To what extent are exogenous antioxidants beneficial for human health?

BY Xinyao Zhong

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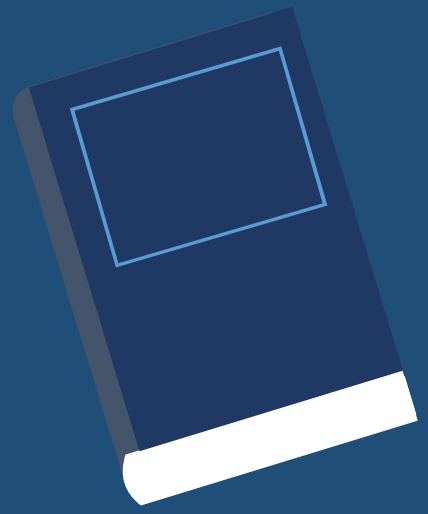
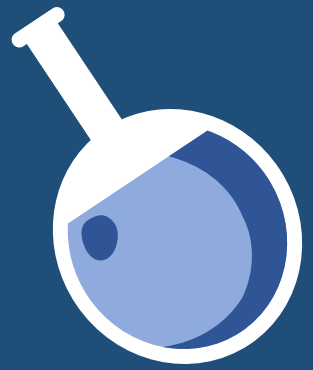
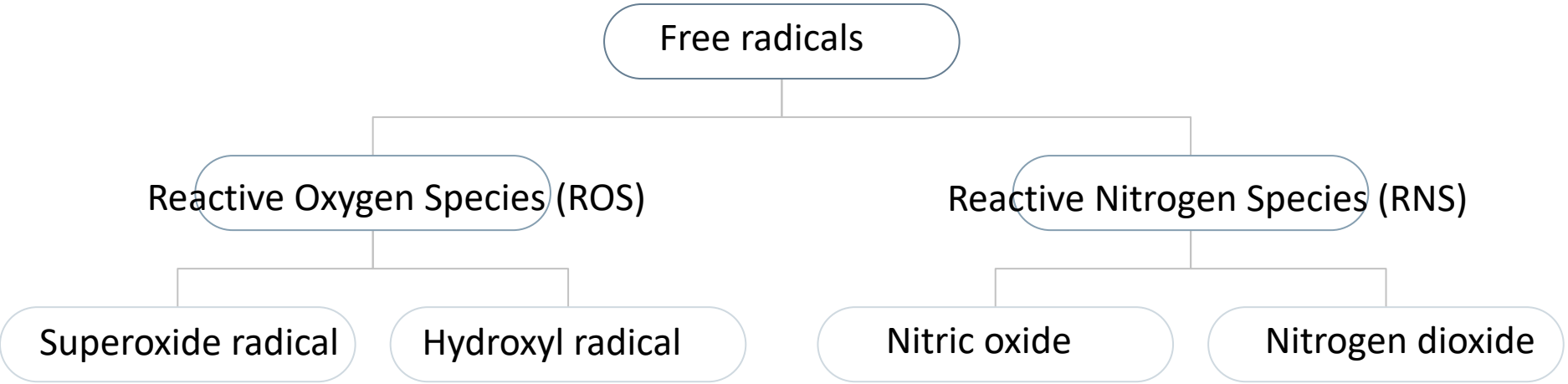


Introduction



KEY TERMS

- **Antioxidants:** substances that stabilise free radicals, thus preventing or slowing down damage to cells caused by free radicals.
- **Free radicals:** unstable and short-lived atoms or molecules with unpaired valence electrons produced in the body that can collide with and oxidise cells and tissues, thus causing damage.



- **Oxidative stress:** imbalance between the amount of free radicals and antioxidants due to presence of excess ROS.

Effects of free radicals

- At low/moderate concentration, free radicals play an important role in normal physiological functions (cellular signalling, gene expression, regulation of immune responses)
- At high concentrations, free radicals cause undesirable effects (oxidative stress):

-Lipid peroxidation: contribute to atherosclerosis and cancer

-DNA oxidation: contribute to cancer

-Inactivation of proteins

- Diseases associate with oxidative stress: cardiovascular disease (CVD), cancer, neurodegenerative diseases etc.

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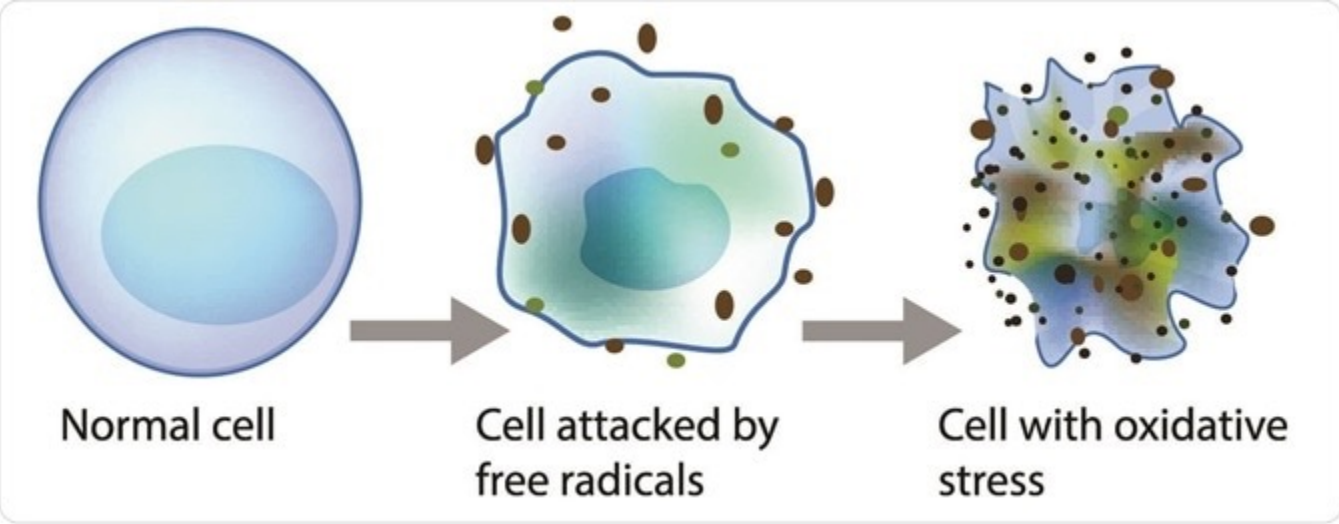


Classification of antioxidants

Endogenous antioxidants

•Endogenous antioxidants are antioxidants that are made by our bodies.

Examples-catalase, glutathione, uric acid

Exogenous antioxidants

•Exogenous antioxidants are antioxidants that are obtained through diet.

Examples-vitamin C, vitamin E, carotenoids

Mechanisms of exogenous antioxidants

- ✓ Donate electrons/ Transfer hydrogen atoms to free radicals
- ✓ Block the action of some enzymes involved in the production of free radicals
- ✓ Combine with free radicals to form a more stable molecule
- ✓ Examples of exogenous antioxidants: vitamin C, vitamin E, carotenoids, phenolic compounds

Sources of exogenous antioxidants

- **Natural Sources:**
- Fresh fruits and vegetables (eg. Pumpkin, carrots, grapes)
- Red wine
- Tea
- Nuts
- Seafood

- **Supplements:** concentrated forms of natural antioxidants.
- At high concentrations, antioxidants can become pro-oxidants and increase ROS production, which contributes to oxidative-induced diseases
- As age increases, endogenous antioxidant production declines so exogenous antioxidant intake should increase to maintain the balance between concentrations of antioxidants and free radicals so older people can consider supplemntation

Background & Rationale to the project

Reasons for investigation

- ✓ Personal interest
- ✓ Related to future studies
- ✓ Personal experience
- Friends and family taking antioxidant supplements
- Curious to know if antioxidants are as beneficial for health as they are portrayed to be
- ✓ Importance of the topic
- Potential of antioxidants to promote cell longevity and improve life expectancy

Plan of the project

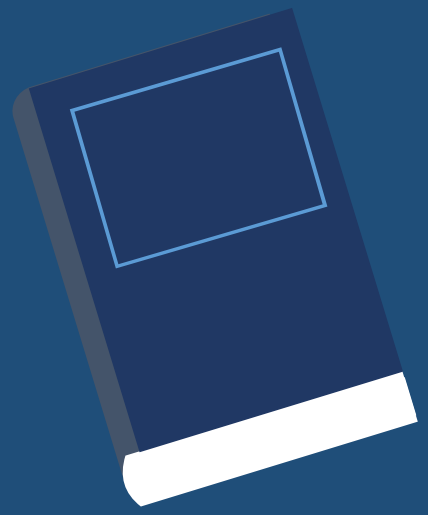
- Main rationale: to find out the effects of exogenous antioxidants on human health
- Definition of health: a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.
- For the purpose of this project, I will leave out the social aspect of health and only discuss the effects of exogenous antioxidants on physical and mental health
- Effects on physical health can be further measured by:

- Ability in disease prevention/treatment – Cardiovascular disease (CVD), Cancer, Type II Diabetes Mellitus (T2DM)
- Presence of adverse effects

- Mental health can be further measured by:

- Ability to prevent/improve symptoms of common mood disorders like depression

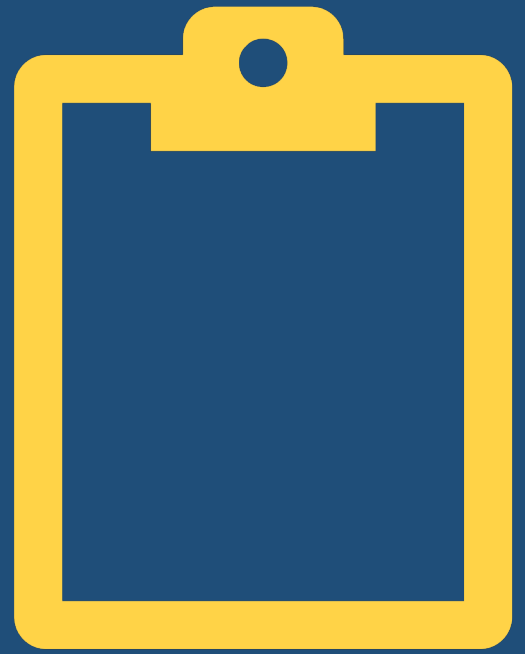
Main findings



Types of studies

In vitro vs In vivo studies

- The adjective “In vitro” has a Latin origin which means “in glass” and it describes medical experiments and tests that are conducted in a controlled environment such as test tubes or petri dishes
- “In vivo” which means “within the living” in Latin, refers to tests or clinical trials that are conducted in living organisms. The results represent how things work in a real living organism



Types of in vivo studies

- Observational studies (eg. Cohort studies and case-control studies), which are “a type of study in which individuals are observed or certain outcomes are measured. No attempt is made to affect the outcome.”
- Randomised controlled trials (RCTs). They involve randomly assigning a group of similar participants into two groups (experimental/treatment and control/placebo)
- RCTs are more reliable than observational studies and is able to establish a causal relationship between the independent and dependent variables

Physical Health

Disease Prevention

- **Cardiovascular disease (CVD):**
  - Natural antioxidants, vitamin C and E, in particular, are effective to reduce the risk of developing CVD
  - Supplementary antioxidants are not associated with reduced risk of CVD
- **Cancer:**
  - Results highly variable
  - The effect of both natural and supplementary antioxidants on cancer is unclear
- **Type II diabetes mellitus (T2DM):**
  - Both natural and supplementary antioxidants are found to be effective in preventing T2DM
- **Overall:**
  - it can be concluded that natural antioxidants are effective in preventing age-related diseases, while the effect of supplementary antioxidants needs to be assessed by more RCTs to see if long-term supplementation is appropriate.

Adverse effect

- Adverse effect of antioxidants arises mainly when the concentration of antioxidants in the body are too high
- **High concentrations of antioxidants can:**

- Prevent free radicals from performing their normal physiological functions (eg. Helping white blood cells to fight off pathogens)
- Lead to pro-oxidant activities, which is when antioxidants promote the generation of free radicals rather than stabilizing them
  - Long-term supplementation increases the concentration of antioxidants in the body very rapidly
  - **Overall:**
  - Benefits of antioxidants still outweigh their adverse effects
  - As long as the dose of intake is controlled to maintain the balance between antioxidant and free radical concentrations

Mental Health

Mental Health

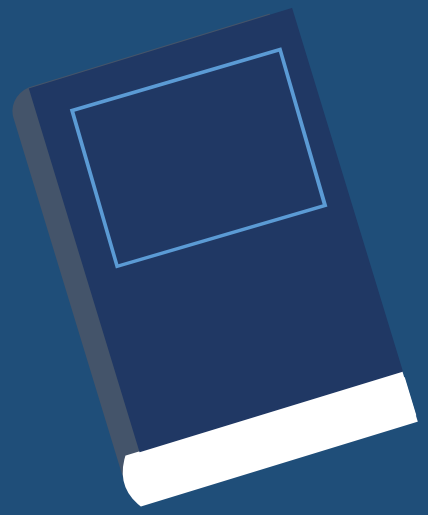
- Natural antioxidants - an inverse relationship found between fruit and vegetable intake and the risk of depression
- Supplementary antioxidants - are effective in reducing symptoms of generalized anxiety disorder and depression
- Overall: both natural and supplementary antioxidants are beneficial for mental health

Main Conclusion

Main Conclusion

- To a larger extent, exogenous antioxidants are beneficial for health
- They generally play a preventive role in age-related diseases and mood disorders
- Although there can be some undesirable side effects when the intake dose is large, they are still essential for maintaining health both physiologically and mentally, as long as the dose is moderate

Project Evaluation



Validity of conclusion

- Overall, my conclusion is valid since it is supported by the evidence and it is reached after considering the effects of antioxidants on multiple aspects of health
- However, there are still some limitations that can decrease its validity:

- some studies used to draw the conclusion are of low quality
- some studies are conducted on a particular population
- I only used observational studies to assess the effect of natural antioxidants on human health

Ideas for further work

- Can discuss about the effects of antioxidants on social well-being because it is indirectly affected
- Can extend the topic to a more social aspect such as how people's socioeconomic status affects their availability of antioxidants
- Can gather primary data such as interviewing an expert in the field

Problems encountered & Skills gains

- Problems encountered:
- found it challenging to understand many journal articles written by professionals→had to search for the meaning of difficult terms
- too much information on antioxidants and free radicals→had to be selective
- Struggled to structure my dissertation→decided to follow a thematic structure
- Skills gained:
- Gained more knowledge about the topic
- Better research skill
- Improved critical thinking
- Better time management

Thanks for your attention!

Any questions?