Curcuminoid Content of Turmeric Grown in Hawai`i

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HYPOTHESIS

The curcuminoid content of turmeric varieties grown in Hawai'i can be determined by high-performance liquid chromatography.

BACKGROUND

Turmeric in Hawai`i

Turmeric (*Curcuma longa* and *Curcuma* spp.), known as *`olena* in Hawaiian, arrived to Hawai`i with Polynesian voyagers as a medicinal herb and pigment.[1] Today, many varieties are available, each with distinct colors, shapes, and flavors.[2] Interest has grown in the medicinal uses for turmeric, which are attributed to a class of secondary metabolites known as curcuminoids.[2,3] It is necessary to quantify the curcuminoids present to assist with crop selection for farmers and proper dosing for consumers.

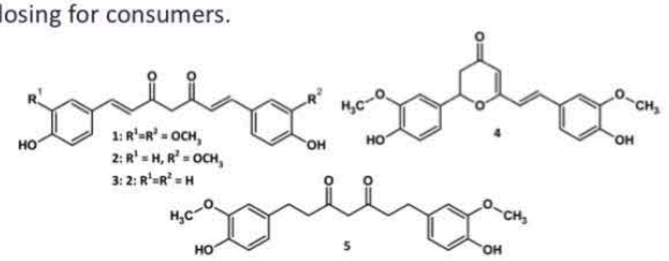

Fig. 1 Turmeric (*Curcuma longa* and *Curcuma* spp.) produces compounds known as curcuminoids: curcumin (**1**), demethoxycurcumin (**2**), bis-demethoxycurcumin (**3**), cyclocurcumin (**4**), and tetrahydrocurcumin (**5**)

Curcuminoid and Turmeric Color

Curcumin (**1**) is the most largely produced curcuminoid and is primarily responsible for the deep yellow-orange color in turmeric. Other curcuminoids (such as **2-4**) have a yellow chromophore as well, while others (such as **5**) are colorless.

OBJECTIVES

I. Extract curcuminoids from local turmeric cultivars

II. Quantify each curcuminoid by high-performance liquid chromatography

1. Kaaiakamanu, D. M., & Akina, J. K. (1976). *Hawaiian Herbs of Medicinal Value*. Honolulu, HI: Pacific Book House.
2. Ravindran, P. N., Babu, K. N., & Sivaraman, K. (2007). *Turmeric: the Genus Curcuma*. Boca Raton: CRC Taylor; Francis.
3. Sun, W., Wang, S., Zhao, W., Wu, C., Guo, S., Gao, H., ... Chen, X. (2017). Chemical constituents and biological research on plants in the genus *Curcuma*. *Critical Reviews in Food Science and Nutrition*, *57*(7), 1451–1523.

METHODS

Sample Preparation

- Turmeric rhizomes obtained from Waimanalo Research Station at Waimanalo, HI
- Freeze-dried powders were extracted in acetic acid and acetonitrile, assisted by sonication and centrifugation

Fig. 2 **Top left and right,** turmeric crops at the Waimanalo Research Station. **Bottom left and right,** colors of fresh rhizomes and dry powders.

High-Performance Liquid Chromatography

- C18 reverse-phase Kinetex® column
- Curcuminoids absorbed at 280, 360, and 450 nm
- Solvent isocratic 40:60; acetonitrile: 2% v/v acetic acid aq.

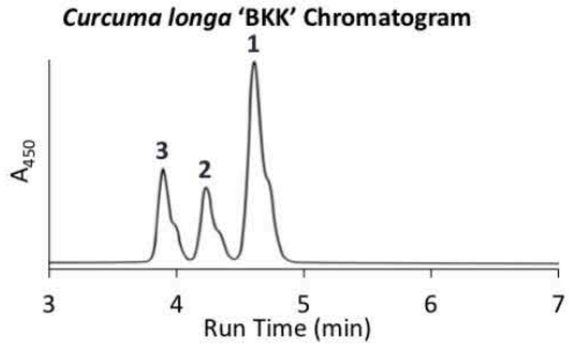

Fig. 3 Chromatogram of *Curcuma longa* 'BKK' at 450 nm showing the peaks associated with curcumin (**1**), demethoxycurcumin (**2**), and bis-demethoxycurcumin (**3**); peak shoulders reflect keto-enol tautomers.

RESULTS

Curcuminoid Content

Curcumin, demethoxycurcumin, and bis-demethoxycurcumin comprised 98-99% of the total curcuminoids analyzed in our samples with exception to the *Curcuma caesia* 'Black' variety, which only contained tetrahydrocurcumin. *Curcuma longa* varieties produced more curcuminoids overall, while non-*longa* varieties had little, if any. *C. longa* 'BKK' had the highest curcuminoid content out of all varieties.

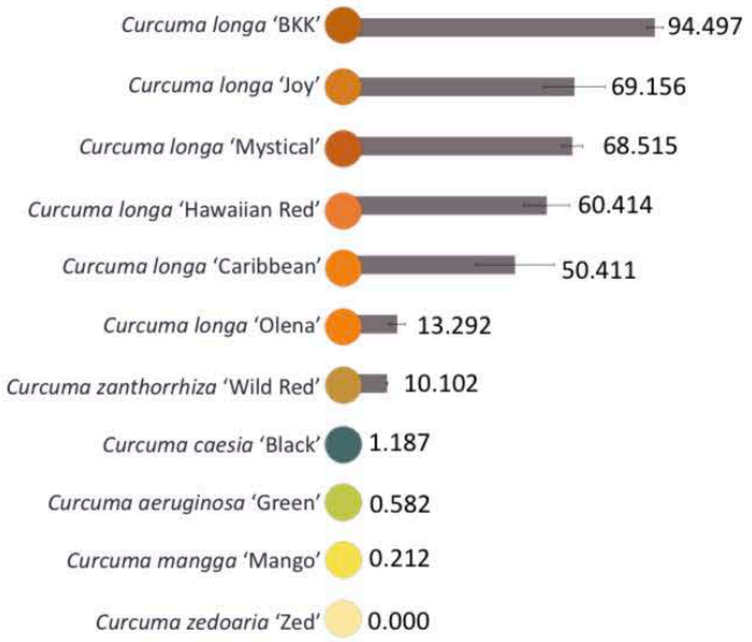

Fig. 4 Turmeric cultivars accompanied by their cross-sectional center color and total curcuminoid value in mg/g dry weight. Error bars indicate 1 s.d.

CONCLUSION

Curcuminoids have been quantified in turmeric varieties (*Curcuma longa* and *Curcuma* spp.) by high-performance liquid chromatography. *C. longa* cultivars produced more curcuminoids and were accompanied by an orange pigmentation, while the *C.* spp. cultivars were either blue, green, or yellow with little to no curcuminoids. This study was funded by the USDA Hatch and Hawaii Department of Agriculture.