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JOURNAL OF SCIENCE
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ORIGINAL RESEARCH

Colorless tetrapyrrolic chlorophyll catabolites found in ripening fruit are effective antioxidants - Evidence review

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ONLINE ARTICLE

ARTICLE INFORMATION

Published: November 10, 2026
Updated: November 11, 2026

DOI 10.5281/zenodo.24140471

1. ABSTRACT

The analyzed publication examined the relationship between fruit ripening, chlorophyll degradation, and the formation of colorless tetrapyrrolic catabolites, now included in the family of phyllobilins. The full text and abstract are not available in the provided material; therefore, it is not possible to directly verify the sample, experimental procedures, concentrations, statistical analyses, or the magnitude of the effect observed in the original study. However, the title of the publication and the bibliographic context indicate that the research was cited to document the antioxidant properties of compounds derived from chlorophyll in ripening fruit.In the section "The Choice to Live in Health or Illness" by Dr. A. Colonnese and R. Panzironi, the study contributes to the passage stating that early harvesting and artificial ripening can reduce protective phytochemicals present in ripe fruit. Independent studies confirm that, during the loss of green color, phyllobilins increase in some plant products and that specific phyllobilins show antioxidant activity in extracts, chemical systems, and cells. However, this evidence does not prove that early harvesting reduces the health benefits of fruit in humans, nor that a single compound explains the overall nutritional value of a food.

MISSION

LIFE Science Hub – Journal of Science was founded with the aim of making scientific knowledge accessible without giving up methodological rigour, quality of sources and authoritativeness of content. The journal promotes the dissemination of knowledge in the health, nutrition, medical and longevity sciences, building a bridge between the world of research and society.

Through articles, reviews, in-depth analyses and expert contributions, the Journal champions evidence-based medicine and science, fostering a correct interpretation of scientific data and countering misinformation. Every piece of content is developed with the aim of translating the complexity of research into understandable, useful and applicable information, while keeping intact the principles of accuracy, transparency and scientific independence.

Free from political, industrial and commercial influence, the journal stands as an authoritative and independent editorial space, dedicated to promoting scientific culture, professional development and the growth of health awareness among the public.

2. ANALYZED STUDY

The research question that can be reconstructed from the title was whether chlorophyll catabolites with antioxidant activity are formed in fruit that loses its green color during ripening. An antioxidant is a substance that, in a given test, can slow down oxidation reactions caused by reactive molecules. This does not automatically equate to demonstrating a health benefit for those who consume that food.The relevance to the book's section concerns a specific point: ripe fruit may contain phytochemical compounds that are not evident from its color or the content of traditionally measured vitamins. The publication subject to the Evidence Review is therefore relevant to the narrative because it links ripening and chlorophyll degradation to the appearance of potentially antioxidant compounds. However, it cannot, on its own, demonstrate that early harvesting or ripening with ethylene reduces these compounds, nor can it establish clinical effects in humans.

3. MATERIALS AND METHODS OF THE ORIGINAL STUDY

The material available for this Evidence Review does not contain the full text or the abstract of the original publication. Consequently, the experimental design, number of fruits analyzed, cultivars, origin of the samples, harvest period, selection criteria, ripening conditions, extraction techniques, analytical methods, controls, concentrations tested, and statistical analyses are not reported in the available material.The experimental endpoints are also not described in the provided material. From the title, it can only be inferred that the authors identified colorless tetrapyrrolic chlorophyll catabolites in ripening fruit and evaluated their antioxidant activity. However, this deduction does not allow for a reliable reconstruction of the methodology or the quantitative robustness of the study.

4. RESULTS

Since the text and abstract of the original study are not included in the input, quantitative results are not reported in the available material. It is therefore not possible to indicate absolute quantities of catabolites, differences between unripe and ripe fruit, statistical significance values, experimental concentrations, or comparisons with other antioxidants.The only result that can be cautiously inferred from the title is that colorless tetrapyrrolic chlorophyll catabolites were found in ripening fruit and that these were described as effective antioxidants. For the book section, the relevant scientific segment is not a generic health effect of fruit, but rather the possibility that plant ripening makes specific phytochemical compounds derived from chlorophyll degradation available.

5. INTERPRETATION

In simple terms, when a fruit changes from green to the colors typical of ripening, a portion of the chlorophyll is transformed. Some of the end products of this process are phyllobilins, which are tetrapyrrolic molecules—meaning they are formed by four chemical rings linked together. Their ability to react with radicals or slow down oxidation can be measured in a laboratory.The point supported by the publication that is the subject of this evidence review is therefore: the ripening and degradation of chlorophyll can be accompanied by the formation of colorless compounds with antioxidant activity. This is a biological correspondence consistent with the book's statement regarding the powerful antioxidants present in ripe fruit. The essential limitation is that antioxidant activity in a test tube or in cells does not demonstrate intestinal absorption, the concentrations reached in the body, a reduction in chronic diseases, or the nutritional superiority of fruit harvested later.

6. INDEPENDENT CONFIRMING EVIDENCE

Independent research on stored iceberg lettuce and cucumbers has shown that phyllobilins increase during the loss of green color. Extracts obtained at the end of storage showed higher antioxidant activity in vitro compared to extracts from fresh produce. The authors also isolated phyllobilins and studied their activity in HEK293 and Caco-2 cells, which are models of human embryonic kidney cells and human intestinal cells, respectively. This evidence confirms the general premise that chlorophyll degradation can be accompanied by antioxidant compounds, but it concerns stored vegetables and not ripe apples or pears; furthermore, the extracts contain many substances, so they do not prove that the entire increase in activity depends exclusively on

phyllobilins [1].A second independent study characterized phylloxanthobilins, yellow phyllobilins obtained from the transformation of chlorophyll degradation products, in *Echinacea purpurea*. The isolated molecules showed antioxidant activity in a chemical test and a reduction of reactive oxygen species in HEK293 cells. The cells also absorbed these compounds. The result is biologically consistent with the book's narrative: chlorophyll degradation products can have measurable antioxidant activity. However, it does not concern fruit, does not evaluate commercial ripening, and does not demonstrate an effect in humans after dietary consumption [2].An analysis conducted on Gala cultivar apples during a controlled storage phase identified ten chlorophyll catabolites, including five non-fluorescent colorless phyllobilins. The abundance and diversity of these compounds increased from the onset of chlorophyll degradation. This study directly confirms the apple ripening appearance of phyllobilins pathway. However, it did not measure the antioxidant activity of the identified compounds nor any biological or clinical benefits; therefore, it completes the chemical chain but does not validate the entire nutritional claim [3].

7. CONFLICTING EVIDENCE

No directly conflicting evidence of sufficient relevance has been identified; this does not prove the absence of contrary results. The available evidence primarily shows that chlorophyll degradation can be accompanied by the accumulation of phyllobilins and that some phyllobilins possess antioxidant activity in experimental tests.However, there is a significant interpretative limitation. In the study on Gala apples, the authors documented the increasing presence of phyllobilins during ripening and storage, but they did not verify whether these compounds increased the overall antioxidant capacity of the fruit or produced health benefits. This result is neutral regarding antioxidant activity, not contrary, but it prevents the automatic extension of chemical data to a nutritional or clinical conclusion [3].

8. QUADRO COMPARATIVO E SINTESI DELLE EVIDENZE

The table distinguishes the publication subject to the review from independent research and separates chemical or cellular demonstrations from conclusions applicable to human nutrition.

Quadro comparativo

Reference	Study type	Population or model	Main result	Direction of evidence	Strength of evidence
Original study	Experimental study; details not reported in available material	Ripening fruit; species and sample size not reported in available material	The title indicates the presence of colorless chlorophyll catabolites with antioxidant activity.	biologically consistent evidence	preliminary
[1]	Experimental study on stored foods, extracts, and cells	Iceberg lettuce, cucumbers, HEK293 and Caco-2 cells	Phyllobilins increased with storage; final extracts showed higher antioxidant activity in vitro.	indirect confirmation	moderate
[2]	Cellular and chemical study	Phylloxanthobilins from Echinacea purpurea and HEK293 cells	Phylloxanthobilins showed antioxidant activity and reduced reactive oxygen species in cells.	biologically consistent evidence	moderate

[3]	Experimental analytical study	Gala apples during controlled storage	Ten chlorophyll catabolites increased in abundance and diversity with chlorophyll degradation.	neutral evidence	moderate

9. SINTESI EDITORIALE E CONCLUSIONI

CONCLUSIONS

The passage in the book regarding the presence of powerful antioxidants in ripe fruit is supported at a mechanistic level: the degradation of chlorophyll can produce phyllobilins, and some of these molecules show antioxidant activity in laboratory and cellular tests. However, the chain of evidence has not been proven to lead to a clinical benefit in humans. It is therefore correct to speak of potentially protective phytochemical compounds, while it would be excessive to use these data to attribute certain or quantified health effects to fruit ripening.

Aggiornato al 17/11/2026. Questo contenuto riflette una sintesi divulgativa delle evidenze scientifiche al momento della pubblicazione e non sostituisce il parere medico.

10. TRANSPARENCY AND SCIENTIFIC RESPONSIBILITY

Artificial Intelligence was used solely as a tool for editorial and documentary support. All content, interpretations, bibliographic citations and conclusions have been verified, reviewed and approved by the author, who assumes full scientific responsibility for them.

The manuscript was also subjected to independent peer review prior to publication.

To ensure the greatest transparency, the complete history of the article, including the dates of submission, revision, acceptance and publication, as well as information on the peer review process, is available on the dedicated Article History page.

11. RIFERIMENTI BIBLIOGRAFICI

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