

Effect of fruit maturity on physicochemical properties, sugar accumulation and antioxidant capacity of wild harvested Kakadu plum (*Terminalia ferdinandiana*)

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INTRODUCTION

Kakadu plum (KP), belonging to the family Combretaceae, is endemic to Australia. KP fruits are traditionally harvested from the wild for food cuisine and/or functional/medicinal ingredients. KP fruits have been reported to have antimicrobial, antioxidant, anti-inflammatory and anticancer activities (Tan et al., 2011; Chaliha and Sultanbawa 2019; Akter et al., 2019).

Determination of appropriate fruit maturity at harvest, particularly at wild conditions, is a key factor to ensure fruit quality, bioactivity, and postharvest shelf-life to meet the growing demand. Therefore, a better understanding of maturity effects on the morphology, physicochemical properties, sugar accumulation and antioxidant capacity of KP is crucial. This will assist in developing a "standard-harvest procedure" for KP fruit targeted for different markets and demands, and will also benefit the KP industry and Australian Indigenous enterprises.

AIMS

This study aimed to investigate the effects of maturity stages on the morphology, physicochemical parameters, soluble sugar profile, and antioxidant capacity of wild harvest KP.

MATERIALS

KP fruits were randomly harvested from six different trees after obtaining the research permits from the Northern Territory Parks and Wildlife Commission and the Traditional Owners. After harvested, the KP fruits were classified into four different maturity stages (immature to mature) as shown in Fig 1.

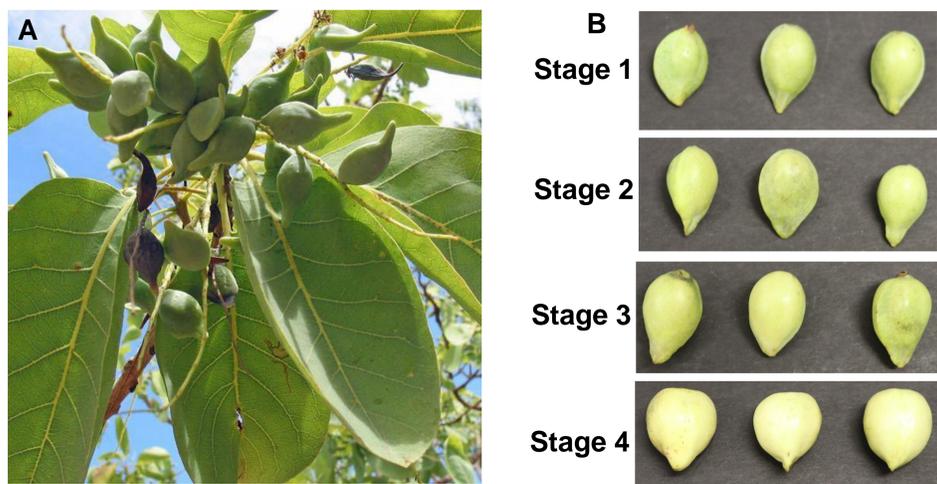


Figure 1. Kakadu plum (A) tree and (B) fruits that were classified into four different maturity stages. Source: (A) https://www.australianseed.com/persistent/catalogue_images/products/terminalia-ferdinandiana-1.jpg

METHODS

Fruit morphology

by physical measurement

Measurement of length, width and weight of:

- Ten fruits at each maturity stage
- Six different trees

Antioxidant capacity

- Total phenolic content (TPC; Folin-Ciocalteu assay)
- DPPH Radical-Scavenging Capacity



Fruit quality

by physicochemical properties

- pH
- Total soluble solid (TSS) content (°Brix)
- Total titrated acid content (TA)

Soluble Sugar Profile

- UHPLC-ESI-MS/MS with MRM using a Triple Quadrupole Mass Spectrometer



RESULTS

Morphology and Physicochemical properties

Table 1 shows an increase in the fruit weight, TSS and TA, and a decrease in pH associated with fruit maturity ($p < 0.05$; Table 1).

Table 1: Morphology and physicochemical properties of KP fruits harvested at different maturity

Maturity Stages	Weight (g)	Length (mm)	Width (mm)	pH	TA (%)	TSS (%)
1	2.0 ± 0.5 b	25.2 ± 4.0 a	15.6 ± 1.5 a	4.0 ± 0.1 a	3.0 ± 0.3 b	19.3 ± 4.9 b
2	2.0 ± 0.5 b	23.8 ± 2.3 a	15.3 ± 1.8 a	3.9 ± 0.1 ab	3.7 ± 0.4 b	32.7 ± 11.7 a
3	2.5 ± 0.4 ab	24.6 ± 1.7 a	15.4 ± 1.0 a	3.8 ± 0.1 b	4.5 ± 0.2 ab	37.2 ± 9.8 a
4	2.8 ± 0.5 a	23.6 ± 2.0 a	15.9 ± 1.9 a	3.8 ± 0.1 b	4.8 ± 0.3 a	41.1 ± 12.2 a

Data present mean ± SD (n=6) on dry weight basis. Different letters at the same column indicate significant differences ($\alpha = 0.05$).

Antioxidant capacity

No statistical differences in both TPC and DPPH radical scavenging capacity of KP fruits harvested at four maturity stages were observed ($P > 0.05$; Fig 2).

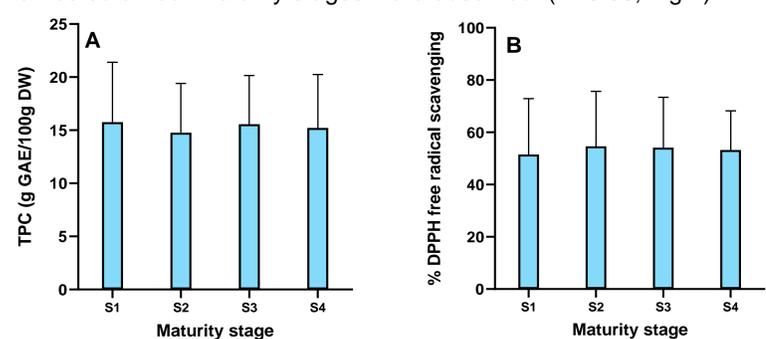


Figure 2: (A) TPC and (B) DPPH radical scavenging capacity of the methanolic extract (20 g/L). Data present mean ± SD (n=6) on dry weight basis.

Sugar accumulation

Differences in sugar accumulation were observed with the advance in maturity ($P < 0.05$, Fig 3).

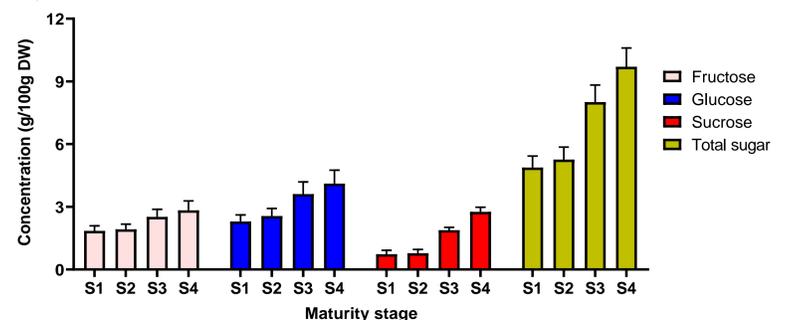


Figure 3: (Main) Individual and total sugars of KP fruits harvested at different maturity stages. Data present mean ± SD (n=6) on dry weight basis.

Correlations between fruit morphology and tested variables

Fig 4 shows (A) a positive correlation between sugar and fruit weight, and (B, C) negative correlations between antioxidant capacity and fruit weight.

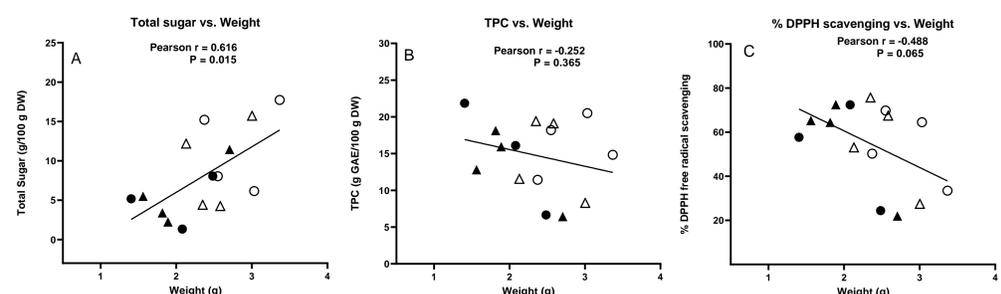


Figure 4: Pearson correlation between fruit morphology and tested variables (●: S1; ▲: S2; △: S3; ○: S4)

CONCLUSIONS

This study reports the effects of different maturity stages on quality and antioxidant capacity of KP fruit. The results showed a significant increase in total sugars and changes in physicochemical properties with maturity, whereas a similar antioxidant capacity was observed from immature to mature. The obtained findings have provided important information for developing a standard procedure for harvesting KP fruits with consistent quality under wild harvested conditions.

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