Almond (*Prunus dulcis* (Mill.) D.A. Webb) Fatty Acids and Tocopherols under Different Conditions

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ABSTRACT

The thesis, comprising four articles (submitted and ready to be submitted), introduction with literature review and conclusion, is presented for a Degree of Doctor of Philosophy. The four journal articles represent four parts of a study on almond (*Prunus dulcis* (Mill) D.A. Webb) fatty acid and tocopherol composition and the influence of different growing conditions, including regionality and variety, solar ultra violet radiation (UVR) and drought.

Fatty acids and tocopherols are key nutrients which give almonds various therapeutic functions in many health aspects, thereby, almond fatty acids and tocopherols are very important for industry and researchers alike. Based on this significance, the current project aimed to investigate: regional and variety differences particularly in Australian growing regions and across Australian almond breeding selections; solar UVR effects; and the influence of deficit irrigation and lipid maturation on tocopherol accumulation during almond fruit ripening.

The regional and varietal study showed that genotype plays a greater role in differentiating almond unsaturated fatty acids (USFA) and tocopherols than environment. The study also found that irrigated regions predominant in Australia and California produced higher linoleic acid concentration in almonds than rainfall dependant regions like Spain and other Mediterranean countries. The results also demonstrated that selections No. 13 and No. 23 from the Australian almond breeding program had high Vitamin E content and oleic/linoleic acid ratio (O/L ratio) comparable with the variety Guara and Somerton, but has a more pleasing appearance for marketing promotion.

The investigation into the influence of solar UVR showed that a medium dose of increased solar UVR from reflective white weed mat below trees enhanced almond tocopherol concentration, i.e. 14% solar UVR increase enhanced almond tocopherol concentration by

30%. The increased solar UVR did not influence almond lipid content but slightly decreased linoleic acid concentration (i.e. by 2%) and increased oleic acid concentration (by 1.5%).

An examination into the effect of deficit irrigation on almond composition demonstrated that moderate water deficiency i.e. 85% of Evapotranspiration (ET_o) irrigation did not impact on almond lipid and tocopherol concentration, and fatty acid composition was unchanged. In order to gain such circumstances, the deficit irrigation needs to be sustained during the irrigation period, rather than up and down in a periodical way.

By studying almond composition during fruit development, almond lipid maturation and tocopherol synthesis was found to predominantly occur in the early stages of fruit ripening; i.e. 95 to 115 days and 74 to 95 day after anthesis, 1.83 g /day per 100g almond and 0.58 mg /day in 100 g lipids, respectively. On average, each kernel weighs 1.0 g, then during the time of 95 to 115 days and 74 to 95 day after anthesis, daily lipid accumulation in each kernel was 1.83 mg and daily tocopherol synthesis in each kernel was 2.2 ng.

In summary, this project concerns academic research and industry interests alike. The results are expected to be useful for almond orchard management in aspects of irrigation, fertilization and spraying, in order to control and improve almond kernel quality, as well as to provide new information to the broader horticultural research area.

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within the three and half years, but also a very pleasant environment, Waite campus where I enjoyed life very much and gained priceless health fitness.

Three and half years was as fast as the moment of snapping fingers, I have learnt and developed scientific research skills with time, and made some contributions to the research area and the industry alike. I should attribute such achievements to all these supports.

SYMPOSIA

1. 29-31 Oct. 2013, Australian Almond National Conference in Adelaide, *poster presentation* 'Moderate deficient irrigation does not impact on almond lipids and Vitamin E content.'
2. 3 MT competition Jul. 2013, the winner of School of Agriculture, Food and Wine and a finalist of Faculty of Science heat in Aug. 2013.
3. 27-31 May 2013, VI Symposium International on Almonds and Pistachios in Spain Murcia, Conference paper presentation 'Effect of deficit irrigation on almond kernel constituents'.
4. 28-30 Oct. 2012, Australian Almond National Conference in the Barossa Valley, *oral presentation* 'Major nutrition analysis of new selections'.
5. 18-20 Sept. 2012, Annual Waite Symposium, *oral presentation* 'Regional and varietal study on almond tocopherols and fatty acids'.
6. 22 Mar. 2012, Health benefits of polyphenol-rich foods and beverages: latest scienceby International Life Science Institute, in Adelaide, participation and discussion.
7. 1-3 Feb. 2012, Australian Food Science Summer School by Australian Institute of Food Science and Technology Incorporated, in Melbourne, *oral presentation* 'Nutrient-intense source, prospect of almonds on food processing'.
8. 10th Nov. 2011, Annual Waite Research Day, *poster presentation* 'Total Polyphenols and Antioxidant Activity present in New Almond Varieties'.
9. 9-11 Nov. 2011, AAOCS biennial conference 2011- Your Global Fats and Oils Connection in Adelaide (Australian Section, American Oil Chemistry Society), participation and discussion.
10. 13-15 Oct. 2011, ICMAN 5 (International Conference of Mechanism Action of Nutriceuticals 5) in Brisbane, *poster presentation* 'Total Polyphenols and Antioxidant Activity present in New Almond Varieties'.
11. 16-17 May. 2010, AIFST Dietary Fibre and Health Conference in Adelaide, participation and discussion.
12. 28-30 Oct. 2010, Australian Almond National Conference in Mildura, participation and discussion.

LIST OF ABBREVIATIONS

BHA	butylated hydroxyanisole
DAD	diode array detector (coupled with HPLC)
ET_o	evapotranspiration
FA	fatty acid
FFA	free fatty acid
FID	flame ionisation detector (coupled with GC)
FLD	fluorescence detector (coupled with HPLC)
GC	gas chromatography
GLC	gas liquid chromatography
HDL	high-density lipoprotein
HPLC	high performance liquid chromatography
LDL	low-density lipoprotein
MED	minimal erythemal dose (200Jm-2 for skin type I)
Me-OH	methanol
MUFA	monounsaturated fatty acid
O/L	ratio of oleic acid to linoleic acid
PUFA	polyunsaturated fatty acid
SFA	saturated fatty acids
UVR	ultraviolet radiation
USFA	unsaturated fatty acids

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