The incorporation of antioxidants to prevent and treat chronic diseases: understanding their effects from a nutrigenomic perspective

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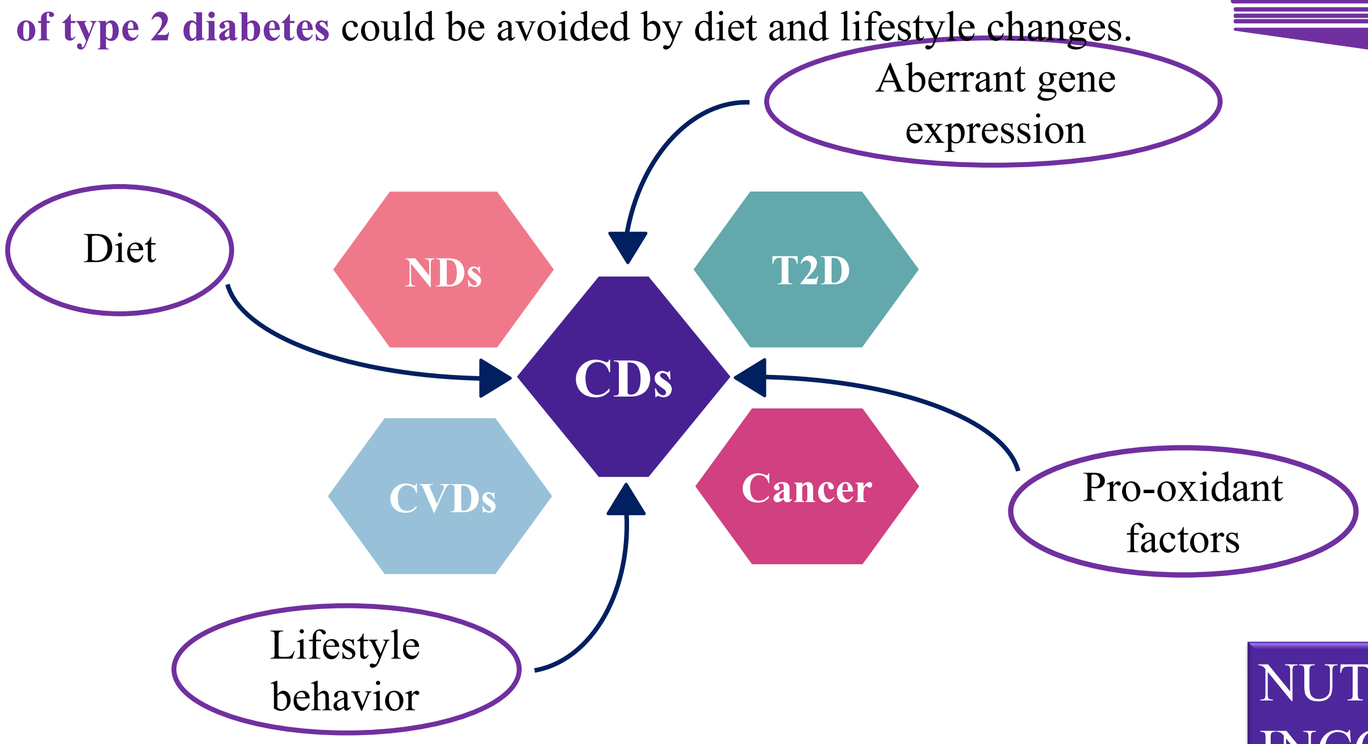
INTRODUCTION & AIM

In contemporary society, one of the most pressing concerns is the prevention and treatment of **chronic diseases** (CDs).

Despite their high prevalence, epidemiological studies indicate that **30% of cancers**, **80% of cardiovascular diseases**, and **90% of type 2 diabetes** could be avoided by diet and lifestyle changes.



ANTIOXIDANT COMPOUNDS TO MODULATE CDs

Table 1. Compilation of studies unveiling antioxidant properties of compounds modulating chronic diseases.

Antioxidant compound	Source	Study type	Sample	Chronic disease	Dose	Time	Results	Ref.
Lycopene	Tomato	Randomized controlled trial	n=36	CVD	7 mg/day	2 months	Improves endothelial function on optimal secondary prevention in CVD patients.	[1]
Allicin	Garlic	*in vitro* *in vivo*	Neonatal rat cardiac myocytes and fibroblasts Adult male C57/B6 mice	CVD	0.1-10 µM	48 hours 120 min	Inhibition of cardiac hypertrophy and block of excess ROS production	[2]
Anthocyanins	Blueberry and strawberry	Prospective study	n=87242 women (NHS II) n=46672 women (NHS I) n=23043 men (HPFS)	Hypertension	12-15 mg/day	4 years	Anthocyanins may contribute to the prevention of hypertension.	[3]
Curcumin	Turmeric	Randomized trial	n=20	Obesity	500mg/day 750mg/day	12 weeks	Lower LDL and lipid peroxidation levels, lower oxidized LDL, and protein levels. Lower protein oxidation.	[4]
Quercetin Epicatechin	NS NS	Randomized trial	n=37	Prehypertension patients	160mg/day 100mg/day	4 weeks	It may contribute to the cardioprotective effects of tea possibly by improving endothelial function and reducing inflammation. It may contribute to the cardioprotective effects of cocoa and tea through improvements in endothelial function.	[5]

Abbreviations: *CVD: cardiovascular diseases; NHS: Nurses' Health Study; HPFS: Health Professionals Follow-up Study; NS: not specified.*

CONCLUSIONS

The ingestion of **antioxidant compounds**, present in several food matrices, **modulate gene involved in the development of these CDs**. Therefore, understanding these **gene changes** can be useful for the **prevention of CD** by designing **personalized dietary interventions**.

ACKNOWLEDGEMENTS

The research leading to these results was supported by MICIU/AEI/10.13039/501100011033 supporting the predoctoral industrial grant for A. Perez-Vazquez (DIN2024-013416) in collaboration with Mercantia Desarrollos Alimentarios S.L; by Xunta de Galicia for supporting the post-doctoral grant of A.G. Pereira (IN606B-2024/011), and the pre-doctoral grant of P. Barciela (ED481A-2024-230). The authors are grateful to the National funding by FCT, Foundation for Science and Technology, through the individual research grants of A.O.S. Jorge (2023.00981.BD). Funding for open access charge: Universidade de Vigo/CISUG.

Prolonged exposure to elevated levels of **pro-oxidant factors** has been linked to **functional impairments in enzymes** and **cellular structures**, which in turn lead to **aberrant gene expression**.

1. The integration of **antioxidant compounds** into the diet has been proposed as a **preventive strategy** to mitigate oxidative stress and thereby **reduce the incidence of CDs**.

2. Implementing **dietary interventions** is expected **to reverse the oxidative imbalance** that favors the development of these diseases by combining a **preventive dietary approach** with **therapeutic intervention**, being nutrigenomics a key tool by determining the influence on gene expression.

NUTRIGENOMICS TO PREVENT CDs INCORPORATING ANTIOXIDANT COMPOUNDS

Figure 1. Nutrigenomic general approach as a preventive tool in CD.

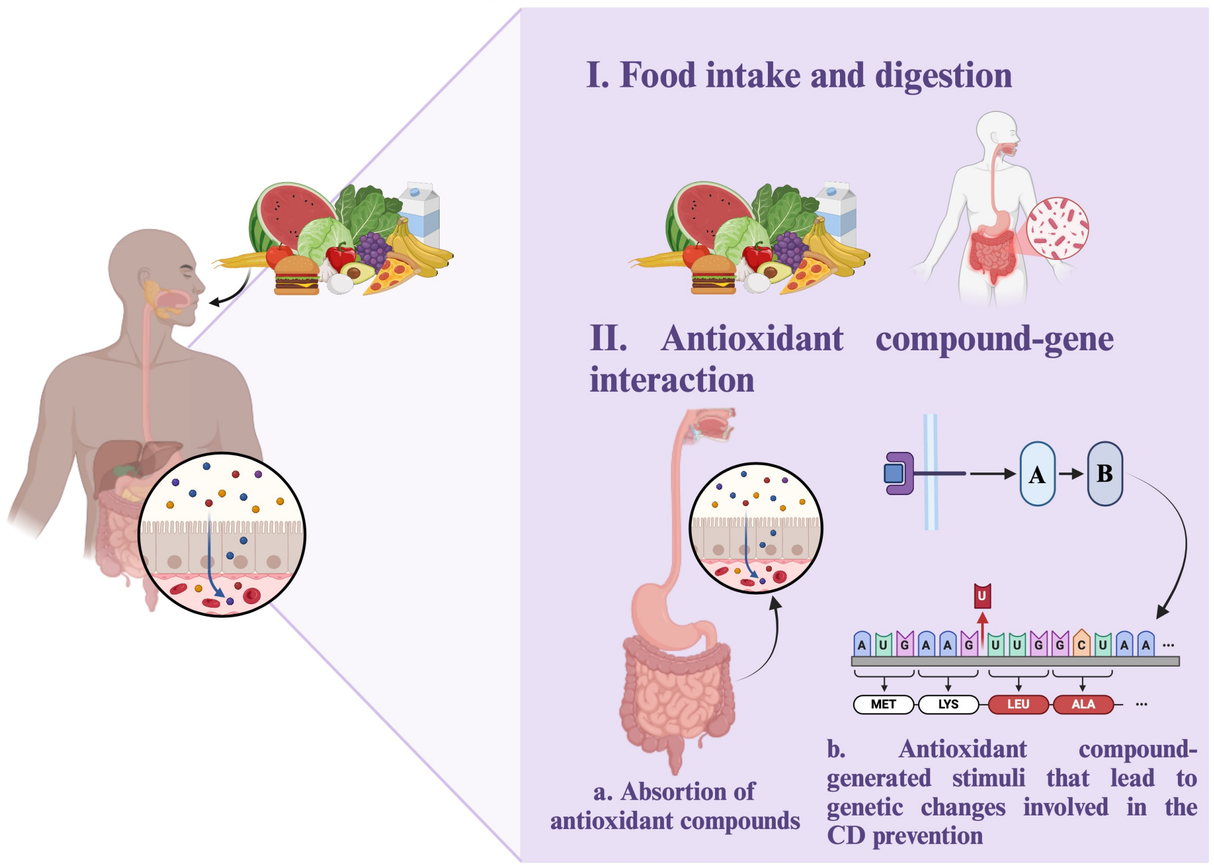


Table 2. Gene modulation produced by antioxidant compounds and its role in the prevention and treatment in chronic disease.

Antioxidant compound	Food source	Effective dose	Mechanism of action	Modulated genes	Disease	Ref
Curcumin	Turmeric	500-2000 mg/day	Inhibits NF-κB, reduces oxidative stress and inflammation	Nrf2, TNF-α, IL-6, COX-2	Cancer, Alzheimer's, CVD, Arthritis	[6]
Resveratrol	Grapes, Red Wine, Berries	150-500 mg/day	Activates SIRT1, reduces ROS, modulates inflammatory pathways	SIRT1, PGC-1α, Nrf2	CVD, Neurodegenerative Diseases, Diabetes	[7]
Quercetin	Onions, Apples, Berries	500-1000 mg/day	Inhibits lipid peroxidation, modulates MAPK and NF-κB pathways	Nrf2, HO-1, IL-1β	Hypertension, CVD, Cancer	[8]
Epigallocatechin Gallate	Green Tea	200-800 mg/day	Scavenges ROS, modulates apoptosis, inhibits NF-κB	Nrf2, Bcl-2, Bax, p53	Cancer, Metabolic Disorders, CVD	[9]
Lycopene	Tomatoes	10-20 mg/day	Inhibits oxidative damage, reduces LDL oxidation	Nrf2, SOD, CAT	Cancer, Atherosclerosis	[10]
Anthocyanins	Blueberries, Blackberries	50-500 mg/day	Inhibits oxidative stress, modulates inflammatory response	Nrf2, TNF-α, IL-6	CVD, Cognitive Decline, Diabetes	[11]