Apple storage and quality management

Monitoring natural phenolics and antioxidants in processing apple juice

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Health benefits of apples - health professionals, consumers

**Antioxidant claims - beware the hype!**

The emergence of evidence linking fruit to health has been accompanied with controversy, with some studies finding no benefit, while others find fruit of specific types - such as apples - are beneficial. Apples are now believed to contain at least five key antioxidant compounds, which can improve health and reduce the risk of disease.

**The results**

Antioxidant capacity of Old Julia relative to a Red Delicious Apple

**WHAT ARE PHOTOCHEMICALS?**

Photochemicals are phytochemicals in food and fruit that have health benefits in addition to vitamins, minerals, and other nutrients. Photochemics are phytochemicals that have been found in plants, including fruits and vegetables. The major categories of dietary photochemicals include:

- Alkaloids
- Antioxidant-containing compounds
- Carotenoids
- Cytotoxic or carotenoids
- Flavonoids
- Phenolic acid
- Phytosterols
- Quercetin
- Sesquiterpene
- Terpenoids

**APPLE PHYTOCHEMICALS**

Apples are particularly high in flavonoids, which include quercetin, myricetin, and kaempferol.

**Antioxidant capacity of Acai, Mangosteen and Nomi Juice relative to a Red Delicious Apple**

**The health benefits of apples - cancer**

Apples are one of the top ten most popular fruits in the United States, and they are recommended as part of a healthy diet. While they may be eaten raw or cooked, apples are particularly beneficial when eaten raw, especially when the peel is included.

Apples contain a variety of antioxidants, including flavonoids, which are known to have anti-inflammatory and anti-cancer properties. Studies have shown that consuming apples regularly may reduce the risk of developing cancer, particularly breast cancer.

**Did you know?**

Apples are a rich source of vitamin C, which is essential for maintaining a healthy immune system. Vitamin C also helps to reduce inflammation and oxidative stress, which can contribute to the development of cancer.
Monitoring natural phenolics and antioxidants in processing apple juice

Horticulture Australia Project Number: AP10020
Voluntary contribution from Appledale Cooperative, Orange

Antioxidant activity (ORAC Assay) in 9 juices made from imported concentrate and 8 Australian apples

Polyphenolic compound content in 11 clarified juices and 6 cloudy juices (p value for the comparisons)

Dr. Costas Stathopoulos, Dr. Paul Roach and Vincent Candrawinata. University of Newcastle
The antioxidant activity of each juice was measured by subtracting the antioxidant activity of their vitamin C content and expressed as µM Trolox Equivalence (TE) (Mean±S.E.)

Antioxidant activity of 11 clarified juices and 6 cloudy juices

Candrawinata V.I., **Golding J.B.**, Roach P.D. and Stathopulos C.E. (2013) From apple to juice - The fate of polyphenolic compounds. *Food Reviews International* 29, 276-293.

Extraction and utilisation of the polyphenolics from apple juice pomace

(PhD student - Vincent Candrawinata. University of Newcastle)
Effect of storage conditions – cold storage, CA and 1-MCP - on apple phenolic and antioxidant levels in Australian apples

Effect of storage time on total phenolics in storage

Air storage over time – 9 months

Granny Smith
Lady Williams
Crofton

Concentration (µg/g FW) of total phenolics during 160 days storage (with 7 days storage life)

Cripps Pink total antioxidant capacity

TAA (g TE/kg FW) during 160 days storage (with 7 days storage life)

using DPPH method of measuring TAA
Nitric oxide (NO)
Ubiquitous bioactive molecule. Highly reactive $2 \text{NO} + \text{O}_2 \rightarrow 2 \text{NO}_2$
Human medical effects - signalling molecule and widely used in medicine. Effects of plants?

Browning of apple slices

Untreated

Effective on all apple cultivars tested (Royal Gala, Golden Delicious, Sundowner, Fuji and Red Delicious)

10ppm NO gas

→ Extension 25 – 75 % shelf life

6 days at 10°C

Other NO donors

**DETANO** 2,2’-(Hydroxynitrosohydrazino) bis-ethanamine

**SNP** Sodium nitroprusside (Na$_2$ [Fe (CN)$_5$ NO] 2H$_2$O)

**SNAP** S-nitroso-N-acetylpenicillamine

**Piloty’s acid** N-hydroxybenzenesulfonamide
Nitric oxide and apple slice browning


*In press*

![Chemical structure of DETANO](image)
General apple handling and storage


Superficial scald


**Market access**


**Apple storage book chapters**


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... only 396 days to go