The Orange Conundrum

Understanding orange-fleshed kiwiberries

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What are we looking at? And why?

Carotenoids are colourful isoprenoids which play a vital role in plant growth and development.

Humans cannot synthesize vitamin A and are therefore dependent on dietary intake of carotenoids as they are precursor of vitamin A.

Beta-carotene acts as a substrate for vitamin A synthesis (Van Eck et al., 2007).

Carotenoids also play an essential role in maintaining eye health and improving our immune health.

The biosynthesis pathway is well conserved in plants.

The most popular Kiwifruit cultivar *A.chinensis var. chinensis* (golden fleshed) has low levels of carotenoids.

Therefore, orange-fleshed kiwiberries with high carotenoid content(belonging to Actinidia genus) act as a genetic resource to understand the difference in carotenoid biosynthesis pathway.

Methods

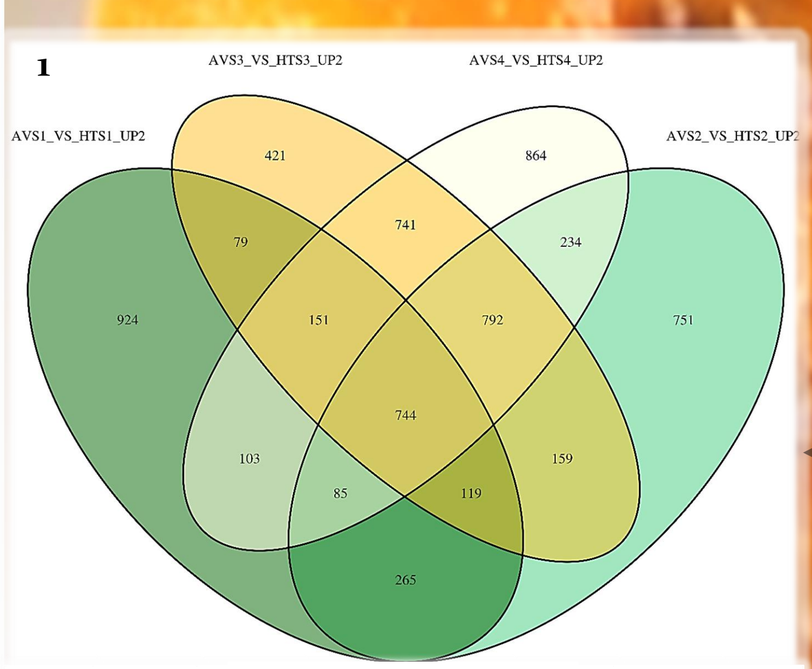
1. Metabolic analysis to understand the carotenoid profile between orange-fleshed (*A. valvata*), yellow-fleshed (*A. polygama*) and green-fleshed (*A. arguta*) species.
2. Microscopy to visualize the differences in plastid type and number between the three species. Plastids (primarily chromoplasts) are organelles known to accumulate high levels of carotenoids.
3. Expression analysis (RNA-Seq) and functional analysis of the biosynthesis pathway genes and candidate transcription factors (TFs).

What did we find?

1. Beta-carotene is the pre-dominant carotenoid in the orange fleshed (OF) species.
2. Crystalline chromoplasts are abundant in OF species and have been found to accumulate high levels of carotenoids (primarily beta-carotene) in other plant species such as carrots (Schweiggert et al., 2012).
3. RNA-Seq analysis between green-fleshed (GF) and OF species revealed 744 differentially expressed genes that are upregulated (with potential candidate TFs for functional analysis).
4. Phytoene synthase (PSY) is the rate-limiting step of the pathway in many plant species(Datta et al., 2003). Therefore, high expression of PSY in OF species may lead to an increase in carotenoids levels.

Actinidia valvata flesh was used to derive the results

1



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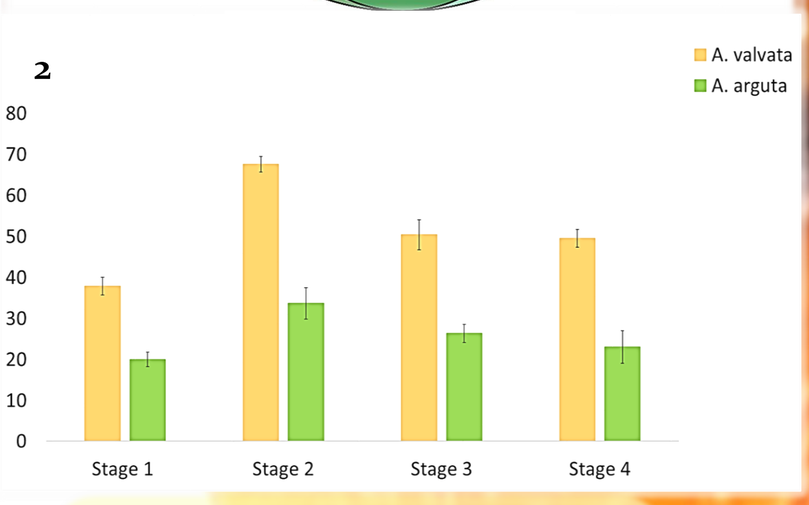

Figure 1: Differentially expressed genes (upregulated) between OF and GF species

Figure 2: Phytoene synthase (PSY) expression levels (FPKM) from RNA-Seq analysis

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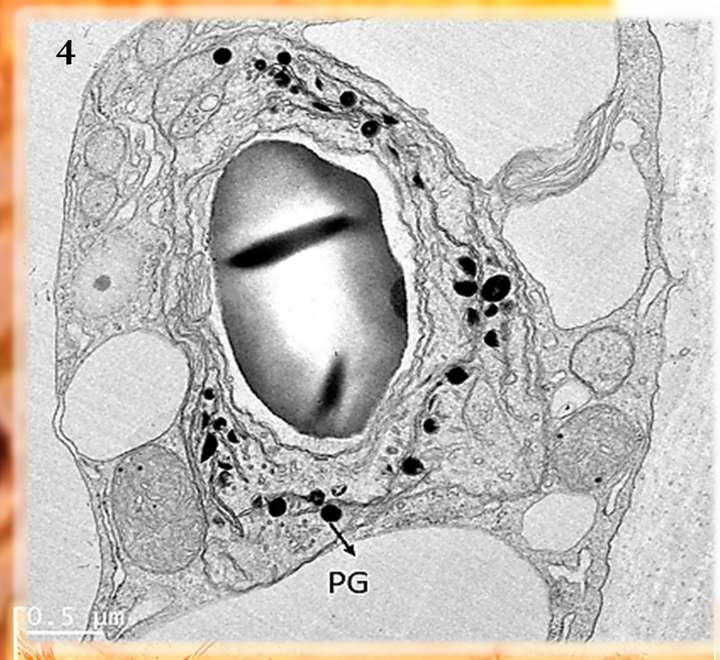

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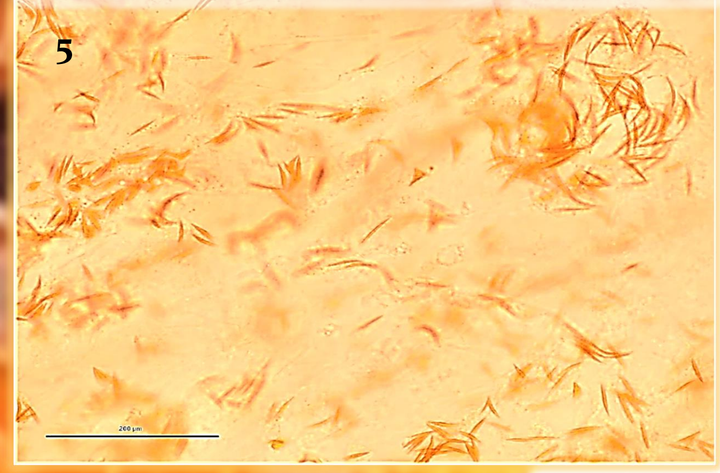

Figure 3: Metabolic profile in the fruit flesh between three Actinidia species

Figure 4: Ultrastructure of the chromoplasts found in the OF species using TEM

Figure 5: Crystalline chromoplasts that accumulate high levels of Beta-carotene were found in abundance in the OF species (flesh). Image using bright field microscopy

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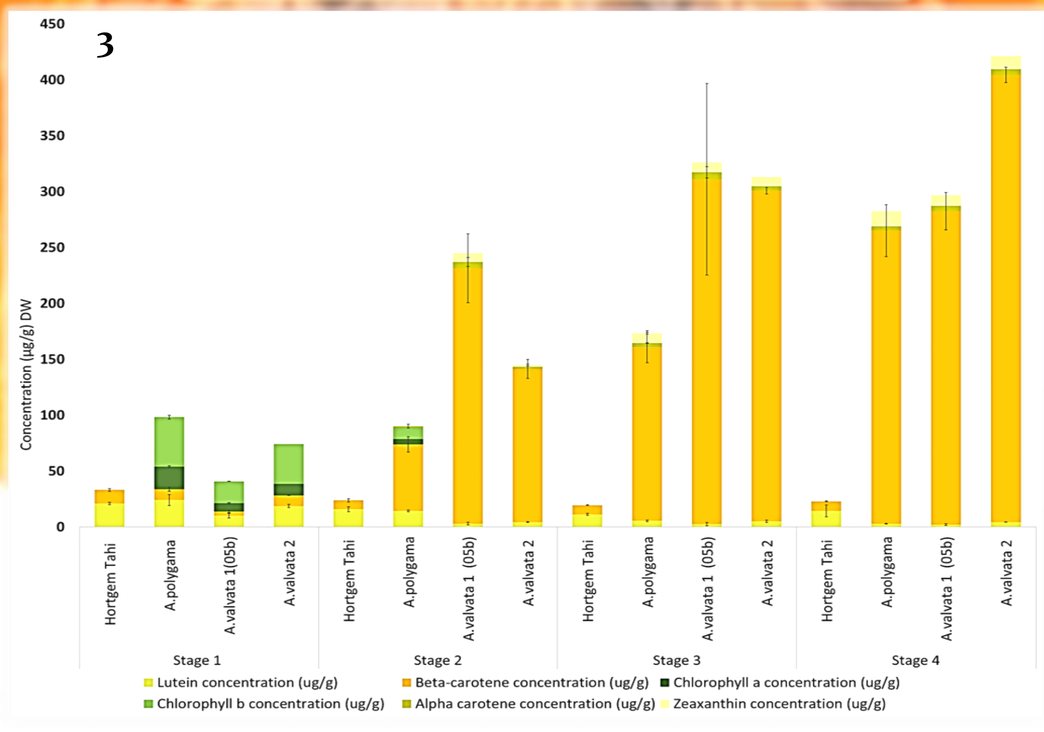

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