

Antioxidant Capacity of Tomato Paste is Stable During Growing Season and Shelf-Life

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Abstract

Few data exist regarding the effect of growing season and shelf life on the stability of the antioxidant capacity of foods. To assess these factors in commercially available tomato paste, the sum of lipophilic and hydrophilic antioxidant capacity [oxygen radical absorbance capacity (ORAC), Brunswick Laboratories, Norton, MA] was measured in composite samples comprised of production lots prepared from tomatoes harvested during early, middle, and late growing season periods early in their shelf life (± 6 months) and at 12 and 18 months post-production. All composites comprised 12 individual consumer units from the same production lot and where measured in duplicate. ORAC for tomato paste produced from early growing season tomatoes was 1341 ($\mu\text{mole Trolox equivalents}/100\text{ g}$). Values for composites made from tomatoes from middle and late growing season harvest were 109% and 118% greater, respectively. Compared to composites measured within 6 months post-production, ORAC values were 105% and 109% greater at 12 and 18 months post-production, respectively. These data demonstrate neither within season growing period, nor storage time, adversely affects the antioxidant capacity of tomato paste.

Background

The genesis and progression of a number of chronic diseases is believed to involve oxidative based cellular insult and injury (1). As a measure of antioxidant capacity the Oxygen Radical Absorption Capacity (ORAC) assay quantifies the degree of inhibition of peroxy-radical-induced oxidation in units of Trolox equivalents (TE)(2). Although this method has been applied to a wide variety of foods, a number of common foods have not been measured. Furthermore, relatively little data exist regarding growing conditions, harvesting practices, and the shelf life stability of this food attribute.

Objectives

1. Determine the influence of harvest season and shelf life on ORAC values of tomato paste.
2. Determine the per capita food availability of ORAC from the most commonly consumed non-starchy vegetables in the USA food supply.

Methods

ORAC of Tomato Paste

The sum of lipophilic and hydrophilic ORAC [fluorescein probe and 2,2'-azobis (2-amidinopropane) dihydrochloride as peroxy generator] was measured (Brunswick Laboratories, Norton, MA) in duplicate from composites comprised of 12 individual consumer units each. Composites corresponded to:

- 1) Tomato paste made with tomatoes from the beginning, middle, and end of the raw tomato harvest season
- 2) Tomato paste measured during early, middle, and late shelf life ($\leq 6, 12,$ and 18 months, respectively).

U.S. Food Availability of ORAC From Vegetables

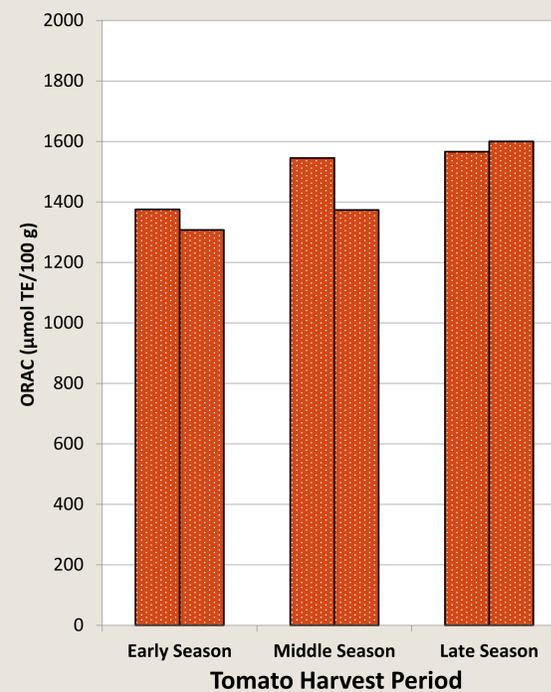
Vegetables (non-starchy) making the greatest quantitative contribution to total intake (grams per capita) were selected using the USDA Economic Research Service loss-adjusted food availability database (2009) (3). The predominant source of the vegetable (raw, canned, or frozen) was used exclusively unless a second source contributed 20% or more of the total availability of that vegetable. For tomatoes, raw consumption is 29% of total tomato intake and canned (sauce, paste, and tomatoes) is 71% of the total. ORAC values from the USDA database for ORAC of selected foods (2010)(4) were used except for tomato paste and canned tomatoes which came from composite samples as described above.

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Results

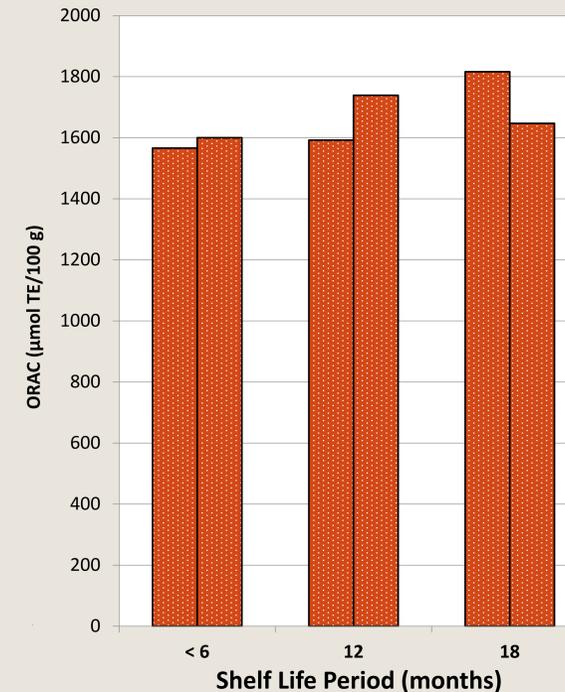
Effect of Tomato Harvest Period on ORAC of Tomato Paste

(values are duplicate analyses from composites comprising 12 individual samples from a single production lot from each harvest period)



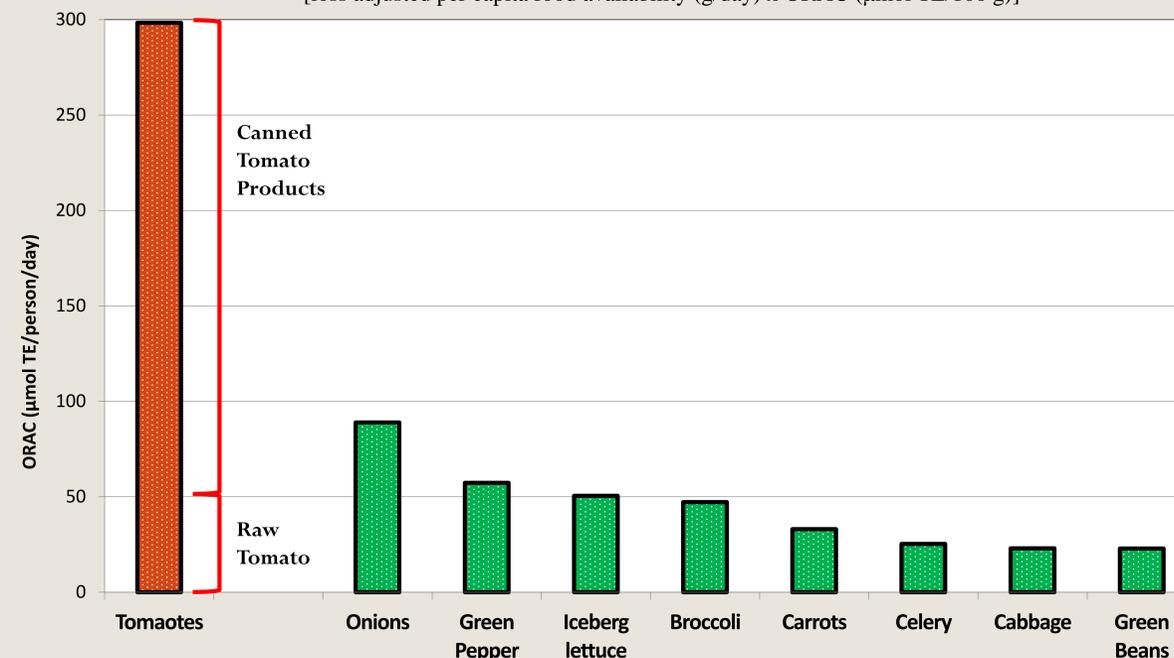
Effect of Shelf Life on ORAC of Tomato Paste

(values are duplicate analyses from composites comprising 12 individual samples from a single production lot)



Per Capita Availability of ORAC From Commonly Consumed Vegetables

[loss adjusted per capita food availability (g/day) x ORAC ($\mu\text{mol TE}/100\text{ g}$)]



ORAC of Commonly Consumed Vegetables in the US Food Supply

| Vegetable | ORAC ($\mu\text{mol TE}/100\text{ g}$) |
|----------------------------|--|
| Tomato Paste | 1580 |
| Broccoli (raw & frozen) | 1003 |
| Green Bell Pepper | 935 |
| Onions | 797 |
| Carrots | 566 |
| Green Beans (raw & canned) | 544 |
| Cabbage | 529 |
| Celery | 522 |
| Iceberg Lettuce | 438 |

Value for tomato paste is the average from composites comprised of early, middle, and late harvest season and shelf life. Other values are from the USDA database for the ORAC of selected foods, release 2 (2010) (4)

Discussion & Conclusions

1. Tomato paste ORAC is stable across harvest and shelf life period (mean \pm SD ORAC = 1580 \pm 115).
2. Tomato paste ORAC is 1.5 - 3 fold greater than other commonly consumed non-starchy vegetables in the U.S. food supply.
3. Canned tomato products (sauce/paste/tomatoes) are the single largest contributor to ORAC availability (~ 40% of total) from commonly consumed vegetables in the US food supply.

Tomatoes account for the large majority of dietary lycopene, the predominant carotenoid in the food supply and make significant contributions to total dietary intakes of vitamin C, potassium, and fiber (5). Moreover, a high per capita availability combined with a high ORAC concentration establishes canned tomato products as the single largest contributor of ORAC availability amongst non-starchy vegetables commonly consumed in the USA. Canned tomato products are widely available year round and have a high degree of culinary versatility and acceptability across food form and cultural preference. In addition, canned tomato products are more economical compared to raw (average cost per cup equivalent of raw vs canned \$1.08 vs. \$0.26, respectively)(6). As such, emphasizing increased consumption of tomato products may be an effective and economical strategy for increasing total vegetable consumption and achieving the health benefits associated with this.

References

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