# PIGMENT COMPOSITION OF 'HASS' AVOCADO AND THE EXTRACTED OIL

A THESIS

PRESENTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

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*Dedication*
*To my beloved deceased parents*

## Abstract

The changes in the concentration of pigments in the skin and the three pulp sections of the *Persea americana* (Hass var.) and the extracted oil up to 13 days after harvest at 20°C were identified and quantified by High Pressure Liquid Chromatography (HPLC). In the fresh tissue, seven pigments identified belonging to the carotenoid family were lutein, β-carotene, neoxanthin, violaxanthin, zeaxanthin, antheraxanthin and α-carotene. Chlorophyll *a* and chlorophyll *b*, pheophytin *a* and pheophytin *b*, chlorophyllide *a* and chlorophyllide *b* were identified and measured. In the oil extracted using Accelerated Solvent Extraction (ASE), lutein and antheraxanthin were identified. Neoxanthin, violaxanthin and zeaxanthin were not present. The β-carotene and α-carotene were not tested due to the limitation of the method used in the oil determination. Chlorophyllide *a* and chlorophyllide *b* were absent. In the pulp starting from the dark pulp adjacent to the skin towards the stone, the carotenoid and chlorophyll concentrations in the fresh tissue and the extracted oil both showed a decreasing pattern. The highest oil yield was found to be between days 6 and day 8 after harvest. The pigment composition patterns of the avocado fresh tissue correspond to that of the extracted oil. There was an on-going increase in the concentration of the total anthocyanins in the avocado skin. The major anthocyanin identified was cyanidin 3-*O*-glucoside.

Cold pressed avocado oil in the laboratory and in a commercial factory with different levels of skin included during the malaxing were produced. The peroxide value, free fatty acid value, fatty acid composition and antifungal diene were measured to determine the quality of avocado oil with different levels of skin. These showed that the addition of skin had no effect on the quality of oil produced. The addition of skin during cold pressed extraction increased the pigment levels. The stability of factory cold pressed avocado oil with added skin was investigated using accelerated shelf life testing.

The addition of skin during avocado oil production in the factory shortened the shelf life. Storage of avocado oil under dark and at lower temperatures ($\leq$20°C) provided greater stability for avocado oil pigments. The levels of antifungal diene in the avocado oil were undetectable. The comprehensive data regarding pigment composition obtained

in this research may be of used in food technology, nutrition, postharvest management and gene technology.

***Keywords:*** avocado fruit, avocado oil, pigments, colour, carotenoids, chlorophylls, anthocyanin, lutein, chlorophyll *a* chlorophyll *b*, chlorophyllides, pheophytins, accelerated solvent extraction, cold pressed extraction, diene, peroxide value, shelf life.

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# Chapter 1. General Introduction

Pigment degradation during ripening of fresh fruit and during processing results in colour deterioration, quality and reduces shelf life (Heaton and Marangoni, 1996). Strategy and efforts to maximise colour retention in fresh fruit and processed food is essential as colour is most of the time the first among many criteria in determining the acceptability and hence marketability of the product (von Elbe and LaBorde, 1989; Heaton and Marangoni, 1996 and Artes et al., 2002). Colour often indicates the ripeness or freshness of fruit (Artes et al., 2002). The chemical bases of colours are the pigments anthocyanin, carotenoids and chlorophylls (Jen, 1989).

Knowledge of the pigments present and composition of fruit at different stages of ripening would be very useful in the postharvest management in terms of colour retention and consequently prolonging the shelf life of fruits and the products derived from it (Artes et al., 2002). Understanding changes of the pigment composition of the fresh fruit and their derivatives during ripening would be of use in optimizing treatment after harvest, handling and storage. This knowledge is also of importance to optimise handling and storage of the processed product (Jen, 1989). It is critical to understand the pigment composition and stability during ripening. In the oil extracted from avocado, it is imperative to understand the pigment stability during processing and what critical factors need to be controlled.

Normally, during ripening of fruit, the chloroplast is being converted to chromoplast. In ripe avocado fruit, chloroplast still dominates (Artes et al., 2002). Observation of the fruit flesh reveals a graduated change in colour from that immediately under the skin through to the stone. The flesh falls into three colour sections indicating differing pigment levels (Cran and Possingham, 1973). Data has been published about the pigments and their concentrations in the total fruit flesh with scant information about their relative levels in the different flesh sections and there is no data about the oil content in the different flesh sections. None has been published about pigment compositions in the skin and pulp sections and the extracted oil of 'Hass' avocado in New Zealand.

After harvest, colour and firmness change during ripening. Little has been published about the optimum period after harvest for extracting the greatest amount of oil from the avocado. The degree of ripeness is therefore of interest for extracting oil from the fruit. Information about pigment composition of avocado oil with flesh/skin mixtures is not available. Little is known about the effect of pigment concentrations on the oil by the addition of skin to the flesh section mixture prior to oil extraction and its effect on oil quality, shelf life and toxic compounds such as antifungal diene present in great quantities in avocado skin.

The objectives of this research are to determine the pigment composition of the 'Hass' avocado skin and the fresh flesh tissue and the extracted oil during ripening.

The pigment composition of fresh avocado tissue and the extracted oil during ripening will be compared. Likewise, the fate of the pigments of avocado oil with three levels of skin during storage at different temperatures will also be compared. The effects of skin levels during extraction on the concentration of pigments, stability and shelf life of the avocado oil will be investigated.