



////Title: Understanding the Antioxidant Boom: Trend or Treatment?

////Standfirst:

Recent studies have suggested that dietary intake of antioxidants (**Ann-tee-ock-sid-ants**) could reduce the risk of diseases including coronary heart disease, diabetes, and Alzheimer's disease. These studies are based on a long history of research into antioxidants, stretching back to the 1950s. In a recent review, Dr Andy Wai Kan Yeung at the University of Hong Kong and his colleagues examine the growth of the recent scientific literature concerning antioxidants to better understand how the scientific focus on these potential therapeutic molecules has changed over time.

////Body text:

Oxygen is essential to human life. The human body uses oxygen to make energy through a process known as respiration, and oxygen is also needed to make up the building blocks of our bodies, from DNA and proteins to teeth and bones. However, our relationship with oxygen comes at a price. Recent research has linked toxic forms of oxygen that can react with our body tissue leading to the development of a range of diseases. These toxic oxygen molecules, known as reactive oxygen species, or ROS, can be released as a natural by-product of respiration, but their levels can increase in stress conditions such as cancer or chronic inflammation. ROS can cause damage to cellular DNA, and some studies have even linked the damaging effects of ROS to the effects of ageing.

Molecules that can remove ROS from the tissue are known as antioxidants. These molecules are made naturally in the body to counteract the damaging effects of ROS. They can also exist in the food we eat. For example, vitamin C is an antioxidant and is present in high concentrations in citrus fruits. Although there is significant debate as to whether dietary intake of antioxidants can protect against disease, some recent epidemiological studies have shown supplementary antioxidants may protect against the onset of cancer, cardiovascular disease, and diabetes.

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As our understanding of reactive oxygen species has grown, the potential for antioxidants as a potential therapeutic has become evident. Scientific literature over the past 50 years has seen a gradual change in how these molecules are perceived, with recent years seeing hundreds of studies being conducted into the clinical use of antioxidants.

Dr Andy Wai Kan Yeung and his colleagues recently took a systematic approach to analysing the current state of research in this field. Specifically, the team aimed to understand which antioxidant chemicals and pharmaceuticals were being highlighted in the research literature, and the countries and journals contributing to this research.

To do this, Dr Yeung and colleagues searched through the literature for all publications mentioning the word 'anti-oxidant' and evaluated these studies for publication year, journal name, and number of subsequent citations. They used specialist software to extract and analyse words from the titles and abstracts of papers to identify the most commonly used terms. Overall, the group analysed results from almost 300,000 publications, dating from 1957 to the present day.

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Through analysing the literature in this fashion, the authors found that the number of publications regarding antioxidants has exponentially increased over the past 25 years. In 1977, 100 studies were published on antioxidants. But by 2017, the annual number of publications had risen to 30,000.

To understand how the content of these papers has changed over the years, the authors split the publications into four groups based on their year of publication. They found that studies before 1990 were mostly focused on antioxidants and the development of cancer, were mostly based within the United States, and with the most cited terms being related to the antioxidants uric acid, vitamin C, and selenium. These publications had a higher proportion of pure chemistry studies, reflecting the fact that a basic chemical understanding of these molecules was being gained during this period.

During the next period from 1991 to 2000, studies from the biochemistry and molecular biology fields accounted for a larger share of the publications. Atherosclerosis (**Ath-air-roe-skleh-roe-sis**) was mentioned alongside antioxidants in 627 studies, indicating that the appreciation of oxidative stress in chronic disease was beginning to take off. Highly cited topics in publications after 2001 included chronic diseases such as atherosclerosis, Parkinson's disease and Alzheimer's disease. Another interesting finding was that a high number of the studies were published in open-access multidisciplinary journals such as PLOS One and Scientific Reports.

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Dr Yeung and colleagues identified an important change in the type of chemicals being discussed in the literature, noting that scientific interest had transitioned from a focus on antioxidant vitamins and minerals, such as vitamin C and selenium, to the chemicals involved in the metabolism of plants.

The researchers found that the most recent, highly cited chemicals are two plant-based chemicals classed as polyphenols (**Polly-fee-nolls**) and known as curcumin (**Sir-cue-min**) and resveratrol (**Res-veh-rah-trol**). Curcumin is the bright yellow chemical that gives turmeric its yellow colour. Resveratrol is found in grapes, blueberries, raspberries, and peanuts, and has been detected in red wine. Recent studies have suggested polyphenols can have beneficial effects against cardiovascular disease and diabetes. Both red wine and turmeric have been adopted to some extent by the media as potentially improving general health. The finding that these are some of the most cited chemicals suggests that the scientific literature is moving in tandem with the press coverage of these substances.

Interestingly, during the period between 2011 and 2018, the authors found that China had overtaken the United States as the most prolific publisher in the field of antioxidant therapy. The authors suggest that this may be because the experimental techniques needed to analyse antioxidants require less sophisticated equipment, so emerging research powers have caught up with more established research environments in recent years.

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Understanding how the landscape of publishing relating to antioxidants has changed will undoubtedly help researchers as they explore these potentially therapeutically useful chemicals. In their review, Dr Yeung and colleagues show that the literature on antioxidants has changed considerably over the last 30 years. What the future will hold for this rapidly growing field of



research is unclear, but this synthesis of the literature suggests it shows no sign of slowing down. A shift towards plant-based products and the study of chronic and difficult-to-treat conditions such as Alzheimer's and Parkinson's disease shows that more and more interest is being shown in the therapeutic promise of antioxidants.



Meet the Researcher

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