

Bark traits, decomposition and flammability of Australian forest trees

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Table S1. Trait measurements, decomposability measurements and flammability measurements based on species' means, n = 9. Measurements marked with an asterisk (*) are not independent since we standardised by bark-size at the beginning of the experiment.

Trait	Bark (range; x-fold variation)	Leaves (range, x-fold variation)
One sided surface area (cm ²)	10.9-16.5; 1.5*	13.0-38.1; 2.9
Thickness (mm)	0.99-7.11; 7.2	0.33-0.81; 2.5
Dry mass (g)	0.40-2.20; 5.6*	0.27-1.02; 3.8
Density (g cm ⁻³)	0.22-1.13; 5.1	0.33-0.74; 2.2
Area per mass (cm ² g ⁻¹)	5.63-30.67; 5.4 (BAM)	27.23-59.97; 2.2 (SLA)
Tensile strength (Newton mm ⁻¹)	3.75-53.75; 14.3	N/A
Moisture content - before burning (% odw)	11.8-14.4; 1.2	7.3-10.0; 1.4
Energy content (MJ kg ⁻¹)	18.7-20.2; 1.1	20.8-22.8; 1.1
C (%)	44.5-48.9; 1.1	48.2-51.9; 1.1
Ca (%)	0.02-0.96; 48.0	0.36-1.01; 2.9
Cu (mg kg ⁻¹)	1.15-8.37; 7.3	2.97-22.03; 7.4
K (%)	0.01-0.15; 15.0	0.05-0.35; 6.5
Mg (%)	0.01-0.16; 16.0	0.14-0.28; 1.9
N (%)	0.05-0.32; 6.4	0.31-0.68; 2.2
P (mg kg ⁻¹)	22.1-63.4; 2.9	66.6-367.7; 5.5
Lignin (%)	19.3-45.7; 2.4	8.0-24.2; 3.0
Cellulose (%)	36.1-53.8; 1.5	19.0-44.1; 2.3
Ash (%)	0.05-1.05; 21.0	0.06-1.16; 18.2
Tannins (%)	0.08-33.64; 420.5	0.96-31.95; 33.3
Decomposition after 12 months (% mass loss)	6.7-27.8; 4.2	22.1-60.1; 2.7
Decomposition after 24 months (% mass loss)	26.7-71.2; 2.7	55.8-91.9; 1.6
Time To Ignition (s)	2.6-14.0; 5.4	1.9-4.2; 2.2
Flame Duration (s)	11.2-94.2; 8.4	6.0-16.4; 2.7
FD/mass (g s ⁻¹)	26.8-47.9; 1.8	12.0-29.3; 2.4
Smoulder Duration (s)	55.0-566.6; 10.3	22.0-79.0; 3.6
SD/mass (g s ⁻¹)	122.5-205.4; 1.7	53.1-97.3; 1.8
Combustibility (mg s ⁻¹)	4.9-7.5; 1.5	9.8-18.3; 1.9

Table S2. Bivariate regressions between bark traits and several parameters of decomposability and flammability. Significant relationships ($P < 0.05$) are presented in bold, followed by the sign of these relationships in parentheses; (+) for positive, (-) for negative relationships.

Bark traits	Mass loss 12 months (%)	Mass loss 24 months (%)	TTI (s)	Log FD/mass (s g ⁻¹)	SD/mass (s g ⁻¹)	Combustibility (mg s ⁻¹)
Surface area	$r^2 = 0.03$ $P = 0.655$	$r^2 = 0.01$ $P = 0.852$	$r^2 = 0.17$ $P = 0.232$	$r^2 = 0.04$ $P = 0.597$	$\rho = 0.20$ $P = 0.590$	$r^2 = 0.02$ $P = 0.711$
Log Thickness	$r^2 = 0.06$ $P = 0.483$	$r^2 < 0.01$ $P = 0.860$	$r^2 < 0.01$ $P = 0.932$	$r^2 < 0.01$ $P = 0.947$	$\rho = 0.26$ $P = 0.467$	$r^2 = 0.12$ $P = 0.326$
Log Dry mass	$r^2 = 0.04$ $P = 0.587$	$r^2 = 0.02$ $P = 0.673$	$r^2 = 0.19$ $P = 0.209$	$r^2 = 0.01$ $P = 0.741$	$\rho = 0.10$ $P = 0.777$	$r^2 = 0.29$ $P = 0.107$
Log Density	$r^2 = 0.03$ $P = 0.652$	$r^2 = 0.02$ $P = 0.730$	$r^2 = 0.13$ $P = 0.313$	$r^2 = 0.02$ $P = 0.728$	$\rho = 0.16$ $P = 0.663$	$r^2 = 0.04$ $P = 0.596$
Area per mass	$r^2 = 0.06$ $P = 0.509$	$r^2 = 0.01$ $P = 0.798$	$r^2 = 0.10$ $P = 0.384$	$r^2 = 0.04$ $P = 0.580$	$\rho = 0.07$ $P = 0.855$	$r^2 = 0.10$ $P = 0.378$
Log Tensile strength	$r^2 = 0.05$ $P = 0.519$	$r^2 = 0.11$ $P = 0.359$	$r^2 = 0.28$ $P = 0.113$	$r^2 = 0.03$ $P = 0.609$	$\rho = 0.12$ $P = 0.751$	$r^2 = 0.01$ $P = 0.800$
Moisture content	$r^2 = 0.05$ $P = 0.522$	$r^2 < 0.01$ $P = 0.919$	$r^2 = 0.40$ (+) $P = 0.049$	$r^2 = 0.01$ $P = 0.852$	$\rho = 0.22$ $P = 0.533$	$r^2 = 0.01$ $P = 0.742$
Energy content	$r^2 = 0.55$ (-) $P = 0.014$	$r^2 = 0.19$ $P = 0.212$	$r^2 = 0.28$ $P = 0.116$	$r^2 = 0.26$ $P = 0.129$	$\rho = 0.14$ $P = 0.701$	$r^2 < 0.01$ $P = 0.939$
Log C	$r^2 = 0.56$ (-) $P = 0.012$	$r^2 = 0.29$ $P = 0.108$	$r^2 = 0.13$ $P = 0.304$	$r^2 = 0.31$ $P = 0.093$	$\rho = 0.01$ $P = 0.987$	$r^2 < 0.01$ $P = 0.910$
Log Ca	$r^2 = 0.06$ $P = 0.483$	$r^2 < 0.01$ $P = 0.943$	$r^2 = 0.61$ (+) $P = 0.008$	$r^2 = 0.04$ $P = 0.607$	$\rho = 0.23$ $P = 0.532$	$r^2 = 0.47$ (-) $P = 0.029$
Log Cu	$r^2 = 0.09$ $P = 0.400$	$r^2 = 0.07$ $P = 0.465$	$r^2 = 0.04$ $P = 0.568$	$r^2 = 0.54$ (+) $P = 0.016$	$\rho = 0.41$ $P = 0.244$	$r^2 = 0.29$ $P = 0.107$
Log K	$r^2 = 0.32$ $P = 0.090$	$r^2 = 0.30$ $P = 0.104$	$r^2 = 0.20$ $P = 0.201$	$r^2 = 0.03$ $P = 0.640$	$\rho = 0.03$ $P = 0.945$	$r^2 < 0.01$ $P = 0.879$
Log Mg	$r^2 = 0.12$ $P = 0.330$	$r^2 = 0.03$ $P = 0.615$	$r^2 = 0.62$ (+) $P = 0.007$	$r^2 < 0.01$ $P = 0.924$	$\rho = 0.05$ $P = 0.894$	$r^2 = 0.12$ $P = 0.318$
Log N	$r^2 < 0.01$ $P = 0.893$	$r^2 = 0.04$ $P = 0.562$	$r^2 = 0.69$ (-) $P = 0.003$	$r^2 = 0.06$ $P = 0.498$	$\rho = 0.01$ $P = 0.987$	$r^2 = 0.03$ $P = 0.638$
P	$r^2 = 0.22$ $P = 0.173$	$r^2 = 0.22$ $P = 0.168$	$r^2 = 0.03$ $P = 0.613$	$r^2 = 0.03$ $P = 0.628$	$\rho = 0.44$ $P = 0.200$	$r^2 = 0.03$ $P = 0.613$
Lignin	$r^2 = 0.66$ (-) $P = 0.004$	$r^2 = 0.64$ (-) $P = 0.006$	$r^2 = 0.01$ $P = 0.811$	$r^2 = 0.49$ (+) $P = 0.025$	$\rho = 0.37$ $P = 0.293$	$r^2 = 0.25$ $P = 0.144$
Cellulose	$r^2 = 0.57$ (+) $P = 0.011$	$r^2 = 0.43$ (+) $P = 0.038$	$r^2 = 0.10$ $P = 0.375$	$r^2 = 0.38$ $P = 0.056$	$\rho = 0.49$ $P = 0.150$	$r^2 = 0.18$ $P = 0.227$
Log Ash	$r^2 < 0.01$ $P = 0.932$	$r^2 = 0.01$ $P = 0.854$	$r^2 = 0.29$ $P = 0.106$	$r^2 = 0.40$ $P = 0.052$	$\rho = 0.13$ $P = 0.725$	$r^2 = 0.01$ $P = 0.840$
Tannins	$r^2 = 0.06$ $P = 0.503$	$r^2 = 0.05$ $P = 0.547$	$r^2 = 0.03$ $P = 0.626$	$r^2 = 0.14$ $P = 0.296$	$\rho = 0.30$ $P = 0.405$	$r^2 = 0.10$ $P = 0.364$

Table S3. Decomposition after 12 and 24 months (percentage mass loss of initial samples) versus the different flammability parameters, i.e., time-to-ignition (TTI), mass-standardised flame duration (FD/mass), mass-standardised smoulder duration (SD/mass), and combustibility. Results (r^2 or ρ and P -values) are presented for bark and leaves. No significant relationships were found (all $P \geq 0.180$).

Material	Mass loss after x months	Flammability parameter	r^2 (or ρ)	P
Bark	12	TTI	0.005	0.854
		Log FD/mass	0.002	0.894
		SD/mass	ρ : -0.091	0.803
		Combustibility	0.054	0.517
	24	TTI	0.066	0.475
		Log FD/mass	0.188	0.211
		SD/mass	ρ : -0.321	0.365
		Combustibility	0.213	0.180
Leaves	12	TTI	0.001	0.947
		Log FD/mass	0.168	0.239
		SD/mass	0.092	0.395
		Combustibility	0.005	0.845
	24	TTI	0.004	0.869
		Log FD/mass	0.204	0.190
		SD/mass	0.088	0.404
		Combustibility	0.000	0.953

Table S4. Traits with significant importance for decomposition and flammability parameters. Results after stepwise multiple regressions; both for bark and leaves. Relationships are based on species-means. TTI = time-to-ignition, FD = flame duration and SD = smoulder duration.

Material	Mass loss 12 months (%)	Mass loss 24 months (%)	TTI (s)	Log FD/mass (s g ⁻¹)	SD/mass (s g ⁻¹)	Combustibility (mg s ⁻¹)
Bark	Lignin (-) <i>P</i> = 0.004 <i>r</i> ² = 0.66	Lignin (-) <i>P</i> = 0.006 <i>r</i> ² = 0.63	Log [N] (-) <i>P</i> = 0.003 <i>r</i> ² = 0.69	Log [Cu] (+) <i>P</i> = 0.016 <i>r</i> ² = 0.54	N/A	Log [Ca] (-) <i>P</i> = 0.029 <i>r</i> ² = 0.47
	Tannins (-) <i>P</i> = 0.013 Tot <i>r</i> ² = 0.87	Tannins (-) <i>P</i> = 0.037 Tot <i>r</i> ² = 0.81	Log [Ca] (+) <i>P</i> < 0.001 Tot <i>r</i> ² = 0.96	[P] (-) <i>P</i> = 0.019 Tot <i>r</i> ² = 0.80		Cellulose (+) <i>P</i> = 0.015 Tot <i>r</i> ² = 0.79
Leaves	Lignin (-) <i>P</i> = 0.005 <i>r</i> ² = 0.64	Lignin (-) <i>P</i> = 0.015 <i>r</i> ² = 0.55	SLA (-) <i>P</i> = 0.001 <i>r</i> ² = 0.79	Log [K] (-) <i>P</i> = 0.037 <i>r</i> ² = 0.44	N/A	N/A
		Thickness (-) <i>P</i> = 0.015 Tot <i>r</i> ² = 0.82				

Table S5. Variance component analysis for two decomposition and six flammability parameters (based on MINQUE – Minimum Norm Quadratic Unbiased Estimation).

Material	Parameter	Variation within species (%)	Variation among species (%)
Bark	Decomposition 12 months	39.8	60.2
	Decomposition 24 months	43.2	56.8
	Log TTI	42.9	57.1
	Log FD	45.9	54.1
	Log FD/mass	88.0	12.0
	Log SD	20.4	79.6
	Log SD/mass	71.4	28.6
	Log combustibility	72.7	27.3
Leaves	Decomposition 12 months	42.8	57.2
	Decomposition 24 months	44.1	55.9
	Log TTI	57.9	42.1
	Log FD	48.6	51.4
	Log FD/mass	64.3	35.7
	Log SD	34.4	65.6
	Log SD/mass	66.7	33.3
	Log combustibility	65.0	35.0

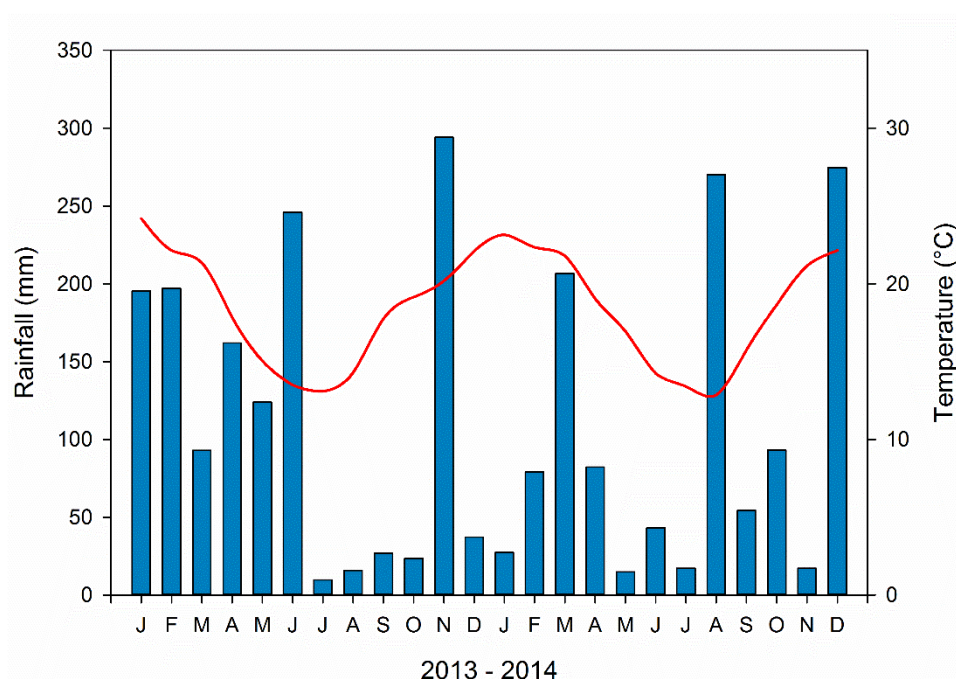


Fig. S1. Rainfall and temperature for the years 2013 and 2014. Rainfall from Turrumurra weather station, 3.8 km from Macquarie University campus; temperature from Riverview Observatory, 7.0 km from Macquarie University campus (www.bom.gov.au).

Text S1. Extraction methods for leaf and bark chemistry

Carbon and nitrogen

0.25 g of sample was weighed out into a tin foil capsule which was placed into the induction furnace of a LECO Truspec CHN combustion analyser set at 1100°C and calibrated on EDTA. The carbon present was combusted to CO₂ which was determined with an infrared detection cell. The nitrogen present was combusted to N₂, NO₂ and NO. The oxides were reduced to N₂ which was determined quantitatively using a thermal conductivity cell.

(Rayment, G.E. & Lyons, D.J. (2011) *Soil Chemical Methods: Australasia*. CSIRO Publishing. Handbook section 6B2, p75.)

Other elements (acid digestions)

0.25 g of sample was weighed out and digested with 15 ml of 5:1 nitric-perchloric acid. The digested sample was made up to a volume of 25 ml and the elemental concentrations were then determined by ICPAES.

(Martinie, G.D. & Schilt, A.A. (1976) *Wet oxidation efficiencies of perchloric acid mixtures for various organic substances and the identities of residual matter*. *Analytical Chemistry*, 48, 70-74.)

Tannin analysis

0.2 g of sample was weighed out and extracted 3 times with 8 ml of 70% acetone for 45 minutes with the extracts made up to 25 mL volume. 1 ml of extract was heated with 5 ml of 19:1 butanol-HCl at 95°C for 45 minutes in a water bath. The extracts were analysed at a wavelength specific to the tannin in question. Bound tannin is measured by adding 5 ml of Butanol HCl to the extraction residue and heating as above. Please note that these samples have been quantified using a condensed tannin stock prepared from *Acacia aneura* (mulga) which was the best fit we could find for the range of samples in question. As a consequence these values should be reported as relative numbers rather than absolutes.

(Dalzell, S.A. & Kerven, G.L. (1998) *A rapid method for the measurement of Leucaena spp proanthocyanidins by the proanthocyanidin (butanol/HCl) assay*. *Journal of the Science of Food and Agriculture*, 78, 405-416.)

Lignin and Cellulose analysis (ADF extraction)

ADF analysis measures cellulose + lignin + ash content. ADF reagent was prepared from CTAB (cetyltrimethylammonium bromide) and H₂SO₄. 1.0 g of sample was extracted with 45 ml of ADF reagent at 100°C for 70 minutes. The samples were then filtered, rinsed and dried at 60°C for 12 hrs. The dried samples were then reacted with 25 mL of cold 72% H₂SO₄ for 3 hours; then filtered and rinsed again prior to ashing at 500°C for three hours.

(Rowland, A.P. & Roberts, J.D. (1994) *Lignin and cellulose fractionation in decomposition studies using acid-detergent fibre methods*. *Communications in Soil Science and Plant Analysis*, 25, 269-277.)