the Genetic Epidemiology Research on Adult Health and Aging (GERA) Cohort. Kyle Lapham, Mark N Kvale, Jue Lin et al. Genetics: Early Online, 2015 January;19 as 10.1534/genetics.115.178624

"If you look at all those data together, you walk away with the idea that the loss of telomerase could be a very important instigator of the aging process,” according to Harvard professor Dr. Ronald DePinho.
Published Research on TA-65®: A Selected Bibliography


This one year human study showed improvements in telomere length for people taking TA-65® capsules.

The group taking TA-65® capsules showed improvement in the following biomarkers of aging:
- Decreased percentage of short telomeres
- Reduced percentage of non-functioning senescent cytotoxic T cells


This animal study looked at the effects of TA-65® and confirmed its mechanism of action.


TA-65® increases Telomerase Activity.


This follow up human study tracked changes in metabolic markers.

The group taking TA-65® capsules showed improvement in the following biomarkers of aging:
- Reduction in fasting blood glucose and improvement in insulin sensitivity
- Reduction in total and LDL cholesterol
- Reduction in systolic and diastolic blood pressure
- Reduction in homocysteine, a key marker of inflammation
- Increase in bone mineral density

Experimental increase in telomere length leads to faster feather regeneration. Reichert S, Bize P, Arrive M, Zahn S, Massemin S, Criscuolo F. Exp Gerontol. 2014 April;52:36-8

This animal study looked at the effect of TA-65® on the telomere length and feather regeneration versus a control group.

For more information about these and other studies, visit www.tasciences.com

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TA-65® Safety and Efficacy Studies

T.A. Sciences® is committed to thorough testing to ensure product safety and efficacy. As the leader in telomere biology, the company has several clinical trials currently underway. The latest updates on our studies are available on www.tasciences.com.

TA-65® Pharmacokinetic Profile

This graph shows the relative blood plasma concentration of TA-65® versus post-dosing time in human subjects after oral dosing of TA-65MD®. It demonstrates that TA-65® is absorbed and circulates in the blood for about 12 hours. Orally consumed supplements must be absorbed into the bloodstream to convey effects in the body.

This limit of roughly 12 hours in the bloodstream is important because permanent Telomerase Activation in somatic cells is associated with unhealthy cell growth. Thousands of people take TA-65MD® nutritional supplements and there have been no serious adverse effects reported.

TA-65® Generally Recognized as Safe (GRAS)

An independent expert panel has determined TA-65® to be Generally Recognized as Safe (GRAS) for use in a medical food. T.A. Sciences® provided extensive animal and human clinical data to support the status of Generally Recognized as Safe. A medical food is formulated to be consumed or administered enterally under the supervision of a physician and is intended for the specific dietary management of a disease or condition for which distinctive nutritional requirements, based on recognized scientific principles, are established by medical evaluation.

125-Person Study Demonstrates TA-65® Safety and Efficacy

An independent lab studied 125 human subjects for 30 days to measure the safety and efficacy of TA-65MD® nutritional supplements. There were no drop outs and no reported adverse events. Statistically significant improvements were seen in immune, inflammatory, cardiovascular, and stress biomarkers.
What are telomeres?

Telomeres are parts of our chromosomes that affect how cells age. Like the plastic tips at the end of shoelaces, telomeres are caps at the end of each strand of DNA that protect it and allow cells to function and reproduce properly. Telomeres shorten each time a cell divides, which, over time, leaves genetic DNA unprotected and causes cellular function to be compromised — ultimately leading to cell apoptosis (death) or senescence.

Every organ in the body (skin, liver, heart, etc.) is made up of cells, so telomeres are vital to good health. Slowing or stopping the shortening of telomeres can slow cellular aging.

How do short telomeres impact your cellular health?

The length of a person’s telomeres is a good indicator of their cellular health status. Having short telomeres can accelerate the natural aging process on a cellular level. Some cells, like those found in the skin and immune system, are most affected by telomere shortening because they reproduce more often.

Telomerase Reverse Transcriptase

The body has its own mechanism to protect telomere length; the enzyme telomerase which is activated by a protein-coding gene Telomerase Reverse Transcriptase (TERT). Telomerase is an enzyme that adds nucleotides to telomeres, extending these DNA end caps. As cells lose their ability to make enough telomerase, they cannot replenish worn out cells.

TA-65® is a patented, all natural plant-derived compound that is designed to help maintain or rebuild critically short telomeres by activating telomerase. TA-65MD® nutritional supplements are the first research-based products that in vitro, animal, and human studies indicate specifically target Telomerase Activation.

What is the science behind TA-65® products?

Based on in vitro and animal studies, the TA-65® compound is a Telomerase Activator. Telomerase is the enzyme known for its ability to lengthen telomeres. Telomeres and telomerase have been studied extensively; there are more than 10,000 published scientific articles on the emerging science of Telomere Biology. McClintock observed the importance of telomeres in protecting chromosomes during the 1930s. In the early 1960s, Hayflick noted the phenomenon of cellular aging. Olonikov linked telomere length to cell replication ability in the 1970s. Cooke and Smith connected telomere length to cellular aging as early as 1986. And in 2009, the Nobel Prize for Physiology/Medicine was awarded to three scientists who discovered telomerase, the enzyme that in vitro and animal studies indicate that TA-65® activates. Published and unpublished scientific studies on TA-65® can be found at www.tasciences.com.
What is the primary ingredient in TA-65MD® nutritional supplements?
The primary ingredient in TA-65MD® nutritional supplements is a patented, all-natural plant-derived compound.

After more than a decade of research and development, T.A. Sciences®, in collaboration with experts around the world, has perfected exclusive methods to extract and enhance the bioavailability of this naturally-occurring molecule.

How do TA-65MD® nutritional supplements compare to other products or approaches?
T.A. Sciences® is recognized as a leader in the field of Telomere Biology. Many other companies have attempted to duplicate our patent-protected technology, but none of these companies have been able to prove they activate telomerase, much less improve cellular health.

The TA-65MD® formulation is several times more bioavailable than the plant extract itself. No other supplement utilizes this proprietary technology.

How does T.A. Sciences® assure the quality of its products?
T.A. Sciences® is committed to ensuring the highest quality products from end-to-end of the supply chain. This dedication to quality entails a rigorous testing and analysis program across all phases of supply and production, from start to finish.

The TA-65® compound is blended with United States Pharmacopeia (USP) grade products to ensure consistency, and produced according to Good Manufacturing Practices (GMP) for Dietary Supplements, in state-of-the-art facilities.

How do you know that TA-65MD® is safe?
TA-65MD® contains a blend of natural ingredients with an excellent safety profile. No other company can offer the depth and breadth of research on the science of Telomerase Activation.

An independent expert panel has determined TA-65® to be Generally Recognized as Safe (GRAS) for use in a medical food under the provisions of the Federal Food, Drug and Cosmetic Act, administered by the United States Food and Drug Administration (FDA). T.A. Sciences® provided extensive animal and human clinical data to support the status of Generally Recognized as Safe.

These supplements have been on the market since 2007 and there have been no reportable adverse events. All senior executives at T.A. Sciences® personally take TA-65MD® nutritional supplements.

Please visit www.tasciences.com for more information on TA-65MD® scientific studies.

Are there any allergens in these products?
TA-65MD® nutritional supplements do not contain dairy, eggs, nuts, gluten, corn, soy, wheat, sugar, starch, salt, preservatives, artificial color, flavor, or fragrances.

These materials have not been reviewed by the U.S. Food and Drug Administration (FDA). This product is not intended to diagnose, treat, cure or prevent any disease. These materials are for physician education purposes only. Not for consumer distribution. www.tasciences.com