# Kumquat (*Fortunella margarita*): a good alternative for the ingestion of nutrients and bioactive compounds

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- Citrus fruit is preferred in the choice of consumers.
- Kumquat (*F. margarita*) is an unconventional citrus of increasing consumer.
- It is exotic flavor, and its functional potential that offers health benefits to consumers.
- It is a fruit traditionally consumed by whole fruit (peel and pulp), giving this fruit a distinctive flavor.
- For this reason, this study analyzed physical, chemical, and nutritional characteristics of kumquat (peel+pulp).

Physicochemical analysis

Instituto Adolfo Lutz (2005)

Fibers

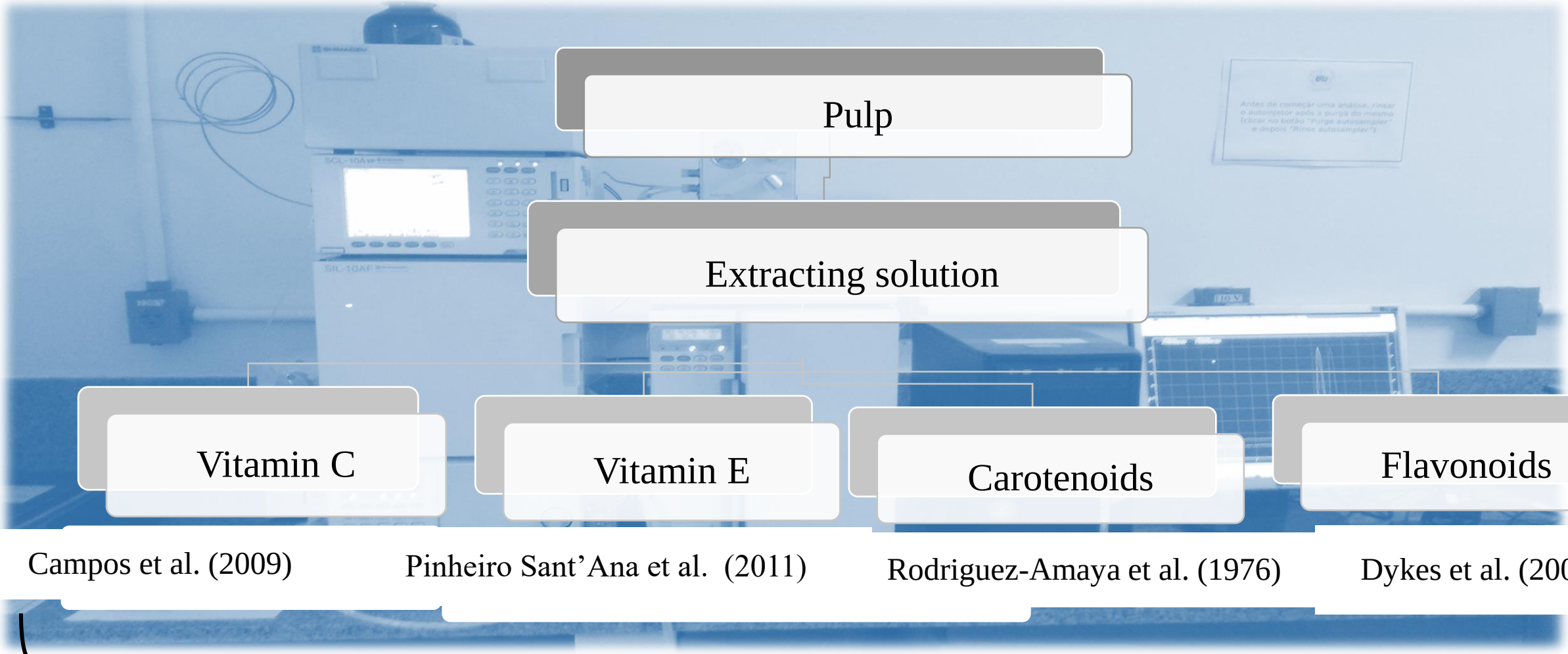
Association of Official Analytical Chemists (2012)

Analysis of moisture, ashes, macronutrients

Association of Official Analytical Chemists (2012)

Chemical elements

Inductively coupled plasma optical emission spectrometry (ICP-OES).



Pulp

Extracting solution

Vitamin C

Vitamin E

Carotenoids

Flavonoids

Campos et al. (2009)

Pinheiro Sant'Ana et al. (2011)

Rodriguez-Amaya et al. (1976)

Dykes et al. (2009)

High Performance Liquid Chromatography (HPLC)

The total phenolic compounds Folin-Ciocalteu

Singleton et al. (1999)

Capacidade antioxidante

DPPH solution (1.1-diphenyl-2-picrylhydrazyl)

Bloor (2001)

**Table 1.** Centesimal composition of kumquat (*F. margarita*) (peel+pulp) collected in Brazil.

| Centesimal composition | | | | |
|---|---|---|---|---|
| Moisture[1] (g.100 g$^{-1}$) | Lipids[1] (g.100 g$^{-1}$) | Total ash[1] (g.100 g$^{-1}$) | Protein[1] (g.100 g$^{-1}$) | Carbohydrates[1] (g.100 g$^{-1}$) |
| 76.79 ± 0.98 | 1.18 ± 0.06 | 3.66 ± 0.18 | 7.38 ± 0.39 | 5.23 ± 0.30 |
| Total fiber[2] (g.100 g$^{-1}$) | Insoluble fiber[2] (g.100 g$^{-1}$) | Soluble fiber[2] (g.100 g$^{-1}$) | TEV[3] (kcal. 100 g$^{-1}$) | |
| 5.31 ± 0.06 | 3.28 ± 0.15 | 2.03 ± 0.09 | 61.06 | |

Data expressed as fresh basis, as mean ± standard deviation
[2] Data expressed as fresh basis, as mean ± standard deviation
[3]TEV – Total energy value

**Table 2.** Composition of chemical elements present in kumquat (*F. margarita*) (peel+pulp) collected in Brazil.

| Chemical elements | Concentration (mg.100 $g^{-1}$) |
|---|---|
| Phosphor | 16.94 ± 0.23 |
| Potassium | 163.16 ± 3.29 |
| Calcium | 64.99 ± 1.41 |
| Magnesium | 16.71 ± 0.40 |
| Sulfur | 13.92 ± 0.23 |
| Copper | 0.07 ± 0.01 |
| Iron | 0.30 ± 0.06 |
| Zinic | 0.09 ± 0.00 |
| Manganese | 0.10 ± 0.00 |
| Sodium | 2.63 ± 0.00 |
| Chrome | 0.01 ± 0.33 |
| Cadimium | 0.00 ± 0.00 |
| Aluminum | 0.57 ± 0.33 |
| Nickel | 0.00 ± 0.00 |
| Lead | 0.00 ± 0.00 |

Data expressed as fresh basis, as mean ± standard deviation.

**Figure 2.** Analysis by HPLC in kinkan (peel+pulp) collected in Brazil. Vitamin C (A); vitamin E (B); carotenoids (C); eriodictiol (D) and apigenin (E).

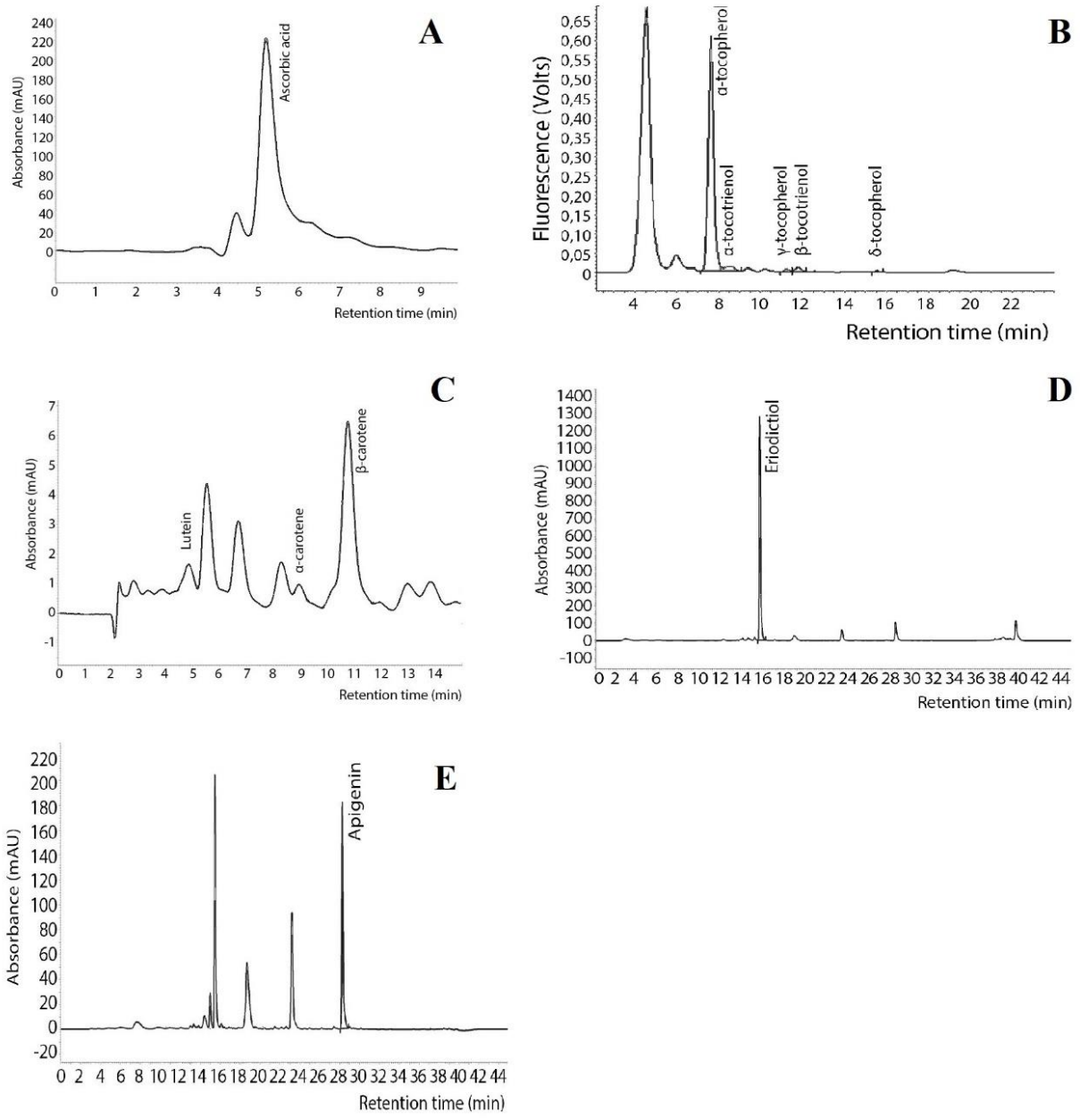


**Table 3.** Occurrence and concentration of vitamins, carotenoids and bioactive compounds in kinkan (*F. margarita*) (peel+pulp) collected in Brazil.

| Components | Concentration |
|---|---|
| **Vitamin C** (mg.100 $g^{-1}$) | |
| Ascorbic acid | 2.32 ± 44.24 |
| **Vitamin E** (µg.100 $g^{-1}$) | |
| α-tocopherol | 569.00 ± 10.20 |
| α-tocotrienol | 35.76 ± 4.03 |
| β-tocopherol | nd |
| β-tocotrienol | 66.89 ± 39.93 |
| γ-tocopherol | 4.22 ± 0.13 |
| γ-tocotrienol | nd |
| δ-tocopherol | nd |
| δ-tocotrienol | nd |
| Total Vitamin E | 675.87 ± 54.29 |

**Table 3.** Occurrence and concentration of vitamins, carotenoids and bioactive compounds in kinkan (*F. margarita*) (peel+pulp) collected in Brazil.

| **Components** | **Concentration** |
|---|---|
| **Carotenoids** (μg.100 $g^{-1}$) | - |
| α-carotene | 661.81 ± 22.76 |
| β-carotene | 447.74 ± 19.90 |
| Lutein | 173.60 ± 33.61 |
| Sum of carotenoids | 1283.15 |
| Vitamin A value (RAE 100 $g^{-1}$)[1] | 129.77 |

**Table 3.** Occurrence and concentration of vitamins, carotenoids and bioactive compounds in kinkan (*F. margarita*) (peel+pulp) collected in Brazil.

| Components | Concentration |
|---|---|
| **3-desoxyanthocianidins** (μg.100 $g^{-1}$) | |
| Luteolinidin | nd |
| Apigeninidin | nd |
| 5-methoxy-luteolinidin | nd |
| 7-methoxy-apigeninidin | nd |
| **Flavones** (μg.100 $g^{-1}$) | |
| Apigenin | 38157.30 ± 531.00 |
| Luteolin | nd |
| Sum of flavones | 38157.30 ± 531.00 |

**Table 3.** Occurrence and concentration of vitamins, carotenoids and bioactive compounds in kinkan (*F. margarita*) (peel+pulp) collected in Brazil.

| **Components** | **Concentration** |
|---|---|
| **Flavanones** (μg.100 $g^{-1}$) | |
| Eriodictiol | 36880.95 ±384.02 |
| Naringenin | nd |
| Sum of flavanones | 36880.95 ± 384.02 |
| **Total phenolics** (mg GAE.100 $g^{-1}$) | 98.55 ±1.93 |
| **Antioxidant capacity** (%) | 62.01 ± 3.41 |

Data expressed as fresh basis, as an average of 4 replicates ± standard deviation.

[1]Equivalent of retinol activity

Nd: not detected.

The fruit kumquat (peel + pulp) is a good source of dietary fiber and vitamin A, has a low amount of fat and low caloric value.

The fruit contains ascorbic acid, carotenoids, flavonoids (eriodictiol and apigenin) and high concentration of total phenolic compounds, which contribute to its good antioxidant capacity.

Thus, kumquat is a good alternative for planting, marketing and consumption, which can contribute to food and nutritional sovereignty and security and provide a source of income for farming families.