

Utilisation of Euphorbiaceae in Australia

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Outside of Australia the family is the source of industrial rubber (*Hevea brasiliensis*), the root crop Cassava (*Manihot esculenta*), fruits (*Antidesma bunius*, *Baccaurea* spp., *Phyllanthus acidus*, *P. emblica*), the emetic Castor Oil (*Ricinus communis*), varnish oils (*Vernicia* spp.), dye plants (*Chrozophora tinctoria*, *Mallotus philippensis*), waxes (*Euphorbia antisyphilitica*) and timber (*Heywoodia lucens*, *Ricinodendron heudelotii*, *Uapaca* spp.). A considerable number of popular and widespread garden and landscape plants (*viz.* *Acalyphas* (*Acalypha* spp.), *Breynia* (*Breynia nivosa*), *Crotons* (*Codiaeum variegatum*), *Euphorbias* (*Euphorbia* spp.), *Jatrophas* (*Jatropha* spp.), *Poinsettias* (*Euphorbia pulcherrima*) and *Pedilanthus* are widely grown in suitable climates worldwide.

As yet, no species of Euphorbiaceae that is native to Australia can be considered of commercial significance. The best potential may be in the development of fruit crops from *Antidesma* and *Flueggea* spp. (Considine 1996).

Traditional Aboriginal Usage

Many Euphorbiaceae are common plants in the landscape, particularly in northern tropical Australia. Not surprisingly a range of species from the different subfamilies have been recorded as being utilized by aboriginal groups and several species (*viz.* *Euphorbia drummondii*, *Excoecaria parvifolia*, *Flueggea virosa*) can be construed as constituting 'broad-spectrum' multiuse species (*cf.* Pearn 2005). The following account of uses is dependent on published sources and should not be relied upon for nutritional or clinical accuracy. Recorded uses tend to practical outcomes such as food, medicine and fibre and to some extent reflect the approach of the particular botanists and anthropologists, especially in terms of wider community application of this knowledge (Clarke 2003). The relationship of these particular plants to aspects of Aboriginal cultures and land management practices are poorly understood (Clarke 2003). Some species (e.g. *Excoecaria parvifolia*) increase in density in the landscape following the cessation of fire (Sharp & Whittaker 2003); however, little is known about Aboriginal land management regimes and their specific effects on Euphorbiaceous plants.

Bush food plants

The fruits of *Antidesma bunius*, *A. erostre*, *A. ghesaembilla*, *A. parvifolium*, *Breynia cernua*, *Bridelia tomentosa*, *Drypetes deplanchei*, *Flueggea virosa* and *Mallotus nesophilus* are much prized and eaten without further preparation (Palmer 1884; Roth 1901; Specht 1958; Levitt 1981; Crawford 1982; Altman 1984; Smith & Kalotas 1985; Wightman & Smith 1989; Smith & Wightman 1990; Wightman *et al.* 1992a,b; Smith *et al.* 1993; Marrfurra *et al.* 1995; Yunupinu *et al.* 1995; Bindon 1996; Blake *et al.* 1998; Raymond *et al.* 1999; Lindsay *et al.* 2001; Puruntatameri *et al.* (2001), Wiynjorrotj *et al.* 2005). The fruit of *Aleurites rockinghamensis* (as *A. moluccana*) are eaten after roasting in a fire (Bailey 1902; Roberts *et al.* 1995). The fruit of *Aleurites moluccana* are probably eaten in much the same way (*cf.* Hill & Baird 2003). The leaves of *Drypetes deplanchei* are used to 'sweeten' the flavour of meat and yams (Blake *et al.* 1998) and cooked seafood (fish, turtles) (Yunupinu *et al.* 1995). The leaves of *Mallotus nesophilus* are used to protect certain foods from dirt during cooking in ground ovens (Blake *et al.* 1998). The roots of *Adriana urticoides* (as *A. hookeri*) contain an edible grub (Johnstone & Cleland 1942) and the stems of *Homolanthus novoguineensis* and *Macaranga tanarius* are a good source of witchetty grubs (Lindsay *et al.* 2001; Puruntatameri *et al.* 2001).

Hunting and Gathering

The foliage and latex of *Excoecaria parvifolia*, the bark of *Euphorbia plumerioides* and the fruit of *Petalostigma quadriloculare* are used to poison waterholes to enable fish gathering (Webb 1960; Wightman *et al.* 1992b; Raymond *et al.* 1999; Lindsay *et al.* 2001; Wiynjorrotj *et al.* 2005). The wood of *Excoecaria parvifolia* and *Petalostigma quadriloculare* are used for firewood (Woolston 1973; Raymond *et al.* 1999). The sap of *Euphorbia drummondii* was used to stick small feathers to bees enabling their tracking to hives (Maiden 1889).

Insecticides

The leaves and timber of *Excoecaria parvifolia* were burnt to drive away mosquitoes (Woolston 1973; Lindsay *et al.* 2001).

Material Culture

The fruit of *Antidesma ghesaembilla* are squashed to produce dye used in basketry (Bindon 1996). The leaves of *Petalostigma pubescens* are boiled with those of *Pandanus* to produce a dark grey to black dye (Puruntatameri *et al.* 2001). The inner bark of the roots of *Phyllanthus ditassoides* are boiled in water to produce a red dye (Puruntatameri *et al.* 2001). The white latex of *Euphorbia tannensis* is used for body decoration (Latz 1995) and the oil from fresh fruit of *Aleurites rockinghamensis* (as *A. moluccana*) is used to attach ochre to bodies (Roberts *et al.* 1995). The timber of *Excoecaria parvifolia* is used for clap-sticks (Raymond *et al.* 1999) and for carvings (Yunupinu *et al.* 1995). The leafy branches of *Croton tomentellus* are worn in ceremonies (Smith & Kalotas 1985). Leaves of *Petalostigma pubescens* are placed in bath water to make the skin shiny (Webb 1959) and the fruit of this species are used as marbles by children (Puruntatameri *et al.* 2001). Ash from the burnt wood of *Croton arnhemicus* is mixed with chewing tobacco to increase nicotine release and improve texture and flavour (Raymond *et al.* 1999; Wijnjorrotj *et al.* 2005).

Medicine

Skin Complaints

The white latex or crushed up plants of *Euphorbia australis*, *E. drummondii*, the introduced *E. hirta*, *E. schizolepis* and *E. tannensis* is applied to skin sores, rashes and warts and the bark of *Croton arnhemicus*, *Excoecaria parvifolia* and *Flueggea virosa* is boiled in water (decoction) before being used for the same purpose (Lands 1987; Wightman *et al.* 1992a, 1994; Aboriginal Communities of the Northern Territory 1993; Smith *et al.* 1993; Latz 1995; Bindon 1996). An infusion of the leaves or bark and roots of *Flueggea virosa* is applied to cuts, sores and itchy bites (Webb 1959; Smith & Kalotas 1985). Antiseptic washes are prepared from the latex, leaves and fruit, and bark of *Excoecaria parvifolia*, *Petalostigma quadriloculare* and the seeds of *Flueggea virosa* respectively after they are boiled or steeped in water (Bailey 1902; Smith & Wightman 1990; Aboriginal Communities of the Northern Territory 1993; Smith *et al.* 1993). The root of *Croton multicaulis* subsp. *multicaulis* (as *C. arnhemicus*) is ground and mixed with water before being used as a topical application on skin sores (Kyriazis 1995). Fungal infections of the skin are treated with foliage sap and the fruit skin of *Aleurites rockinghamensis* (as *A. moluccana*) (Roberts *et al.* 1995). Sore eyes are treated with the latex of *Euphorbia drummondii* (Webb 1959) or a water based infusion of the bark or fruit of *Petalostigma pubescens* and *P. quadriloculare* (Crawford 1982; Bindon 1996). A decoction of the leaves of *Phyllanthus lacunarius* is used as a topical wash to treat measles (Latz 1995). Leprosy and “marine stings” were treated with the latex of *Excoecaria agallocha* (Maiden 1889; Webb 1960). Head lice are picked from hair using sticks of *Excoecaria parvifolia* (Raymond *et al.* 1999).

Internal Complaints

Contraceptive concoctions are derived from an infusion of fruit in water of *Petalostigma pubescens* (Levitt 1981). Toothache is treated with a water-based infusion of the bark or fruit of *Petalostigma pubescens* and *P. quadriloculare* (Webb 1959; Crawford 1982; Bindon 1996). Headaches and joint swelling is treated with a decoction of the inner bark of *Croton arnhemicus* (Aboriginal Communities of the Northern Territory 1993). A decoction of the inner bark of *Excoecaria parvifolia* is used to treat joint pain and swellings from trauma (Aboriginal Communities of the Northern Territory 1993). Chest pains are treated with a decoction of *Euphorbia drummondii* rubbed into the skin (Aboriginal Communities of the Northern Territory 1993). A decoction of the leaves and branches of *E. drummondii* was drunk as a cure (probably quite ineffective) for gonorrhoea (Maiden 1889; Johnston & Cleland 1943). The latex of the same species was topically applied to the genitals for venereal infections and sores (Webb 1959). The foliage of *Croton tomentellus* and the bark and roots of *Flueggea virosa* are used to treat rheumatism (Smith & Kalotas 1985). Internal pains and sickness were treated by drinking an infusion of young leaves of *Flueggea virosa* (Webb 1959) or applying the mashed up bark of *Excoecaria parvifolia* as a topical wash (Palmer 1884). Dysentery was treated by a bark infusion of *Breynia cernua*, a foliage infusion of *Euphorbia drummondii* or by the sap of *Mallotus mollissimus* (as *M. ricinoides*) mixed with coconut juice (Maiden 1889; Webb 1960). Diarrhoea was treated by chewing the flowers of *Euphorbia mitchellii* (Webb 1959). Honey from the flowers of *Euphorbia litticola* (as *atoto*) was mixed with water and drunk to ‘clean out the throat’ (Webb 1959).

Wounds

A decoction of pounded roots of *Synostemon glaucus* is applied to open sores and cuts (Aboriginal Communities of the Northern Territory 1993). The sap of *Macaranga tanarius* is applied to deep cuts instead of stitches (Kyriazis 1995).

Tools and weapons

The high density of the woods of many euphorb stems have enabled their use for a variety of purposes (Table 1).

Twine was once fashioned from the stems of *Macaranga tanarius* (Roth 1901). Thin, generally dried, stems of *Breynia cernua*, *Flueggea virosa* and *Phyllanthus reticulatus* are used as fire sticks or bush matches (Lands 1987; Smith *et al.* 1993; Marrfurra *et al.* 1995; Blake *et al.* 1998; Raymond *et al.* 1999; Lindsay *et al.* 2001; Puruntatameri *et al.* 2001). Dried fruits of *Aleurites rockinghamensis* (as *A. moluccana*) are hollowed out and used as whistles to attract birds to slaughter (Roberts *et al.* 1995).

Table 1. Aboriginal use of Euphorbiaceae wood.

Taxon	Wood Use	Reference
<i>Antidesma ghesaembilla</i>	hooked and barbed spear heads, digging sticks	Marrfurra <i>et al.</i> 1995
<i>Choriceras tricorne</i>	digging sticks, fighting sticks, throwing sticks	Blake <i>et al.</i> 1998; Puruntatameri <i>et al.</i> (2001),
<i>Croton triacros</i>	spears	Roth 1901; Bailey 1902
<i>Dissiliaria baloghioides</i>	nulla nullas, spears, paddymelon sticks	Bailey 1902
<i>Excoecaria agallocha</i>	canoes, floats for harpoons and fishing spears, shields	Roth 1901; Bailey 1902; Levitt 1981; Smith & Kalotas 1985; Blake <i>et al.</i> 1998
<i>Excoecaria ovalis</i>	spears	Blake <i>et al.</i> 1998
<i>Excoecaria parvifolia</i>	boomerangs, fighting sticks, nulla nullas, smoking pipes	Wightman <i>et al.</i> 1992a,b, 1994; Smith <i>et al.</i> 1993; Marrfurra <i>et al.</i> 1995; Blake <i>et al.</i> 1998
<i>Flueggea virosa</i>	spears	Yunupinu <i>et al.</i> 1995; Wijnjorrotj <i>et al.</i> 2005).
<i>Homolanthus novoguineensis</i>	spears	Yunupinu <i>et al.</i> 1995; Wijnjorrotj <i>et al.</i> 2005
<i>Macaranga involucrata</i>	spears	Puruntatameri <i>et al.</i> 2001
<i>Macaranga tanarius</i>	spears	Roth 1901; Bailey 1902; Specht 1958; Levitt 1981; Smith & Wightman 1990; Yunupinu <i>et al.</i> 1995; Blake <i>et al.</i> 1998; Puruntatameri <i>et al.</i> 2001; Wijnjorrotj <i>et al.</i> 2005
<i>Mallotus nesophilus</i>	woomerangs, spears	Wijnjorrotj <i>et al.</i> 2005
<i>Margaritaria dubium-traceyi</i>	spears	Wightman <i>et al.</i> 1992b; Wijnjorrotj <i>et al.</i> 2005
<i>Petalostigma pubescens</i>	boomerangs	Wightman <i>et al.</i> 1992a,b
<i>Phyllanthus reticulatus</i>	throwing sticks	Lindsay <i>et al.</i> 2001

Contemporary Uses

Folk Medicine

Many of the 'alternative' or 'pioneer' use of Australian plants undoubtedly arose from observations of local aboriginal people or by similarity with plants used by European settlers in their countries of origin. Pioneering observations and compilations of these uses by Thozet (1866), Bailey (1881, 1902), Palmer (1884), Maiden (1889) and Roth (1901) laid the foundation for much of the information in more recent literature such as the populist works by Cribb & Cribb (1974, 1981a,b), Low (1988) and Bindon (1996), as well as in popular magazines and internet sources. Many of the Australian Euphorbiaceae remain unexplored for their chemical composition and any potential commercial pharmaceutical applications.

Infusions of the foliage of *Euphorbia drummondii* were considered useful against a range of complaints (Bailey 1902); however, no further research appears to have been undertaken. An infusion of the foliage of *E. mitchelliana* (as *alsiniflora*) was used to treat dysentery and fever (Maiden 1889). A decoction of the introduced *E. hirta* (sometimes in early literature as *Euphorbia pilulifera*) was used to treat asthma and a variety of other ailments (Maiden 1889; Bailey 1902) and the flavonoid glycoside quercetin-3-O-β-D-rhamnoside has been found to be responsible for at least antidiarrhoeic effects (Galvez *et al.* 1993; Mallavadhani *et al.* 2002).

Medical Research

Anti-tumor activity has been found in diterpene extracts from *Excoecaria agallocha* (Konishi *et al.* 1998; Konishima *et al.* 2001). Extracts of the introduced weed *Phyllanthus amarus* and some other species in this genus appear to control hepatitis B virus infection (Thyagarajan *et al.* 1988; Lee *et al.* 1996; Liu *et al.* 2001). The sap of the introduced weed *Euphorbia peplus* is effective against skin cancers via the antitumour activity of 3-ingenyl angelate (Ogbourne *et al.* 2004). The sap of the latter species is often used as a direct topical application to skin cancers. The fruit of *Mallotus philippensis* contain phloroglucinol derivatives that are effective anti-allergic agents (Daikonya *et al.* 2002) and that were traditionally used as a vermifuge in India (Maiden 1889). The genus *Croton* is a rich source of alkaloids and other chemicals (Farnsworth *et al.* 1969); however, the Australian species have been largely unstudied.

Dyes and Paints

The red glands covering the fruit of *Mallotus philippensis* are the source of Rottlerin and Isorottlerin and were traditionally used as a dye of food, textiles and medicines in Asia (Maiden 1889; Nair & Rao 1993); however, this technology does not appear to have been applied in Australia (Bailey 1902). Brownish-yellow and reddish-brown dyes have been extracted from the barks of *Petalostigma quadriloculare* and *Croton insularis* respectively (Maiden 1889). The foliage of *Chrozophora tinctoria* (Başlar & Mert 1999) and the bark of *Jatropha curcas* (Alde *et al.* 1947; Kumar & Sinhar 2004) have been used in textile dyeing outside of Australia. Interest in natural colourants may result in renewed interest in this sort of natural product (Kumar & Sinha 2004), particularly given possible anti-viral properties of certain dyes (Gupta *et al.* 2004).

An indelible paint was prepared from the latex of *Baloghia inophylla* and used on bags and other articles (Maiden 1889).

Oils and Resins

A chewable resin of the fruit of *Aleurites moluccana* is used in the Western Pacific (Maiden 1889). This species is well known for the use of its oily fruits as a burnable light source (Maiden 1889). Many species of *Bertya* and *Beyeria* produce copious amounts of resin on the foliage which is secreted from glandular hairs (*cf.* Dell & McComb 1974) and although its potential use was championed by Maiden (1889) nothing has been made of it. The seeds of *Ricinocarpos pinifolius* were observed to produce copious amounts of oil (Maiden 1889). The bark and leaves of *Croton phebalioides* contains small quantities of essential oils (J.J.Brophy, R.J.Goldsack & P.I.Forster, unpubl.).

Timber

The wood of most Australian Euphorbiaceae is not used in any way due to its rarity, poor form, lack of durability and structural strength and the presence of latex in some species. 'Gutta Percha' (*Excoecaria parvifolia*) is occasionally used as a specialty item by wood-turners. The woods of *Antidesma bunius*, *A. ghesaembilla*, *Baloghia inophylla*, *Bridelia exaltata*, *Claoxylon australe*, *Dissiliaria baloghioides*, *Excoecaria parvifolia*, *Petalostigma quadriloculare* and *Mallotus claoxyloides* were considered suitable for cabinet work, *Dissiliaria baloghioides* for fence posts, *Excoecaria dallachyana* and *Glochidion lobocarpus* for tool handles, *Beyeria viscosa* for pulley blocks and turnery, *Drypetes deplanchei* for printer's engraving blocks and turnery and *Bridelia exaltata*, *Glochidion ferdinandi*, *Mallotus discolor*, *M. mollissimus* and *M. philippensis* for general construction, flooring and packing cases (Bailey 1888, 1902; Maiden 1889; Francis 1951). Although *Antidesma bunius*, *A. erostre*, *Baloghia inophylla*, *Bischofia javanica*, *Bridelia insulana*, *Croton triacros*, *Drypetes deplanchei*, *Endospermum myrmecophilum*, *Excoecaria agallocha*, *E. dallachyana*, *E. parvifolia*, *Glochidion ferdinandi*, *G. harveyanum*, *G. sumatranum*, *Homolanthus novoguineensis* (as *Omalanthus populifolius*), *Hylandia dockrillii*, *Macaranga inamoena*, *M. involucrata*, *M. tanarius*, *Mallotus discolor*, *M. mollissimus*, *M. philippensis*, *M. polyadenos*, *Petalostigma pubescens*, *P. triloculare* and *Rockinghamia angustifolia* have listed tradenames (Cause *et al.* 1989), they are not commercially utilized, especially since the cessation of logging in forest reserves in the 'Wet Tropics' of north-east Queensland.

Food

The fruits of *Antidesma bunius* are used in conserves (Bailey 1902) with contemporary use as a gourmet 'bush food'. A similar use for the smaller fruited *A. erostre* (as *A. dallachyanum*) and *A. parvifolium* was also reported (Bailey 1902).

References

- Aboriginal Communities of the Northern Territory (1993), *Traditional Aboriginal Medicines in the Northern Territory*. Conservation Commission of the Northern Territory, Darwin.
- Alde, M.R., Agcaoili, F. & Cochico, R.J. (1947), *Jatropha curcas* Linn. (tuba) as a source of natural dye, *Philippine J. Sci.* 77: 55–60.
- Altman, J.C. (1984), The dietary utilisation of flora and fauna by contemporary hunter-gatherers at Momega Outstation, north-central Arnhem Land, *Aust. Aboriginal Stud.* 1984(1): 35–46.
- Bailey, F.M. (1880). Medicinal plants of Queensland, *Proc. Linn. Soc. N.S.W.* 5: 1–29.
- Bailey, F.M. (1888), *Queensland Woods*. Warwick & Sapswood Printers, Brisbane.
- Bailey, F.M. (1902), Euphorbiaceae. *The Queensland Flora* 5: 1392–1457. H.J.Diddams & Co., Brisbane.
- Başlar, S. & Mert, H.H. (1999), Studies on the ecology of *Chrozophora tinctoria* L. and *Rubia tinctorum* L. in western Anatolia, *Turk. J. Bot.* 23: 33–44.
- Bindon, P. (1996), *Useful Bush Plants*. Western Australian Museum, Perth.
- Blake, N.M., Wightman, G. & Williams, L. (1998), Iwaidja ethnobotany, *Northern Territory Bot. Bull.* 23: 1–166.
- Cause, M.L., Rudder, E.J. & Kynaston, W.T. (1989), Queensland Timbers: their nomenclature, density and lyctid susceptibility. *Technical Pamphlet No. 2*. Queensland Department of Forestry, Indooroopilly.
- Clarke, P.A. (2003), Australian ethnobotany: an overview, *Aust. Aboriginal Studies* 2003(2): 21–38.
- Considine, J.A. (1996), Emerging indigenous crops of Australia, in J. Janick (ed), *Progress in New Crops*, pp. 26–36. ASHS Press, Alexandria.
- Crawford, I.M. (1982), Traditional Aboriginal plant resources in the Kalumburu area: aspects in ethno-economics, *Rec. West. Aust. Mus., Suppl.* No. 15: 1–86.
- Cribb, A.B. & Cribb, J.W. (1974), *Wild Food in Australia*. Collins, Sydney/London.
- Cribb, A.B. & Cribb, J.W. (1981a), *Wild Medicine in Australia*. Fontana/Collins, Sydney.
- Cribb, A.B. & Cribb, J.W. (1981b), *Useful Wild Plants in Australia*. Fontana/Collins, Sydney.
- Daikonya, A. *et al.* (2002), Anti-allergic agents from natural sources (4): anti-allergic activity of new phloroglucinol derivatives from *Mallotus philippensis*, *Chem. Pharm. Bull.* 50: 1566–1659.
- Dell, B. & McComb, A.J. (1974), Resin production and glandular hairs in *Beyeria viscosa* (Labill.) Miq. (Euphorbiaceae), *Aust. J. Bot.* 25: 195–210.
- Galvez, J. *et al.* (1993), Antidiarrhoeic activity of *Euphorbia hirta* extract and isolation of an active flavonoid constituent, *Planta Med.* 59: 333–336.
- Gupta, D., Khare, S.K. & Laha, A. (2004), Antimicrobial properties of natural dyes against Gram-negative bacteria, *Coloration Technology* 120: 167–171.
- Hill, R. & Baird, A. (2003), Kuku–Yalanji rainforest Aboriginal people and carbohydrate resource management in the Wet Tropics of Queensland, Australia, *Human Ecol.* 31: 27–51.
- Johnston, T.H. & Cleland, J.B. (1942), Aboriginal names and uses of plants in the Ooldea region, South Australia, *Trans. Roy. Soc. S. Aust.* 66: 93–103.
- Johnston, T.H. & Cleland, J.B. (1943), Native names and uses of plants in the north-eastern corner of South Australia, *Trans. Roy. Soc. S. Aust.* 67: 149–173.
- Konishi, T. *et al.* (1998), Anti-tumor-promoting activity of diterpenes from *Excoecaria agallocha*, *Biol. Pharm. Bull.* 21: 993–996.
- Konoshima, T. *et al.* (2001), Anti-tumor-promoting activity of the diterpenes from *Excoecaria agallocha*. II., *Biol. Pharm. Bull.* 24: 1440–1442.
- Kumar, J.K. & Sinha, A.K. (2004), Resurgence of natural colourants: a holistic view, *Nat. Prod. Lett.* 18: 59–84.
- Kyriazis, S. (1995), *Bush Medicine of the northern Peninsula area of Cape York*. Nai Beguta Agama Aboriginal Corporation, New Mapoon.
- Lands, M. (1987), *Mayi. Some bush fruits of Dampierland*. Magabala Books, Broome.
- Latz, P.K. (1995), *Bushfires and Bushtucker. Aboriginal plant use in central Australia*. IAD Press, Alice Springs.
- Lee, C.D. *et al.* (1996), *Phyllanthus amarus* down-regulates hepatitis B virus mRNA transcription and replication, *European J. Clinical Investigation* 26: 1069–1076.
- Levitt, D. (1981), *Plants and People. Aboriginal uses of plants on Groote Eylandt*. Australian Institute of Aboriginal Studies, Canberra.
- Lindsay, B.Y. *et al.* (2001), Malakmalak and Matngala plants and animals, *Northern Territory Bot. Bull.* 26: 1–128.
- Liu, J., Lin, H. & McIntosh, H. (2001), Genus *Phyllanthus* for chronic hepatitis B virus infection: a systematic review, *J. Viral Hepatitis* 8: 358–366.
- Low, T. (1988), *Wild Food Plants of Australia*. Angus & Robertson Publishers, North Ryde.
- Maiden, J.H. (1889), *The Useful Native Plants of Australia*. Turner & Henderson, Sydney.
- Mallavadhani, U.V. *et al.* (2002), Quantitative estimation of an antidiarrhoeic marker in *Euphorbia hirta* samples, *Pharm. Biol.* 40: 103–106.
- Marrfurra, P. *et al.* (1995), Ngan’gikurunggurr and Ngan’giwumirri ethnobotany. Aboriginal plant use from the Daly River area, northern Australia, *Northern Territory Bot. Bull.* 22: 1–112.
- Nair, S.P. & Rao, J.M. (1993), Kamaladiol-3-acetate from the stem bark of *Mallotus philippinensis* [sic], *Phytochemistry* 32: 407–409.
- Ogbourne, S.M. *et al.* (2004), Antitumor activity of 3-ingenyl angelate: plasma membrane and mitochondrial disruption and necrotic cell death, *Cancer Res.* 64: 2833–2839.

- Palmer, E. (1884), On plants used by the natives of North Queensland, Flinders and Mitchell Rivers, for food, medicine etc., etc. *J. Proc. Roy. Soc. N.S.W.* 17: 93–113.
- Pearn, J. (2005), The world's longest surviving paediatric practices: some themes of Aboriginal medical ethnobotany in Australia, *J. Paediatr. Child Health* 41: 284–290.
- Puruntatameri, J. *et al.* (2001), Tiwi plants and animals, *Northern Territory Bot. Bull.* 24: 1–192.
- Raymond, E. *et al.* (1999), Wardaman ethnobiology, *Northern Territory Bot. Bull.* 25: 1–191.
- Roberts, J., Fisher, C. & Gibson, R. (1995), *A guide to traditional Aboriginal Rainforest plant use*. Bamanga Bubu Ngadimunku Inc., Mossman.
- Roth, W.E. (1901), Food: its search, capture and preparation, *N. Queensland Ethnography, Bull.* 3. Government Printer, Brisbane.
- Sharp, B.R. & Whittaker, R.J. (2003), The irreversible cattle-driven transformation of a seasonally flooded Australian savanna, *J. Biogeog.* 30: 783–802.
- Smith, M. & Kalotas, A.C. (1985), Bardi plants: an annotated list of plants and their use by the Bardi Aborigines of Dampierland, in North-western Australia, *Rec. West. Aust. Mus.* 12: 317–359.
- Smith, N. & Wightman, G.M. (1990), Ethnobotanical notes from Belyuen, Northern Territory, Australia, *Northern Territory Bot. Bull.* 10: 1–31.
- Smith, N. *et al.* (1993), Ngarinyman ethnobotany. Aboriginal plant use from the Victoria River area, Northern Australia, *Northern Territory Bot. Bull.* 16: 1–64.
- Specht, R.L. (1958), An introduction to the ethno-botany of Arnhem Land, in R.L. Specht & C.P. Mountford (eds), *Records of the American – Australian Scientific Expedition to Arnhem Land. 3. Botany and Plant Ecology*, pp. 479–503. Melbourne University Press, Carlton.
- Thyagaragan, S.P. *et al.* (1988), Effect of *Phyllanthus amarus* on chronic carriers of hepatitis B virus, *Lancet* (8614): 764–766.
- Webb, L.J. (1959), The use of plant medicines and poisons by Australian Aborigines, *Mankind* 7: 137–146.
- Webb, L.J. (1960), Some new records of medicinal plants used by the Aborigines of tropical Queensland and New Guinea, *Proc. Roy. Soc. Queensl.* 71: 103–110.
- Wightman, G.M. & Smith, N.M. (1989), Ethnobotany, vegetation and floristics of Milingimbi, Northern Australia, *Northern Territory Bot. Bull.* 6: 1–37.
- Wightman, G.M. *et al.* (1992a), Mudburra ethnobotany; Aboriginal plant use from Kulumindini (Elliott), Northern Australia, *Northern Territory Bot. Bull.* 14: 1–44.
- Wightman, G.M., Roberts, J.G. & Williams, L. (1992b), Mangarrayi ethnobotany. Aboriginal plant use from the Elsey area, Northern Territory, *Northern Territory Bot. Bull.* 15: 1–59.
- Wightman, G.M. *et al.* (1994), Gurindji ethnobotany – aboriginal plant use from Daguragu, Northern Australia, *Northern Territory Bot. Bull.* 18: 1–76.
- Wijnjorrotj, P. *et al.* (2005), Jawoyn plants and animals, *Northern Territory Bot. Bull.* 29: 1–234.
- Woolston, F.P. (1973), Ethnobotanical items from the Wellesley Island, Gulf of Carpentaria, *Occ. Pap., Anthropology Mus., Univ. Queensl.* No. 1: 95–103.
- Yunupinu, B. *et al.* (1995), Rirratjinu ethnobotany: aboriginal plant use from Yirrkala, Arnhem Land, Australia, *Northern Territory Bot. Bull.* 21: 1–112.