

## Review Article

# Kava: an overview

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Since the first significant contact with Europeans in the 18th century, the Oceanic plant, *Piper methysticum* Forst. (Piperaceae) and the beverage prepared from it, both of which are called kava, have become familiar to much of the outside world through both the written and visual media. The ceremonial preparation and consumption of the beverage are probably its most conspicuous and spectacular features. Kava continues to occupy a central place in everyday life in the islands concerned, although its role has been somewhat diminished by time and outside influences. Despite the large body of literature on kava — about 800 entries are listed in a recent bibliography by Singh (1986) — there has been no comprehensive review on the subject. Earlier contributions by Keller and Klohs (1963) and Shulgin (1973) were selective in treatment and dealt primarily with chemical and pharmacological aspects. The monograph by Steinmetz (1960) remains a standard reference but understandably some of the information in it has become dated. The attention of the reader is also drawn to two excellent additions to the recent kava literature, by Lebot and Cabalion (1988) and Brunton (1989), which are, although somewhat restricted in focus, are very significant contributions to the subject. The present review paper provides an updated and a multidisciplinary overview of the subject. It was prepared on the basis of the author's personal experience — he is a native of Fiji and lived in that country for about 30 years — as well as the relevant literature listed in the Singh (1986) bibliography and some more recent publications.

**Key words:** kava; Oceania; ethnology; chemistry; pharmacology

### Introduction

The term Oceania is usually used to describe the island communities of the Pacific Ocean which are encompassed by the three cultural or ethnic regions of Polynesia, Melanesia and Micronesia (Fig. 1). According to some authorities, Oceania is one of the few culture areas (another being most of North America) which are known not to have had alcoholic beverages by the time of first significant contact with Europeans in the 18th century. However, at that time, which also marked the beginning of recorded history for this geographic region, most of the islands did possess a drink, generally called kava. Like alcohol, it had acquired for itself important symbolic meanings and had associated with it a large number of rules and procedures for its preparation, distribution amongst participants and consumption.

The importance of kava in Oceania should perhaps be considered in the context that every culture has had its own intoxicants, whether they

be narcotics or stimulants or both and in spite of their great diversity, the intoxicants employed have had the same kind of social status and significance (Serpenti, 1969). The sociological role of kava is probably similar in many aspects to that of peyote in the case of many native or 'Indian' tribes of North America, coca leaves with peoples of the South American Andes and opium and its derivatives in the Middle or Far East. The kava custom has been so widespread throughout Oceania that it might be considered the one item in their material culture that linked together most of the peoples of Oceania. Besides being the social beverage for chiefs and noblemen, it was also used to welcome distinguished visitors at formal gatherings (Ford, 1967), at initiation and completion of work (Turner, 1861; Mead, 1930), in preparing for a journey or an ocean voyage, installation in office (Gifford, 1929), validation of titles, ratification of agreements, celebration of important births, marriages and deaths (Mead, 1930) as a libation to the gods (Firth, 1970), to cure illnesses and to remove curses (Mariner, 1827), as a prelude to tribal wars (Newell, 1947) — in fact, in almost all phases of life in the islands.

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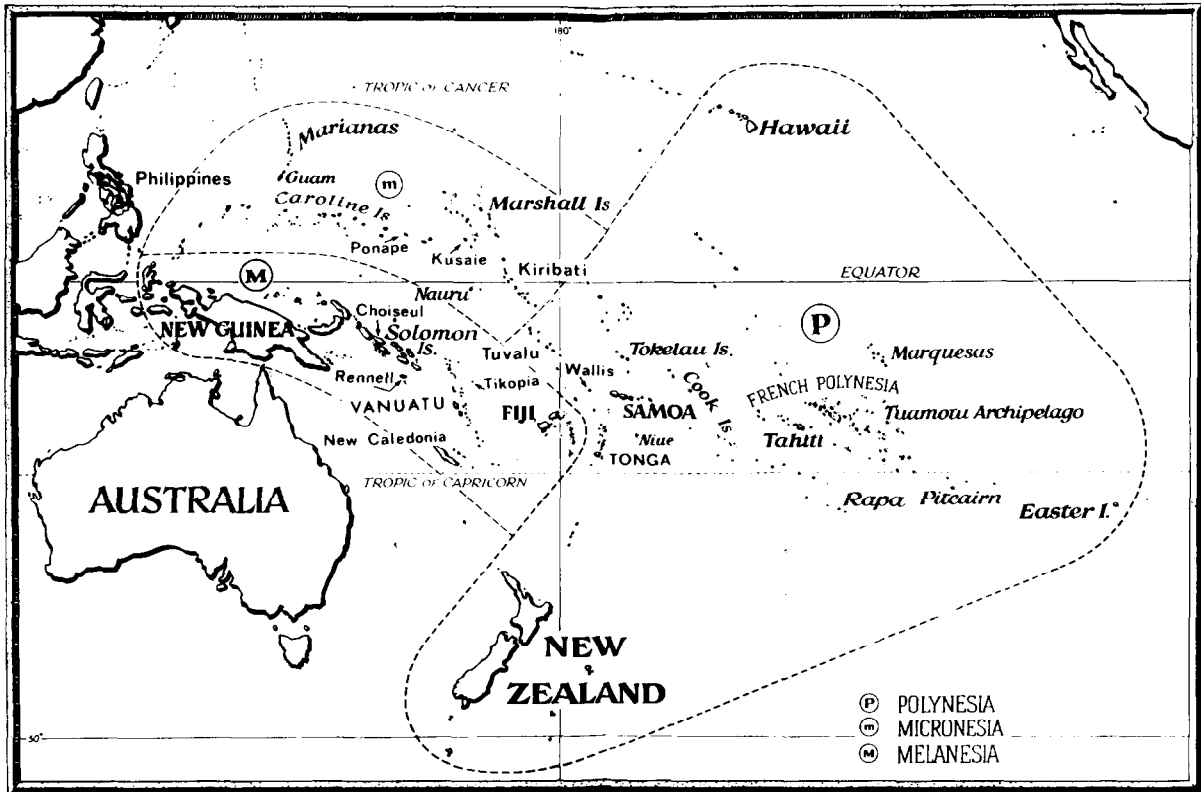


Fig. 1. Map of Oceania showing the three cultural regions of Melanesia, Micronesia and Polynesia. Modified from *Fiji in Colour* and reproduced by permission of the author, Jim Spiers.

The Swedish botanist Daniel Scholander and Sydney Parkinson, the artist charged with the task of making drawings of newly discovered plants, both of whom accompanied Captain James Cook on his first voyage in the 'Endeavour' (1768–1771), were probably the first white men who saw and recorded the kava plant. However, the credit for the first detailed description of the plant is normally given to Johann Georg Forster (Forster, 1777). Forster named the kava plant *Piper methysticum* or intoxicating pepper, *methysticum* being the Latin transcription of the Greek *methustikos* and derived from *methu* which, according to Steinmetz (1960) means 'intoxicating drink'. Since these early accounts, there has accumulated a large body of both scientific and ethnographic accounts on kava. Reference to this literature may be found in three extensive bibliographies (Marshall 1974; Freund and Marshall 1977; Singh, 1986). Additional references are included in Lebot and Cabalion (1988), and Brunton (1989).

Although kava drinking was important on ceremonial occasions, it was not confined to such gatherings. Old men often had a cup first thing in

the morning and senior members of the family had a cup before (but not after) a meal (Turner, 1861). A visitor often took a root of kava as a present for the person being called upon (Churchward, 1887) and this custom persists even today, although the powdered kava is often used because of convenience and the relative unavailability of the root in large enough quantities. Methods of preparation and presentation are described later in some detail.

This paper discusses the origins and the role of kava in Oceanic life, both past and present, the sequence of events and the utensils used in the preparation and consumption of the beverage, including the kava ceremony, the different possible uses of the plant and the beverage, the effects of its consumption on humans and the chemistry and pharmacology of the chemical compounds which have been isolated from it.

#### Etymology of the term kava

The term *kava* and the variant *kawa*, are used for both the plant and the beverage made from it. However, some other names or variants are also encountered. In Hawaii, Tahiti, the Marquesas,

and some other Polynesian areas, the initial *k* of the word is often dropped and it may become *ava* or *awa*. The Maoris, on migration to New Zealand, did not find the kava plant in their new environment, so they applied the names *kava* and *kawakawa* to a related plant (*Piper excelsum*) which was much used in religious ceremonies. However, this plant was not made into a beverage (Rivers, 1914).

The term *kava* or its equivalent may be used in Polynesia to designate various properties of food and drink. In Hawaii, it means 'bitter', 'sour', 'sharp' or 'pungent'. In the Marquesas it signifies 'bitter', 'sour' or 'sharp'. In Tahiti, the range is broad, including 'bitter', 'sour', 'acid', 'acid', 'salty', 'sharp' and 'pungent' (Churchill, 1916).

A commonly held view is that kava was introduced into Melanesia from Polynesia. In some parts of Melanesia, it is probable that the use of kava has been so introduced and that recent Polynesian influence has greatly modified an earlier method of using this substance (Rivers, 1914). Thus, in various members of the Vanuatu group (formerly New Hebrides), e.g. Anaiteum, Tanna, Aniwa and Futuna, the name is the same as in Polynesia (Ray, 1894). In the Banks Islands it is called *gea* and in the Torres Islands *gi*, both of which are perhaps related to the Polynesian word (Rivers, 1914). Elsewhere in Vanuatu, a number of other terms are encountered, so that in Pentecost, kava is known as *malohu*, in Efate *maluk*, in Epi *milik* and in Malekula *meruk* (Ray, 1894) — words which, though evidently related to one another, are absolutely remote from the Polynesian term.

In Fiji, there is a wholly different term, *yagona*, which evidently has no affinity whatsoever to the Polynesian word. In Fijian orthography, the letter *g* stands for the sound *ng* and hence *yagona* is pronounced as *yangona*. Lester (1941) reports that the word *gona* is used on the northwest coast of the main Fijian island of Viti Levu to denote both 'beverage' and 'bitter.' He suggests that this may indicate that it was to this part of Fiji that kava was first introduced and that local people supplied the name *yagona* which is now used throughout the Fijian archipelago.

Although kava usage appears to have had little importance in Papua New Guinea, vernacular names for it have been recorded from all parts of the country. Sterly (1970) used a number of published reports to assemble about 40 different variants, of which *wati* is probably the most widely recognized.

## Geographic distribution of kava usage

Although identified mainly with Western Polynesia, kava has in the past been found and used in nearly all Pacific islands, with the notable exceptions of New Zealand, New Caledonia and most of the Solomon Islands. A survey of the available literature establishes the presence of kava, at least until recently and with only the above exceptions, in all the island groups of Oceania. Figure 1 shows the location of most of the islands in the Pacific Ocean on which kava has been found or used.

The Hawaiians placed great importance on kava drinking as late as the end of the last century (Emerson, 1903). Titcomb (1948) states that the kava custom was highly esteemed in Hawaii because it was a sacred drink of great significance in many phases of Hawaiian life. Outside of water and coconut milk, no other drink was known. Its effect was to relax the mind and body and it was used by farmers and fishermen alike for this purpose. Medical *kahunas* (or learned men) had many uses for it. It was customary for chiefs to drink it before meals, commoners also if it was obtainable. It was essential on occasions of hospitality and feasting and was the drink of pleasure of the chiefs. However, the sale and use of kava rapidly decreased from the beginning of this century. Titcomb (1948) notes that in 1903 'no Hawaiian went home from the Saturday market without an 'awa' root tied to his saddle.' In 1930 *awa* was still to be purchased in the market. By 1948 the practice had completely disappeared, although the plant continues even today to grow in the wild.

Kava drinking seems to be of major importance in Vanuatu where it is drunk socially, but not ceremonially and where the plant is recognized as a remedy for a number of physical ailments. The resurgence of kava drinking which was noted on the Vanuatu island of Tanna in the early 1940s may be related to the ritual of the John Frum cargo cult, which arose partly as a repudiation of the teachings of the Christian missionaries (Guiart, 1956). Carleton Gajdusek (the Nobel Laureate who is credited with identifying the etiology of *kuru*, the slow developing viral disease of the New Guinea highlanders) spent several weeks on another island of this group, Tongariki. He found that the current kava drinking there was more like that of the early John Frum movement on Tanna in its lack of formality and restraints (Gajdusek, 1967).

In historic times, the most important centers of

kava usage were Fiji, Samoa and Tonga. In these countries it was consumed not merely as a beverage but had become the focus of an elaborate system of social ceremonials and rituals and also had certain important magico-religious aspects. In the last few decades kava has begun to resume some of its earlier importance. This may be closely linked to the gaining of political independence and the subsequent reassertion of ethnic values and customs which were somewhat suppressed or discouraged during the colonial era.

According to Rivers (1914), kava was drunk in the Solomons on the islands of Vanikoro and Utupua, whereas Codrington (1891) and Thomson (1908) found it to be unknown in the Santa Cruz islands. Fox (1924) related that men drank kava at burial ceremonies but not on other occasions. The only island in the Solomons group reported to have contemporary knowledge of kava and its uses is Choiseul where some islanders claim it is used medicinally. Rennel Island at the bottom end of this archipelago does not have *Piper methysticum* but has a coconut drink which curiously is called *kava kava ngang*i (Holmes, 1979).

Kava was, during the last century, grown on all the islands of the Cooks group but the infusion which was usually prepared from the root of the plant did not have the same ceremonial significance as it had in Western Polynesia (Buck, 1944). However, it is now virtually impossible to locate the plant on any of these islands and all practices related to it seem to have completely disappeared.

It is asserted by Hood (1862) and Turner (1861) that kava was not drunk in Niue. Percy Smith (1920) states that the Niue people did not make or use the drink and draws attention to the difference in this respect between them and the Samoans and Tongans with whom they are closely connected, suggesting that the reason for this may have been scarcity of the plant. Thomson (1902) found that kava was not used as a beverage by the Niue people but was used for inspiration by their priests.

Scarcity is the reason sometimes given for the fact that in Tahiti kava drinking was only indulged in by the chiefs (Parkinson, 1784; Wilson, 1799). Although the kava root was scarce and little used in Tahiti, in the other Society Islands (or French Polynesia) there were great plantations of it (Forster, 1777). This suggests that it was probably a lack of desire rather than of supply which limited kava drinking by the natives of Tahiti, as they could presumably have obtained supplies from the other nearby islands if they so wished.

On Wallis Island (called Uvea in Polynesian), the position of the kava ceremony was as highly esteemed as anywhere else in the Pacific (Mangeret, 1884). All official decisions and promulgations concerning the community's administration, such as promotions, official takings of possessions, proclaiming of laws and codes of conduct, were made at such ceremonies. The kava root was often used in reconciling with enemies or in preserving the goodwill of kings and chiefs. Indeed, guilty persons often owed their pardon and sometimes even their lives to it. In the neighboring island of Futuna, as elsewhere in the South Pacific, kava was used to express friendship and to allay fear. Mangeret (1884) notes that once, on the arrival of a French ship, the native people, fearing vengeance for the murder of a missionary a few months earlier, presented the captain with an enormous kava root.

Thomson (1889) says kava was not grown, nor was the drink known on Easter Island. Perhaps the climatic conditions were not favorable. This, however, cannot explain why kava is not cultivated on Rapa where the climate is favorable (Metraux, 1940).

Kava has also been found in Tokelau Islands, Tuvalu (formerly the Ellice Islands) (Newell, 1895), in the Caroline Islands where it occurs only on Ponape and where it is called *sakau* and on Kusaie (also called Kosrae) (Krieger, 1943). It also occurs in some of the 'Polynesian outliers' (i.e. islands which lie in Melanesia but whose people are Polynesian in origin), although information here tends to be quite scanty or unreliable except in the case of Tikopia.

Tikopia is perhaps the most famous of the Polynesian outliers, mainly because of the extensive work done there by the renowned anthropologist Sir Raymond Firth. In Tikopia the use of kava differs radically from its use in other areas of the Western Pacific. Firth (1970) contends that 'historically there is little doubt that the kava rites of Tikopia belonged to the same general series as those of Tonga, Samoa and Fiji and may well have been imported from that area.' In Tikopia kava was and still is very rarely drunk. Most of the liquid is poured away in libations and the remainder usually emptied out on the ground before the bowl is wiped clean.

The Australian Aborigines had no contact with kava until the early 1980s when they learned about it from missionaries who came to their communities from Fiji, Tonga and other kava-growing societies of the South Pacific (Cawte, 1985). At

about the same time Aboriginal leaders visiting Fiji and Polynesia were impressed with the kava ceremony and advocated kava use in their own communities as an alcohol substitute (Moyles, 1983). Soon thereafter kava was introduced from Fiji to Aboriginal communities in Northern Australia and rapidly became a drug of abuse (Cawte, 1985; Smiles, 1987), probably because of a lack of ceremonial or traditional restraints controlling its use. Estimates for individual consumption have ranged as high as fifty times the amount habitually consumed in the Pacific Islands. An epidemic of kava abuse has become a serious social and health problem in regions of Northern Australia (Cawte, 1986; Matthews et al., 1988) — so much so that the perceived gravity of the situation has prompted statements like ‘kava turns people into zombies’ (Northern Territory News, March 11, 1987), ‘the kava killer’ (Sunday Territorian, March 15, 1987) and ‘it is important that everyone learns about it before it combines with diseases like AIDS to wipe out whole Aboriginal communities’ (Northern Territory News, March 16, 1987). For a detailed account of the impact of kava in Australia, see Prescott and McCall (1988).

### Botanic origins of kava

The origins of kava usage in Oceania are not known. Kava drinking itself is much older than any written history of this part of the world and oral traditions do not seem to have brought forward relevant reliable accounts. It should be noted that at first contact none of the island communities had an alphabet, and therefore a written language of their own. Some of the hypotheses concerning the botanic origins of kava are worth considering.

According to Newell (1947), the origin of the kava plant appears to have been in the New Guinea-Indonesia area or further north. He discusses three possible ways in which the plant could have been spread to Tonga and the eastern Pacific, namely: (a) by the islands being attached to a main land mass on which kava evolved and developed; (b) by drifting or being otherwise transported from island to island; (c) by being transported by man in canoes.

The first of these proposals may be discounted, as most of the islands of Oceania are of comparatively recent geological origin and consist of coral limestones or volcanic cones. The possibility that the plant or its root drifted to the various islands on which it is now found seems equally remote because of the great distances and the large

number of islands involved. Thus, without completely dismissing the first two possibilities, Newell concludes that the kava root or plant was brought by early Polynesian explorers in much the same way as they brought other plants in their canoes.

Newell’s contention is that kava did not spread eastward from its center of origin in the New Guinea-Indonesia area through the Solomons and nearby territories. Rather, it was transported through the Caroline and the Marshall Islands in Micronesia to Hawaii on the one hand or, alternatively, through Tuvalu to Eastern Polynesia. The obvious route for the spread of kava to Central and Eastern Polynesia is through the Solomons. He argues that if this hypothesis is accepted, it is difficult to explain why the kava custom became the centre of an important ritual in Fiji, Tonga and Samoa but has been of little importance — indeed almost non-existent — in most of the Solomons through which the practice would have been transported.

The second hypothesis places the origins of the kava custom on the Asian subcontinent. In his works on the cultural origins of Polynesians, Handy (1927) proposes an alternative to the theory that the different cultures of the Polynesian area are the product of evolution within Polynesia itself. That is, of a single culture which the original Polynesians brought with them. He compares various cultural traits of Polynesians with those found in Southern China and connects the drinking of kava in Polynesia with the ancient Chinese tea ceremony.

Williamson (1939), on the other hand, thinks that the Polynesians might have originated slightly further west, in the southern parts of India. In a detailed and carefully documented treatise, he argues that the kava ceremony might equally well be compared with the ceremonials, rituals and beliefs connected with the drinking of *soma* in the ancient Vedic religion, a ceremony to which it bears considerable resemblance. He discusses many points of similarity between the kava ceremonial and the Vedic ritual. The fixed number of priests who participated in the *soma* ritual is reminiscent of the formalized kava ring, in which each person has a clearly defined place and function. In particular, the Vedic prohibition against a younger brother offering a sacrifice before his elder brother, has a remarkable parallel in the rule governing the precedence of brothers in the kava ring. Again, the honoring and invoking of deities, together with the pouring out of libations of the beverage were features of both cults. Furthermore,

there was, as with kava, a ritual manner of preparing the beverage by beating — in the earliest times with stones; later with a mortar and pestle — and by straining the liquid into wooden vats. The last two features present a striking parallel to the preliminary breaking up of kava roots with stones, the squeezing of kava juice and its reception in the wooden kava bowl (Williamson, 1939).

Another theory, proposed by Rivers (1914), holds that the kava custom was related to, or developed out of, an earlier established practice of betel nut chewing. In fact, Rivers has suggested the presence of two quite distinct cultural traditions in Oceania: the betel nut culture and the kava culture. Betel nut chewing involves three separate ingredients — crushed nut of the areca palm (*Areca catechu* L.), leaves of *Piper betle* L. and slaked lime — while kava requires only one ingredient. Rivers believes that partly because of this, kava drinking succeeded betel nut chewing as migrants were unable to acquire all the necessary components for the earlier habit. Rivers also thinks that kava drinking arose in part as a result of the needs encountered by the immigrants under alien conditions and who found the kava root more satisfying as a drug than the betel nut. This latter suggestion is queried by Williamson (1939) on two counts. Firstly, both the betel nut and the kava plant grow in the same areas of New Guinea and Samoa, and yet, in New Guinea, kava is of little importance, whereas in Samoa betel nut chewing is virtually unknown. Secondly, the fact that kava is in fact less potent as a drug than the betel nut also somewhat invalidates River's reason for the immigrants' preference for kava over the betel nut.

Churchill (1916a) also proposes the presence of two cultures based on the distribution of kava and betel in Oceania. He suggests that these two cultures belonged to two immigrant peoples whom he calls the kava people and the betel people. The kava people settled in Southern Melanesia, Fiji and Polynesia while the betel people did not extend in their southeasterly movement beyond the Solomon and Santa Cruz Islands. However, certain elements of the culture of the betel people may have carried directly or indirectly to Southern Melanesia, Fiji and Polynesia, although it appears to be minimal and any that does exist is probably of recent origin.

### Legends of the origin of kava

Kava enters into many myths and legends and a

number of them relate to the origin of the plant and the beverage. Different versions have been recorded from all parts of Oceania, e.g. Hawaii (Fornander 1916–20; Titcomb, 1948), Samoa (Churchward, 1887; Kramer, 1902; Williamson, 1939), Marquesas and Rotuma (Christian, 1899), Tonga (Gifford, 1924), Futuna (Lester, 1941), Vanuatu (Rivers, 1914), Fiji (Lester, 1941), Tikopia (Firth, 1970), to name a few. It will suffice to consider only some of these versions.

In Fiji, three legends regarding kava and its origins appear to be remembered (Lester, 1941). The first legend refers to a root which was found growing on the grave of a Tongan leper. The second legend, which comes from the eastern Fijian islands of Lau, implies that kava was introduced into Tonga from Lau — or vice versa — because of the close proximity between the islands. The third and probably the most important, comes from the northeast coast of Viti Levu, which is not far from a traditional settlement. One group of settlers, led by Degei, journeyed inland and settled near Nakauvadra. The legend is that two of the settlers killed a rooster which had awakened Degei by its crowing every morning. This action angered Degei and they fled from his wrath, taking with them samples of all of the material culture of the community with the sole exception of kava, which they left behind for Degei's use. This legend might also explain why kava was originally used only at religious rites, with its consumption limited to the chief (who was considered the mortal representative of the ancestor god) and his priests.

According to a Samoan tale of Manu'a origin (Manu'a is one of the Samoan islands studied by the famous anthropologist Margaret Mead (1930)) Tangaloa came down from heaven with two assistants who went fishing for him. In those days there were no hooks, lines or nets, so they had to fish with their hands. They caught a fish and brought it to Tangaloa, but he wished to have kava to drink with it. As there was none on earth, he sent them back to heaven to bring down a root of it. They, however, pulled up the whole plant and brought it down with them and as Tangaloa scattered the superfluous parts all over the earth, they grew up luxuriantly. He wanted some water in which to infuse the kava and this was supplied by a downpour of rain. The two attendants also brought down from heaven the necessary bowl (*tanoa*), strainer (*tau'anga*) and cup (*ipu*) for preparing and drinking the kava. That is how, according to the tale, this drink of the gods was introduced to earth (Williamson, 1939).

Churchward (1887) narrates another Samoan legend which contends that kava and sugarcane were both obtained from Fiji. In days past, a Samoan girl went to Fiji where she married a great chief. After sometime she returned to Samoa, but just before doing so she noticed two plants growing on a small hill. A rat, after gnawing the stem of one of them, went to sleep. She concluded that the plant was a comforting food and decided to take it to Samoa. This was the sugarcane. When the rat awoke, it began to chew the root of the other plant, which was kava. The animal which had before been weak, became bold, strong and energetic. She thought this plant also would be good for her people, so she took both the sugarcane and the kava to Samoa. On reaching there she planted the two plants which grew exuberantly. A neighboring chief wanted some of them and exchanged the two roots for two laying hens.

In the Marquesas, the original kava was the child of their great god Atea, the provider of good seasons and rain and patron deity of farmers. In Rotuma, in the Fiji group, the original kava was believed to have floated to the island from Samoa (Christian, 1899). And on Pentecost\* in Vanuatu, the story is told that a man once saw a rat nibbling a root of kava and watched it fall down and presently come back to life again. He saw this happen several times and then tried the root himself (Rivers, 1914).

In his monograph, *Tongan Myths and Tales*, Gifford (1924) describes four variants of a Tongan legend, one of which is outlined below. The great chief Loau, who lived in Ha'amea, on the island of Tongatapu, one day sailed to the small island of Euaiki to visit his faithful servant Feva'anga. Feva'anga wished to honor his chief with a great feast but it was time of a great famine. In desperation he and his wife killed and cooked their only daughter to be served to the chief. However, Loau recognized the human flesh in the food when it was served. He instructed Feva'anga to plant the food in the ground and to bring him the plant when it

matured. On receiving the mature plant, Loau instructed that a drink be prepared from it and consumed with due ceremony.

According to Firth (1970), myths of the origin of kava seemed to be known to only a few people in Tikopia and were not well integrated into the body of ritual. They also showed a remarkable similarity to the set of the four well-known Tongan variants as recorded by Gifford (1924) and mentioned above. However, Firth believes that they were probably traditional in Tikopia and are not a modern borrowing from some visiting Tongan. While they are essentially the same stories as the Tongan ones, with the central theme of sacrifice of a human being for food, growth of kava from the body and testing of the properties of the plant, there are some slight differences of emphasis. For instance, the victim in the Tikopia versions was a son, not a daughter, as in the Tongan versions; was apparently healthy, not a leper; and had a completely different name.

#### Botanical characteristics

The kava plant is a robust, fairly succulent, well-branching and erect, perennial shrub belonging to the *Piperaceae* family. It thrives at altitudes of between 150 and 300 m above sea level and grows well in stony ground, both when cultivated and in the wild.

#### Plant description

When cultivated, the plant is usually harvested when it is about 2–2.5 m tall, but in warm humid conditions and with a lot of sunlight, the plant grows densely to heights of up to about 6 m. The leaves are heart-shaped, pointed and smooth and green on both sides, being about 15 cm in length (Figs. 2 and 3). The spaces between the stem joints (the internodes) are sometimes used as a basis for the native names of the species, with the intensity of leaf color, the color of the stems and the quality of the root (Handy, 1940; Titcomb, 1948) also serving this function. For about 60 cm or so just below the ground the root may become 5–8 cm thick at maturity, which occurs 3–5 years after planting. The roots may eventually become a heavy knotted mass (see Fig. 15), which in the past was highly prized, as the root is said to gather strength and flavor with age (Titcomb, 1948).

#### Cultivation

The following account of kava planting is based on Kamakau and quoted by Handy (1940):

\*The island of Pentecost is famous for its 'land divers' whereby young men tie one end of jungle vines to their ankles, the other end being secured to the top of a platform 15–25 meters high and leap to the ground from the top of the platform. The flexibility and the length of the vines are such that the fall is broken just before the divers reach the ground, thus preventing any serious injury from occurring to the young men (see Johnson and Johnson, 1955; Muller, 1970). The recently introduced sport of 'bungee' jumping from bridges and other high structures using large elastic bands (*Time*, April 15, 1991) has its origins in this custom of 'land divers'.



Fig. 2. A number of kava plants arising from the same root. The plants are about 1.5 m high and 2 years old.

*Awa* is planted much like sugarcane, by means of sections of the stalk, from whose joints grow the sprouts or 'eyes'. The planter carries to the place selected the stalks of the variety desired and there cuts them into short sections, being careful not to break off the 'eyes.' The sections later to be planted he lays in the trench filled with mud, leaving them to sprout there, while he clears his ground and leaves the grass and weeds on the soil to rot. When the segments in the trench have sprouted, he removes them and plants them in shallow trenches. A new plantation would require 2–3 years before its *pu awa* were large enough to use; but once a plantation was growing, the roots would continue to grow and sent up new stalks. In other words, the *awa* plantation never required replanting, but would serve as an inheritance to one's descendants (p. 203).

In the past, when only the root was used, the whole plant was dug up and the tops removed, leaving part of the stem attached to the root. The mass of roots was then split up into convenient portions. Two internodes of the stem were left attached to large pieces of roots to form the *tungase* and used as a handle during a presentation of the root to visitors of rank (Buck, 1930, p. 147).

#### Varieties

As mentioned above, the various characteristics

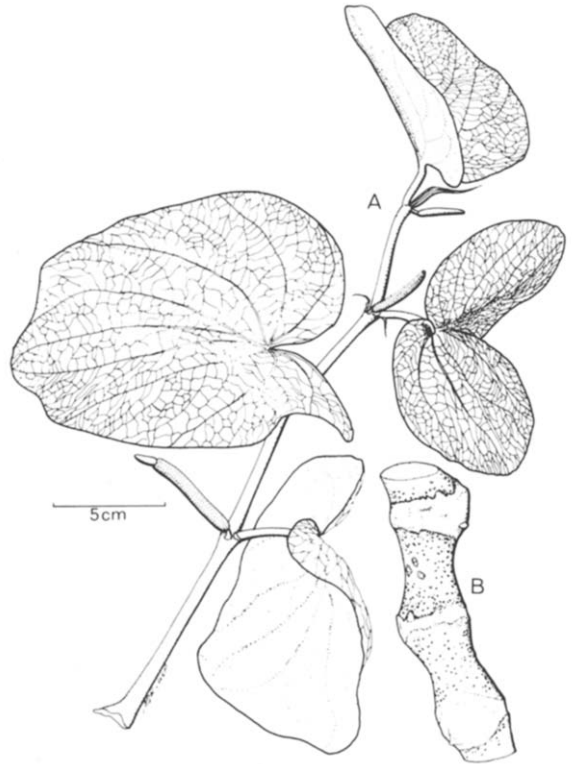


Fig. 3. (A) Habit of a kava branch collected near Suva, Fiji. (B) Part of stem of a mature kava plant showing the nodes and internodes.

of the kava plant, such as the intensity of the green leaf color, the color of the stems, etc., are by no means invariant. It is on the basis of such differences that the different varieties of *Piper methysticum* were classified by the native people. Handy (1940) lists 14 different varieties which had previously been described in Hawaii: *apu*, *liwa*, *ke'oke'o*, *kumakua*, *kuaea* or *nene*, *makea*, *mamaka*, *mamienie*, *mo'i*, *mokilana*, *papa*, *papa ele'ele*, *papa kea* and *kau la'au*. Handy's descriptions of some of these varieties might help to illustrate the bases for the subdivisions:

*apu*, has long joints and dark green stalk.

*makea*, has long internodes and is lighter green than *apu*.

*liwa*, distinguished by short joints and green stalk.

*mo'i*, the internodes are short and dark green and the nodes are somewhat whitish.

*papa*, has short internodes and spotted stalk.

There is evidence to indicate that in Hawaii and elsewhere varieties of kava differed enough to make some preferred for one purpose, some for another. For instance (Beckwith, 1940):

Only the most common variety could be used by the commoner, the rarer kinds were reserved for the chiefs. For the



gods and on ceremonial occasions the *mo'i*, *liwa* and *papa* were used, the *papa*, from which the *mo'i* was often an offshoot, being especially offered to female deities.

Brown (1935) lists 21 varieties from the Marquesas and includes short descriptions for some of them. Parham (1935) lists and describes five Fijian varieties, three white and two black types. All five varieties are still available and used at the present time; white varieties — *kasa leka*, *kasa balavu* (*yalu*) and *golobi*, black varieties — *kasa leka* and *kasa balavu*.

The white varieties are considered to be the source of the best kava, but they take longer (at least 4 years) than the black varieties (2.5–3 years) to attain maturity. Consequently, the black varieties are being cultivated commercially at present.

Nine separate varieties of kava have been recognized in Samoa (Kramer, 1902). Van Veen (1939) has described at least two varieties in Western New Guinea and he maintains that a 'small green variety had much stronger narcotic action than the tall red variety.' The green variety was chemically analyzed and found to contain more dihydrokawain (one of the main active ingredients) than the red variety. Serpenti (1969) reports that on the island of Kolepom in New Guinea, where kava is known as *wati*, five varieties are known: *kuraka*, *dikoje*, *namuru*, *kwadarre* and *ikawati*, but the intoxicating effect of each of these varieties is different. On Ponape, two kinds of kava have been recognized — a 'spotted branch' and a 'smooth branch,' the former being better liked because of the stronger drink made from it (Bascom, 1965). More recently, 72 different varieties, each known to traditional growers by vernacular names and said to have different properties, have been reported from Vanuatu (Ellis, 1984).

### Effects of kava drinking

There is some disagreement as to the taste of the kava drink. Consider the following reports.

In 1903, Emerson wrote: 'While tramping in the woods I have often moistened my tongue with a piece of *awa* chipped from some root, and experienced relief from thirst by its pleasant, cooling, aromatic, numbing effect in the mucous membrane of the tongue'.

According to Sir Peter Buck (1930) — or to use his given name, Te Rangi Hiroa — a Polynesian physician from New Zealand who often drank kava, 'It is cooling, refreshing and stimulating

without being intoxicating. . . Used in moderation, it is probably the best drink for a tropical climate'.

On the other hand, other reports talk of great bitterness and a burning taste in the mouth. For instance, Ellis (1828) wrote: 'If an opinion of its taste might be formed by a distortion of their countenance after taking it, it must be a most nauseous doper', while Churchill (1916b) observed that 'Polynesians do not praise kava for its taste, it is the odor which appeals to their sense of pleasure'.

However, it is generally agreed that the first effect of drinking kava is a numbing and astringent effect on the tongue and, to a lesser extent, the inner lining of the mouth. Titcomb (1948) quotes two Hawaiians, one of whom reported that, 'there is a peculiar bitterness with a feeling of thickness in the mouth, so that one does not taste the deliciousness of food after chewing or drinking *awa*', and the other, 'If you chew a piece in your mouth, it is sour and very bitter. The mouth will not taste food that is eaten after'.

A little while after drinking, kava is found to reduce fatigue, to allay anxiety and to produce a generally pleasant, cheerful and sociable attitude, although some other quite different physiological effects — some bordering on intoxication — have been noted in various parts of Oceania. For instance, consider the following typical accounts from Melanesia and Western Polynesia:

It gives a pleasant, warm and cheerful, but lazy feeling, sociable, though not hilarious or loquacious; the reason is not obscured (Hocart, 1929).

The head is affected pleasantly; you feel friendly, not beer sentimental; you cannot hate with kava in you. Kava quiets the mind; the world gains no new color or rose tint; it fits in its place and in one easily understandable whole (Lemert, 1967).

Thomson (1908) describes slightly more severe effects in this account on 'confirmed toppers':

The body becomes emaciated. The skin becomes dry and covered with scales, especially the palms of the hands, the soles of the feet and the forearms and shins. Appetite is lost. Sleep is disordered. Eye becomes bloodshot. There are pains in the pit of the stomach. The drinker sinks into unwholesome lethargy.

Compare these reports with other accounts from various locations in Eastern Polynesia. Morrison (1935), who visited Tahiti between 1788 and 1791, wrote:

(Kava) almost immediately deprives them of the use of their limbs and speech, but does not touch the mental faculty and

they appear in a thoughtful mood and frequently fall backwards before they have finished eating. Some of their attendants then attend to chafe their limbs all over until they fall asleep and the rest retire and no noise is suffered to be made near them. After a few hours they are as fresh as if nothing had happened and are ready for another dose.

Titcomb (1948) quotes a report by a Hawaiian, Kaulilinoe, written in the last century:

There is no admiration for the body and face of an awa drinker whose eyes are sticky and whose skin cracks like the bark of the *kukui* trees of Liliokoi in unsightliness. If you are drunk with *awa*, you will find your muscles and cords limp, the head feels weighted and the whole body too.

Consider also Torrey's (1848) description of kava drinking in the Marquesas:

Copious draughts cause a dizziness and a horribly distorted countenance. They lose the use of their limbs and fall and roll about on the ground, until the stupefaction wears away.

The missionary William Ellis (1828), who worked in the Society Islands between 1817 and 1824, provides the following account of kava drinking:

They were sometimes engaged for several days together, drinking the spirit as it issued from the still, sinking into a state of indescribable wretchedness and often practicing the most ferocious barbarities... Under the unrestrained influence of their intoxicating draught, in their appearance and actions, they resembled demons more than human beings.

Thus, there are obvious and well-documented differences in the pharmacological effects observed in Eastern Polynesian societies on the one hand and in a large group of Western Polynesian and Melanesian societies on the other. Some reasons that may be advanced in form of an explanation of the differential effects include the following:

(a) Different varieties of *Piper methysticum* were used in different societies. Some indication has already been given of the large number of varieties available and of the differences in the strengths of kava prepared from them. For instance, the Samoan varieties are considered to be much less potent than those cultivated elsewhere in Polynesia (Deihl, 1932).

(b) Related to the above factor could also be differences in soil and climatic variations. Titcomb (1948) notes that certain localities in Hawaii were famous for the potent kava. She quotes the native historian Kamakau who stated that: 'From of old, there were places made famous by the intoxicating

qualities of their awa, for example, Ko'uko'u on Kauai, Hena on Oahu, Lanakila on Maui and Puna on Hawaii'.

(c) The plant may be used in different states of freshness or maturity. Furthermore, the green root or stem provides the much stronger drink. Gadjusek (1967) found that islanders in Tanna and Tongariki in Vanuatu showed a distinct preference for freshly harvested roots for this reason, as do people in the Sigatoka River valley in Fiji.

(d) There are differences in the methods of preparing kava. The 'Tonga method' and the 'Fiji method' are described under the section on 'Chewing and Pounding'. A third method is only sometimes used and usually with the malicious intention of quickly intoxicating the drinker. For this, hot water is used to extract the kava from dry or green stock and the drink allowed to cool before serving. The effect far exceeds that of the other two methods of preparation. Obviously, the method of preparation would increase the amount of the active constituents extracted from the kava stock and hence the strength of the drink.

(e) Effects may vary according to whether or not drinkers combine kava consumption with eating. Imbibers often assume that combination of feasting with kava ingestion may result in less debilitating effects. In earlier times, Tongans always took food with kava to prevent nausea and Mead (1930) speaks of an invariable association of food with kava in Samoa. Morrison (1935), writing of Tahiti, says that 'a gill of this juice is a sufficient dose, but if they eat anything immediately before it, it has no effect', while Holmes (1967) found that in legends describing the origins of the kava ceremony in Samoa, the *fono o le 'ava* (food for the kava) went hand in hand with the beverage.

(f) The accounts of missionaries and explorers exaggerated the deleterious effects of kava drinking. This possibility should be seen in the context of the role of missions in helping shape Oceanic attitudes towards alcohol and kava. O'Brien (1971), for instance, discusses the efforts to ban the drinking of kava and alcohol on Ponape as part of a program by the missions to gain and assert political power. He notes that:

The attack on kava was much more than the general missionary dislike of alcohol. The missionaries were far less concerned with prohibiting coconut toddy or rum. Kava was singled out for special attention because of the important position it held (in the system of political tribute) in native society.

(g) Different psychological attitudes towards

kava drinking affected the response to ingestion of the drink. Those who expected or desired intoxicating effects were more likely to experience them, in very much the same way as with marijuana and other hallucinogens.

(h) Additives, which might have been mixed with the drink, could have produced some of the more extreme effects. The practice of adding extracts of *yagoyagona* (*Piper puberulum*) or the daturas, often with a malicious intent, is still practised in some places in Fiji.

### Utensils

The major utensils used in preparing and serving kava are the bowl, the strainer and the cup. However, in those places where the dried kava stock was powdered rather than chewed and elsewhere after the chewing practice had ceased, mortars and pounders could and may still be counted in the list of utensils. In addition, a

specialized form of the kava bowl, called the *burau* vessel, was in the past used by the priests in the performance of their duties.

### Kava bowls

Kava bowls (*kanoa* in Hawaiian, *tanoa* elsewhere), which have traditionally been prized family possessions, are used exclusively for the preparation of kava and, apart from those used in social drinking, are considered to be sacred. They are usually cut out of a solid section of a tree, *Intsia bijuga* (Colebr.) O. Ktze. (family Caesalpiniaceae) (*vesi* in Fijian), being favored for this purpose because of hardness and durability of the wood.

Kava bowls have one of two shapes — round or elliptical. Round bowls are practically circular at the rim with an inverted dome and feature a narrow or wide rim. They range in size from the small bowls for family use, being 25–30 cm in diameter, to the very large bowls used on ceremonial occa-



Fig. 4. Kava bowls (*tanoas*) and cups on display at the Fiji Pavilion during Expo '86 in Vancouver, B.C. The bowls are 35 cm and 84 cm in diameter, respectively. Note the rim surface of the smaller bowl is perfectly level while in the larger bowl it is inclined inward. The V-shaped suspensory lug and the suspensory cord decorated with cowrie shells are clearly visible in the larger bowl.



Fig. 5. A small tanoa (about 22 cm wide) from the Fiji Museum suitable for personal or small group use. Note the unusual shaped suspensory lug. Photograph supplied by the Fiji Museum.



Fig. 6. A much used multi-legged tanoa on display at the Fiji Museum. Note the unusual suspensory lug and the flat rim surface. Photograph supplied by the Fiji Museum.

sions which can be 100–120 cm in diameter. The cavity is evenly concave and usually fairly shallow. The proportion of depth to diameter is 25–30% although slightly shallower bowls, especially those from Fiji may be encountered. Figures 4–7 show

a variety of round bowls of various sizes and styles.

The rim in almost all bowls shows a level upper surface formed by the horizontal space between the inner and outer surfaces of the bowl. In some



Fig. 7. A multi (26) -legged tanoa from Samoa on display at the Samoan Pavilion during Expo '86 in Vancouver, B.C. Note the flat rim surface and the legs which are set close to the rim.

cases the outer surface of the bowl is inclined inwards from its normal plane near the rim and so makes the upper surface of the rim 1–2 cm greater than the thickness of the wood just below it. In Polynesian bowls (see Fig. 6) the rim surface is usually perfectly level and plain whereas those from Melanesia, especially Fiji, the outer part of the surface may be slightly raised (see Fig. 4, largest bowl) and may often be marked with parallel lines which give an ornamental effect.

The legs, normally 4 in number, are positioned at the sides of the bowl 3–5 cm below the outer rim but sometimes as close as 1 cm. The upper end of the leg is usually oval with the broad end internal. The legs usually taper towards the bottom ends where they are round or elliptical in cross-section (Figs. 4–6). The amount of taper may vary, ranging from legs which are nearly cylindrical to those that are almost pointed. Furthermore, the bottom ends may not be cut level so that only part of the surface rests on the ground.

The spacing between the legs may be unequal with no two pairs being the same distance apart. The legs straddling the suspensory lug are usually wider apart than the other pairs. The lengths of the legs vary even for bowls of the same diameter, but all give good clearance to the bottom of the bowl, which should not touch the ground because of the sacred nature of the kava.

Bowls from Samoa may have many legs — up to 16 or more — rounded in cross-section or sometimes square and set close to the rim (Figs. 6 and 7). According to Buck (1930) the extra number of legs was supposed to distinguish Samoan bowls from those of Fiji and Tonga. However, according to Buck, Samoans concede that this feature may be of relatively modern origin having been stimulated by the requirements of the tourist industry.

A striking feature of all round tanoas is the suspensory lug which projects from the outer side of the bowl with the more widely spaced pair of legs. It can be of 2 main types, V-shaped (Fig. 4) or T-shaped (see Buck, 1930 for details), although other shapes are possible (e.g. in Figs. 5 and 6). It is pierced with 2 holes through which runs a loop of sennit braid forming a suspensory cord (Figs. 5 and 6) by which the bowl may be hung when not in use. This cord may be elaborately braided with cowrie shells woven into it (Fig. 4). This elaboration has more than just utilitarian significance, as discussed below in the section on kava ceremonies.

Elliptical *tanoas* are small and only suitable for one or a few persons. They usually have 4 legs and a suspensory lug. The legs are round but somewhat

elliptical at the point of attachment with the body due to the curve of the outer surface; they are also further away from the rim than in round bowls. The suspensory lug is placed in the middle of one of the long sides at a slightly higher level than the leg attachments.

There are also reports of more exotic tanoas from some parts of the Pacific, like those in which the wooden legs were replaced by human figures (Figs. 8 and 9). Cook (1785), reports that:



Figs. 8 and 9. Exotic *tanoas* in which wooden legs are replaced by carved human figures. These bowls are on display at the Museum of Mankind, British Museum. Photograph supplied by and reproduced by the permission of the Trustees of the British Museum.



Fig. 10. A *burau* or priest's vessel acquired by the Fiji Museum in the early 1980s. Part of the base has been broken off. Photograph supplied by the Fiji Museum.

Captain Clerke. . . received from him a large bowl supported by two figures of men, the carving of which both as to design and the execution showed some degree of skill. This bowl. . . used to be filled with *kava*, or *ava*, which liquor they prepare and drink here as in the other islands in this ocean.

The bowl in Fig. 8, which is at present in the British Museum, may well be this particular bowl.

The *burau* vessels, mentioned earlier, were distinctly Fijian in origin. Although drawings of these artifacts had appeared in publications by Ledyard (1783), Cargill (1841), Williams (1858), Cumming (1881) and others, their existence and function have been, until recently, shrouded in secrecy. Cargill noted that 'the shape and workmanship of this sacerdotal bowl indicate the ingenuity of the artisan' and they 'were informed that it was the dish from which the priest drank an intoxicating liquor, during the paroxysm of in-

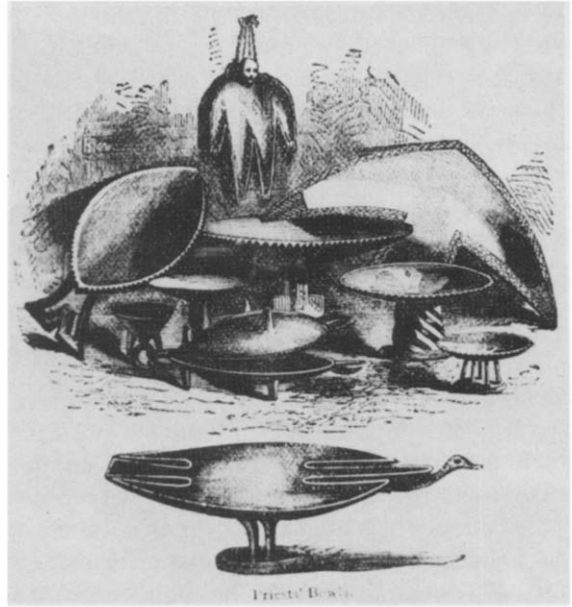


Fig. 11. *Burau* vessels of various shapes and sizes. Photograph supplied by and reproduced by permission of the Fiji Museum.

spirations and that it was sacrilege for any other person to use this sacred vessel'. This bowl, which the Cargills were able to obtain from the priest, was similar in shape and design to that recently acquired by the Fiji Museum (Fig. 10). Other types of *burau* vessels are shown in Fig. 11.

#### *Drinking cups*

Kava drinking cups (*bilo ni yagona* in Fijian, *ipu'ava* in Samoan, *'apu 'awa* in Hawaiian) are made of the pointed end of the coconut which is cut in the transverse direction, although in Hawaii in the past the nut was also cut longitudinally or

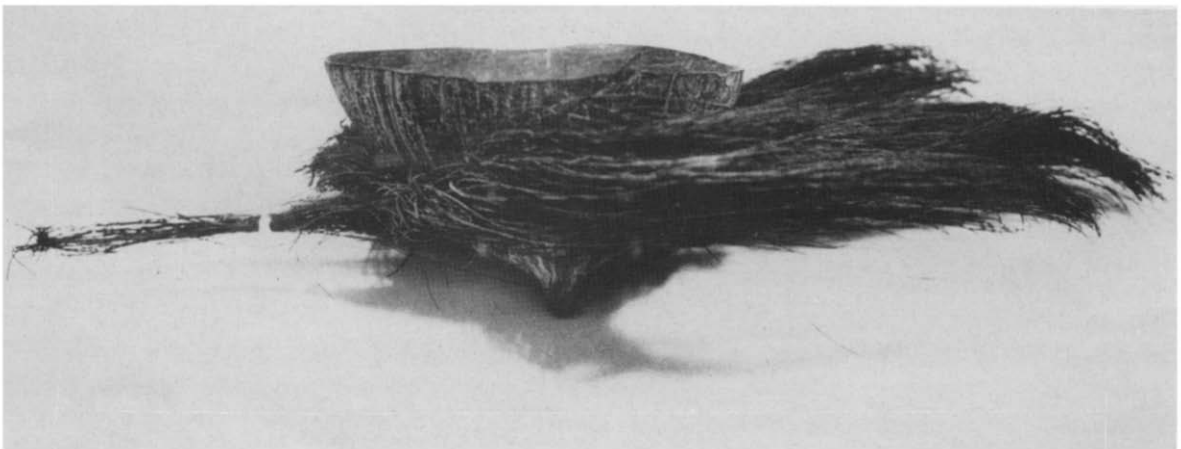


Fig. 12. Kava drinking cup. Some of the husk has been left attached to the nut to form a handle.

obliquely. The cups vary greatly in size, not only from the size of the nut used but also from the segment cut off, i.e. depending on whether the cut is made on the line of greatest circumference or on either side of it. With the smaller nuts the division is made on the other side from the pointed end, thus forming a small but deep cup. With larger nuts, the cut is on the greatest circumference or even below it, thus providing a wide but comparatively shallow cup. Cups of various shapes and sizes are shown in Fig. 4.

The cups are scraped smooth on the outer and often the inner, surface giving them a highly polished appearance. With constant use they become coated with a pale bluish patina which fades to a yellowish color and which may flake off when the cup is no longer in use. Occasionally, the cups may be provided with a handle. In Fig. 12, some of the coconut husk was left attached to the nut, while in Fig. 13 the handle is more elaborate and was made by weaving together coconut fiber and threading the braid through holes made in the cup.

Wooden kava drinking cups have been made in the past and may occasionally be encountered in museum collections. They are very similar in shape to those of coconut shell, but they may be thicker and usually have a handle projecting from them.

#### *The strainer*

The strainer (*aibo* in Fijian, *to tau tava* in Samoan) is normally made of strips of *fau* or *vau* bast although strainers of coconut fibre may be used. Bast strips of *vau* (*Hibiscus tiliaceus* L.), 100–150 cm in length, are strung together in one end by a connecting cord and the strips drawn

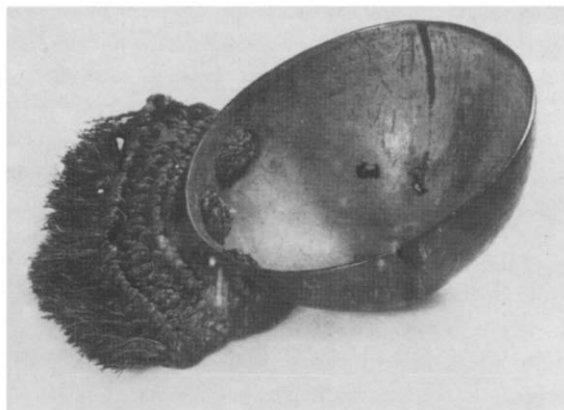


Fig. 13. Kava drinking cup. The elaborate handle was made by weaving coconut fiber together and threading the braid through holes in the cup. Photographs for Fig. 12 and 13 supplied by the Fiji Museum.

together and then folded to form a pad which then acts as the strainer. To render the new strainer fit for use it is soaked in a suspension of kava. The damp strainer is then wrapped in a green banana leaf or placed into a kava cup until needed. With constant use and infrequent washing it assumes the same color as the strained beverage and acquires a tangled appearance. Old strainers are preferred by connoisseurs of kava because they contend that the flavor of the drink is improved when they are used. In social drinking, however, a piece of cloth is nowadays usually used instead of the *vau* strainer, to separate the solid residue from the kava infusion.

#### *Stone mortars and pounders*

Since the habit of chewing was abandoned, the kava stock has almost entirely been pounded. This is most commonly done on a large stone with a smaller one except, of course, when mechanical pulverizers which are now used widely for commercial preparations, are employed. Usually a waterworn stone of suitable size and weight is selected for the anvil. In the past it was often a stone that was originally used for grinding stone adzes. The concavity formed by such grinding furnished a convenient hollow, as the outer lip prevented the pounded material from falling over the edge onto the ground. The stone pounder was any piece of stone which was suitable for the purpose, although it usually was water worn like the anvil and may have been collected from riverbanks and edges of streams.

Wooden mortars hollowed from pieces of tree trunk and long metal rods as pounders weighing about 5 kg are sometimes used, but they are of more recent origin. Metal cylinders, about 20 cm in diameter, 50 cm high and closed at one end, also serve as mortars. In many towns and cities, with the ready availability of powdered kava from shops and markets. However, connoisseurs of the beverage prefer the freshly powdered material, as they can choose the raw material and also safeguard against the possible adulteration of the powder which is often encountered in commercial preparations.

#### **Sociological aspects**

##### *Social ceremonial*

The most significant role of kava continues to be social ceremonial. As Ford (1967) states, it is 'the only way to welcome an important visitor. Sharing a bowl of kava tends to foster socializing and

friendship and it is unthinkable that kava should not be a part of commemorating any important event. The practice is solidly embedded in social and political context'. Holmes (1967), writing on the position of kava in modern Samoa, found that 'kava drinking is without doubt the most important element of the *aiava*, the ceremony of greeting for visiting parties (*malaga*) and therefore carries much of the burden of Samoan hospitality'.

Present day ceremonies of welcome in Tonga, Samoa and Fiji invariably include the kava ceremony. President and Mrs. Lyndon Johnson were offered the kava drink on their visit to Samoa in October, 1965. On that occasion, 'Samoans who had turned out from every corner of the island to welcome the Johnsons, applauded delightedly as the First Lady sipped the bitter juice from a coconut cup' (Pfeiffer, Murphree and Goldstein, 1967). Queen Elizabeth of Great Britain and members of her family are always offered kava on their visits to Fiji and they always drink the beverage!

However, kava is not always in the form of a drink when used in welcoming ceremonies. It appears from Friedlander's (1899) account that it was the custom in Samoa for each of the parties, both guest and host, to make a present of kava root to the other — which was accompanied by polite speeches of welcome. La Pérouse (1798) reports the appearance, on arrival of the French in Samoa, of an old man with a branch of kava in his hand and also the throwing into the sea of several branches of kava, by some natives in another part of Samoa, as a sign of peace. Cook (1813) says that in Tonga it was brought out in canoes to the English ships as a sign of peace and friendship and Mariner (1827) reports an incident where a chief, visiting the island of Vavau to quell an insurrection, was met by one of the rebellious men who removed his turban, gave the chief a piece of kava root and kissed his feet as a mark of respect.

This practice of exchanging kava is still prevalent and is performed even where no chiefs or dignitaries are involved. Waqavonovono (1980), in her study of Fijian medicinal plants, reports that she first 'presented a *sevusevu*\* to the leader of the Y.W.C.A. group who returned the same procedure with another *sevusevu* of welcome. After several bowls of *yaqona*, I described to the group the purpose of my visit'. At present such presentation or exchange of kava is normally done with the

powdered form as the uncut root is not always available and is much more cumbersome to use, or is too expensive.

In the past, ceremonial kava drinking has invariably been the first act of most important community functions, some of which are mentioned in the Introduction. Other important ceremonial uses of kava occur at meetings for divination, pacts of revenge, before the confinement of a woman when prayers are said so that the child may be a son (Gifford, 1929), naming of child at one year of age, after seeing the shark god Sekatua in the water, settling disputes, pigeon snaring (Newell, 1947), consecrating a boy child and ceremonial initiation of girls trained in the sacred hula dancing and chanting (Handy and Handy, 1972). In Tikopia, kava serves as a medium for the reaffirmation of the value of sacred symbols. As it is used as a religious libation and not as a beverage, it is ceremonially poured out, not drunk (Firth, 1970).

In less peaceful times kava was consumed by chiefs and warriors prior to battle. For example, the first king of Tonga, Tautafa'ahau, incited his troops to battle by a kava ceremony (Gifford, 1929) and Mariner (1827) describes how the head chief of a village anointed his war leader by symbolically offering the first cup of honor to him.

#### *Medicinal*

In many parts of the Pacific, it was generally thought that kava, taken judiciously, had a beneficial effect on health. The Hawaiians used it for many purposes — to soothe the nerves, to induce relaxation and sleep and to counteract fatigue (Titcomb, 1948), for congestion in the urinary tract, for asthma and rheumatism and to reduce weight (Handy and Handy, 1972). They considered the leaf good as a poultice for headache or for placing under a patient to make him perspire to break a cold or fever. Treatment by kava for excessive fat brought the body back to normal fitness. According to Diehl (1932), 'it is a spinal rather than a cerebral depressant; it steadies the pulse, does not raise the temperature and acts as a diuretic and a stomachic tonic. Its chief medical use is in the cure of chronic cystitis and gleet and, amongst those South Sea Islanders affected with syphilis, its stimulating and diaphoretic action was highly appreciated'. Harrisson (1937) found that it was formerly extensively used as 'a curative in cases of gonorrhoea. Kava-drinkers very seldom get gonorrhoea. If they do, the kava itself cures it in time, always keeps it under control'.

\*Fijian word for exchange of gifts, often as a prelude to a request for favor.



According to Titcomb (1948), Hawaiian medical men (*kahunas*) made extensive use of kava for cure or alleviation of such ailments as 'general debility, especially in children'; 'weary muscles. . . a great restorer of strength'; for 'chills and head colds'; 'difficulty in passing urine'; 'sharp blinding headache'; and for children having a 'disorderly stomach and. . . thick, white coating on the tongue'. Other disorders for which kava was recommended and used included 'lung and kindred troubles'; 'weaknesses arising from certain conditions during virginity'; 'displacement of the womb'; and as 'a poultice for boils.' Jarret (1933) notes that, 'it was extensively used in Germany previous to the World War, in the manufacture of certain drugs and medicines' and Emerson (1903) mentions kava as an article of export, noting that its 'value as a drug is in the preparation of remedies for urinary troubles'. In Tanna, where custom ascribes to women a mysterious power which may destroy the potency of kava, Tannese women drink it medicinally and give it to their children (a one-teaspoon dose is considered to cure whooping cough); its power then seems unimpaired (Ellis, 1984).

#### *Magico-religious*

In addition to its social ceremonial uses, kava has been employed for a number of magico-religious purposes. One of the most important of these was the pouring out of libations of the beverage to the gods, although in some cases the symbolic offering of kava root was substituted. Turner (1861) notes that in Samoa the head of a household, at the beginning of the evening meal, would pour a little kava onto the ground or around the edge of the mat as an offering to the gods. In pre-Christian days in Fiji, the first cupful was poured out at the foot of the main kingpost of the bure or tribal hall (Brewster, 1922). At formal kava parties, the first cup was always proclaimed by the priest as being for the gods (Young, 1855; Pritchard, 1863–4; Rivers, 1914). Often the names of ancestors were also invoked at this time. Mariner (1827) also refers to a Tongan custom whereby a small piece of kava root was left before a consecrated house or grave, out of respect either to a god (or gods), or to the departed spirit of a relation or chief. On some of the outlying Tongan islands a piece of scraped kava was thrown into the sea on invocation of the shark god Sekatoa (Williamson, 1939).

Reference was made earlier to the presumed absence of kava-drinking by Niueans, probably

because of its scarcity; whatever material was available was reserved for the inspiration of their priests (Thomson, 1902).

In Hawaii, a major function of the *kahunas* was to establish communication with the gods. These priest were experts of religious practice, with knowledge of what to offer, what prayers to use and what interpretations to place on portents (Titcomb, 1948). Of the offerings made, kava was thought to be the most important to propitiate the favor of the gods. Root, beverage and leaves were all suitable, while one exceedingly powerful offering was a 'complete' kava — that is, a plant with one root, one stem and one leaf.

Among the orders of priesthood in Hawaii, there were three which were particularly dreaded — those who prayed victims to death, sorcerers and those who sent evil spirits on errands of death (Titcomb, 1948). Of these, the last named used kava exclusively. In Fiji, kava has also been used both in sorcery and witchcraft (Lester, 1941). If an individual desired the death of his neighbor, he recruited the services of a sorcerer who prepared kava and poured a libation on the grave site of an ancestor of the intended victim. The ceremony was repeated after the victim was dead. In many parts of Fiji kava is considered to have the gift of healing. If a child is sick, a piece of the kava plant is suspended from the roof of the house in full view of the patient. It is claimed that after 2–3 days normal health would be fully restored.

#### **Kava ceremony**

The method of preparation, distribution and all other attendant details have been described in great detail in various places (e.g., Mariner, 1827; Churchill, 1916b; Collocott, 1927; Hocart, 1929; Mead, 1930; Williamson, 1939; Lester, 1941; Newell, 1947; Ford, 1967), thus only an overview and descriptions of a few typical ceremonies are presented here.

Three major types of kava ceremonies can be identified: the full ceremonial as enacted on very formal occasions, such as welcoming of royalty or highly honored guests; that performed at the meeting of village elders, chiefs and nobles and for visiting chiefs and dignitaries; and the less formal kava circle common to social occasions.

#### *Preparation of beverage*

The main requirements for beverage preparation are the kava stock, bowl, cup, strainer and water. Depending on the nature of the occasion,

the kava would be in the form of fine roots, or roots and stems, which are then reduced to fine particles, or commercially prepared powder may be used.

The task of preparation and distribution of the drink is normally entrusted to specific members of the community. In Samoa, these individuals are young, untitled and unmarried men, called *aumanga*; in Manua, kava could be made by either girls or boys, although in the 'high kava' ceremony only boys were permitted to officiate (Mead, 1930). In Tonga the activities have been performed by young boys under the direction of a herald to the chief, called *matabule*. After the kava stock had been scraped clean, it was cut or broken into smaller pieces before being macerated into fine particles using a mortar and a pestle. At present, commercially available kava, especially in the bigger cities, is mechanically ground. However, there is overwhelming evidence in the literature that in all communities where the beverage was used, kava was at one time or another chewed as a prelude to preparation of the infusion\*.

#### *Chewing and pounding*

The chewing was normally done by young men or women (Williamson, 1939), although there appears to be some controversy of opinion among sources as to the degree of involvement of women. Pritchard (1866) and Churchward (1887) say it was done by young girls, while Erskine (1853) found that it was the responsibility of boys. According to Churchward (1887), a man in the security of his own home might sometimes avail himself of the services of his wife, if no girls were available, but this would not be considered proper in front of strangers. Even a strange girl passing by could be pressed into service.

To be selected for the task, the chewers had to have good, strong teeth and jaws (as might be expected!), clean mouths and be free of ailments — e.g., coughs, colds and sores. Before commencing their work, they rinsed their mouths and sometimes their hands and fingers, with clean water (Pritchard, 1866). Brown (1910) says they were supposed to chew kava without wetting it with saliva, but doubts whether they could succeed in this. A test made by a Dr. Macgregor of Fiji, as

related by Cumming (1881), showed that six ounces of kava, when chewed, increased in weight to seventeen. However, Mariner (1827) found it 'astonishing how remarkably dry they preserve the root, while it is undergoing this process of mastication.' A white man, resident in Tonga long enough to have seen kava chewed, related to Collocott (1927) that remarkably little saliva was mixed with the kava and that he himself felt no difficulty in drinking kava prepared in this way.

Although it was inevitable that the chewers would swallow some of the juice, they and the youths who assisted in the making were never allowed to drink the beverage after it had been prepared (Humphreys, 1926). Undoubtedly, the chewing activity was exceedingly taxing for the mouth and jaws of the individuals concerned, so much so that 'the older women who were chewers in their youth speak feelingly of the tiresome labor and great weariness of jaw incident to the older method of preparation. A desire to escape from this fatiguing duty is a traditional explanation of the old time elopement of chief's daughters' (Mead, 1930).

Although chewing was the prevalent method (sometimes called the 'Tongan method'), there is evidence to indicate that in Fiji it was preceded by pounding or grating, called the 'Fijian method' (Rivers, 1914, vol. 1). According to Williams (1858), 'some old men assert that the true Fijian method of preparing the root is by grating, . . . but in this degenerate age the Tongan custom is almost universal (i.e. chewing)'. Later, Brewster (1922) wrote that in 'the beginning and middle of the past century Fiji was nearly conquered by Tongan adventurers. They succeeded in introducing many of their customs and amongst them their fashion of preparing kava. The ancient Fijian way was to pound up the roots with stones'. After Fiji became a British colony (in 1874), the medical officers objected to the chewing on sanitary grounds and subsequently the colonial government forbade the practice (Brewster, 1922; Hocart, 1929; Degener, 1949). Elsewhere, similar pressures by colonizing governments and missionary influence (e.g. see Mead, 1930) led to the abandonment of the chewing technique in favor of pounding.

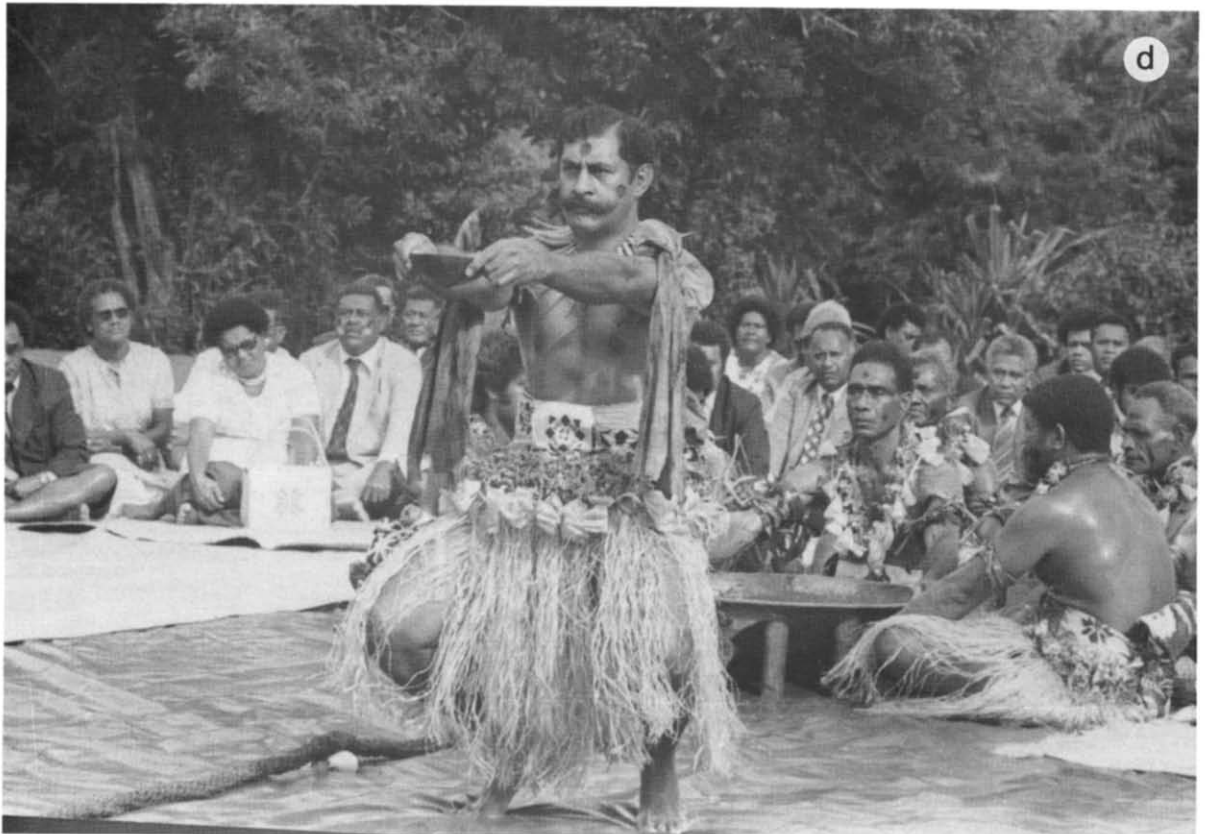
#### *Ceremonial welcome*

The most dignified of the kava ceremonies of welcome, called 'high kava' in Fiji, is reserved for the very highly honored guests. These include visiting heads of state like Presidents and Prime Ministers, the Queen of Great Britain and

\*For details, see Samoa (Pritchard, 1866; Churchward 1887; Churchill, 1916 Tonga (Collocott, 1927; Williamson, 1939) Marquesas (Porter, 1833), Rotuma (Williamson, 1939), Tahiti (Cook, 1813; Henry, 1928), Wallis (Mangeret, 1884), Fiji (Lester, 1941; Hocart, 1929) and Hawaii (Titcomb, 1948).



Fig. 14. Stages in formal kava ceremony. The dignitary being honored is the President of Fiji. (a) Ceremonially dressed kava preparers arrive with a *tanoa*, kava and accessories. (b) Water is poured into the bowl containing the kava and the strainer. Note that the suspensory cord is pointed in the direction of the honored guest. (c) The kava maker kneads the kava, scoops it up in the strainer and allows some of the infusion to fall into the bowl to judge its color and strength. (d) The cup bearer turns towards the honored guest on bent knees. (e) The cup bearer pours the kava into the guest's cup. (f) The guest drinks the kava holding the cup with both hands. Photographs supplied by the Fiji Information Ministry.





members of her family and Monarchs of other countries like Tonga. The following description is of a ceremony typical of Fiji.

All preparations of the site of welcome are done ahead of time. On arrival honored guests are led to a raised platform with chairs for the guests, the main host and his party. Visitors of exalted rank are often accompanied by a spokesman or herald who sits on the floor next to him or her. Kava will be prepared in an area about 15–20 meters from the edge of the platform. Large mats made mainly from leaves of the screw pine or pandanus (*Pandanus tectorius* Soland., family Pandanaceae), have been spread on the platform, in the kava preparation area and on the path connecting the two. The sequence in Fig. 14a–f, illustrates the essential features of the ceremonial welcome. The dignitary involved in the illustration is Ratu Sir Penaia Ganilau, the former Governor-General of Fiji and since the military coup of 1987, the President of that country.

The ceremony begins with the arrival of a group of young men dressed in ceremonial attire and carrying the kava bowl, the kava and other

accessories. The bowl is placed between the kava preparers and the visitors, with the suspensory lug laid out in a line pointing towards the chief guest of honor. The kava is placed in the bowl and water is poured in from a special container. Very often the ceremony is accompanied by the chanting of special kava songs. The kava maker kneads the kava; when it is considered to be ready the cup bearer picks up a cup and approaches the bowl. He squats down before the bowl with knees well apart, turns his back to the guests and holds the cup over the bowl. The kava maker soaks some of the infusion in the strainer and squeezes it into the cup. The server who is holding the cup with both hands slowly turns around on bent knees to face the visitor, walks in this mode for a few steps, then walks upright for the rest of the way. The beverage is poured into a cup reserved for the chief guest, who holds it with both hands and drinks from it. If the whole cup is drained without stopping, everyone says *a maca* (pronounced ‘a matha’, meaning ‘it is empty’) and clap three times with cupped hands. The cup bearer now returns to the bowl and proceeds to serve the person next in rank



Fig. 15. Presentation of a large kava root (with stalks attached). The presenter would normally be dressed in ceremonial attire. Photograph supplied by the Fiji Information Ministry.

or importance, but without the same ceremony. At such occasions the distinguished visitor may also be presented with gifts of the whale's tooth (*tabua*), large kava roots (Fig. 15), tapa cloth, fine mats, dead pigs, yams and other crops.

#### *Kava ceremony in villages*

The ceremony performed in the villages has invariably been the initial act of almost all important community activities. Although less formal than that encountered at ceremonial welcomes, strict protocol still needs to be followed with the preparation and distribution of the beverages. The following describes a typical Samoan ceremony at a village council meeting to discuss the reconstruction of the village guest house which had recently been blown down by a hurricane. This account is derived from a description by Holmes (1974).

After the Chiefs and Talking Chiefs are seated on the periphery of the circular council house (such structures traditionally do not have walls) and the *aumanga* (the society of untitled men) has taken its position outside in tight rows, the council members are welcomed by the orator who presides over the gathering. The kava ceremony begins with the orator selecting a kava root from the many presented to him. A member of the *aumanga* cuts it into small pieces and pounds it into pulp using a stone mortar and pestle reserved for this purpose. Meanwhile, other *aumanga* members wash a multi-legged wooden kava bowl and bring clusters of cups filled with cool, fresh water.

An air of reverence prevails while the preparations are being made. Chiefs speak in whispers and no one smokes. At a location near the back of the council house, some *aumanga* members position the kava bowl and sit behind it, with a kava maker in the center. The kava powder is placed at the bottom of the bowl, which is then half filled with water. The fibrous strainer made of hibiscus bark is laid over the kava, which is then collected into it. The strainer with the kava in it is raised above the bowl and wrung dry of the infusion three times. The entire process is repeated two more times. The pulp-filled strainer is now thrown out of the house to a waiting strainer cleaner who removes the kava pulp by several snaps of the strainer. It is then thrown back into the house and the steeping process is repeated until most of the kava residue has been removed. A generous stream of kava is now showered down from the strainer into the bowl to allow the chiefs to judge if the kava requires more water. If not, then it is announced that the kava is ready and the assembled

chiefs clap their hands, not as applause, but for protocol.

The order in which kava is now served is of vital social significance. The Chief of highest traditional rank drinks first, then the highest ranking Talking Chief. The cup is then passed to the second ranking Chief, the second ranking Talking Chief and so on down the elite hierarchy (Holmes, 1974).

#### *Informal kava drinking*

By its very nature, informal or secular kava sessions have no set procedures or rituals to be followed and depend on the circumstances of the occasion and the whim of the group participating. However, some factors always play a prominent role. For instance, the sacred nature of the beverage warrants that its preparation and use are always done with respect and its distribution is more often than not preceded by the pouring of a libation. Traditionally, *tanoas* have been used as mixing bowls. Recently, however, basins and even plastic buckets started replacing them and this led to a sharp rebuke from some chiefs in Fiji (Wendt, 1969).

Although kava parties may be used to resolve less amicable situations, such as conflict and enmity, their major role undoubtedly is to serve as a social 'mixer'. Typically participants gather at a house or outside, sitting cross-legged in a circle around a kava bowl, with the kava maker at the circle. Someone pounds the kava, which is then mixed with water in the bowl according to traditional procedures but without much ceremony. Often a bark strainer is used to separate out the debris. When a piece of cloth is used as a strainer, it is spread out and the dry kava powder placed in it before immersion into the water. When ready, the kava is served in a coconut cup, proceeding clockwise or counterclockwise around the circle. No precedence is followed unless someone of importance is present. Serving is anticipated for each individual by clapping of hands of the others in the circle. The server then waits patiently in front of each drinker until he has finished. Drinkers usually utter some stylized salutation, then down the contents in one draught (Lemert, 1967). Such kava parties may be held in the afternoon, or even in the morning, but most frequently they begin in the early evening and continue until late at night or even the next morning.

#### **Chemistry**

The reported pharmacological effects of kava drinking have prompted numerous chemical

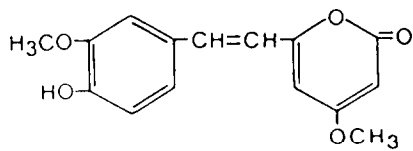
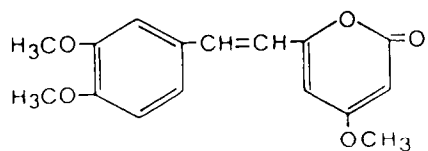
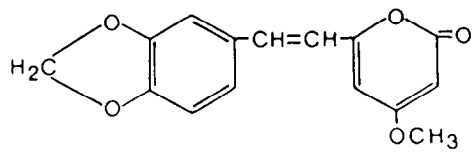
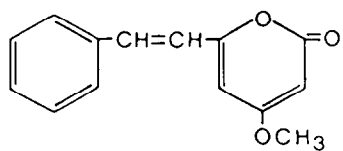
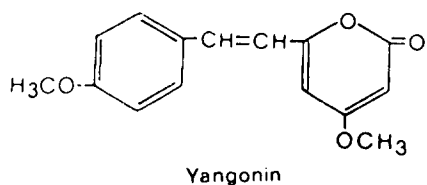


Fig. 16. Chemical structures of substituted alpha-pyrone constituents of kava.

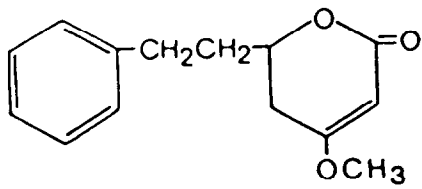
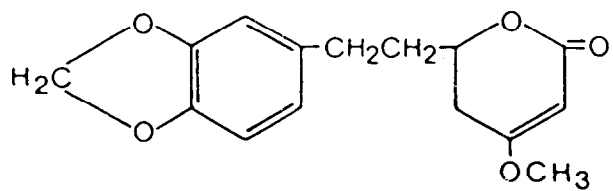
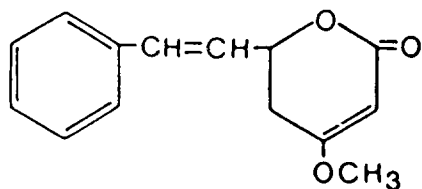
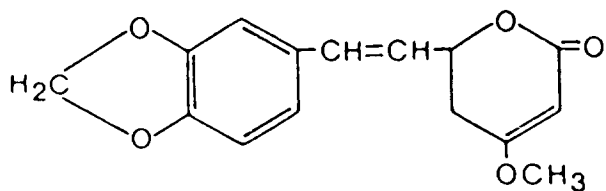


Fig. 17. Chemical structures of substituted 5,6-dihydro-alpha-pyrone constituents of kava.



investigations over the past 130 years in the search for the biologically active constituents. These investigations have resulted in the isolation of two series of closely related compounds which are either substituted alpha-pyrone (Fig. 16) or substituted 5,6-dihydro-alpha-pyrone (Fig. 17) and some other miscellaneous compounds.

Gobley (1860) and Czuczarski (1861) almost simultaneously reported the isolation of the first of these compounds, now called methysticin and previously also known as kavakin, kawakin, kavatin and kanakin. In 1874, Nölting and Kopp reported a crystalline material whose isolation was later repeated by Lewin (1886) and who named this compound yangonin (Fig. 17). The isolation of dihydromethysticin was achieved by Winzheimer in 1908.

The appearance of Lewin's monograph in 1886 was followed by the most extensive chemical investigation undertaken on the kava plant with the publication of a series of 14 papers by Borsche and his coworkers during the period 1914–33. This work covered the isolation of two new constituents, kawain and dihydrokawain (Fig. 17) and their structural elucidation together with that of the 3 previously known components, methysticin, yangonin and dihydromethysticin. However, Borsche and Bodenstein (1929) incorrectly formulated yangonin as the 2-methoxy-4-pyrone structure. It was not until 1950 that the error was corrected by Macierewicz (1950) and independently confirmed by Herbst et al. (1959). It was finally unambiguously synthesized in 1960 (Bu'Lock and Smith, 1960).

Later four new compounds were added to the alpha-pyrone series with the isolation of 5,6-dehydromethysticin, 11-methoxyyangonin and 11-methoxynoryangonin (Mors, Magalhaes and Gottlieb, 1962), and desmethoxy-yangonin (Klohs, Keller and Williams, 1959) (Fig. 16), together with the isolation of two pigment materials, flavokawain A and flavokawain B. The structures of these pigments have been established by synthesis to be substituted chalcones (Hansel et al., 1963). According to Shulgin (1973) these pigments, which are otherwise biologically inactive, might provide an explanation for the skin discoloration observed with chronic exposure to kava extracts.

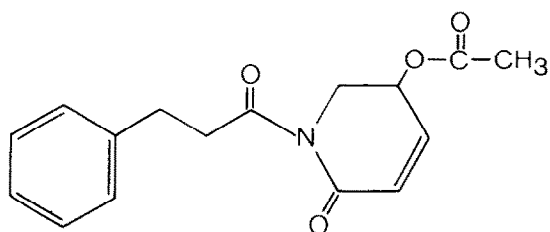
Early attempts to establish the relative amounts of the various components present in the intact plant have yielded uncertain results, being largely dependent on the separation procedures employed. Young et al. (1966) used spectrophotometric analytical techniques while Klohs et

al. (1959a) assayed the fractions from column chromatographic separations. On the basis of the available data (Hansel, Ranft and Bahr, 1963; Hansel and Klaproth, 1966; Hansel, Sauer and Rimpler, 1966; Young et al., 1966; Sauer and Hansel, 1967), the proportion of each component present has been classified by Shulgin (1973) as being major (dihydrokawain, kawain and methysticin), minor (5,6-dehydromethysticin, desmethoxyyangonin, dihydromethysticin, flavokawain A and yangonin), or trace (flavokawain B, 11-methoxynoryangonin and 11-methoxyyangonin).

Renewed interest in kava, especially that arising from its abuse in Australian Aboriginal communities, has prompted a number of groups to develop more rapid and reproducible chemical detection techniques for the active kava components and their metabolites. Duve and coworkers (Duve, 1981; Duve and Prasad, 1983; 1984a, b) have used a gas-liquid chromatographic technique to identify the major active constituents, to assay the effectiveness of various extraction procedures during beverage preparation and to determine the stability of the constituents on long term storage of dried powdered roots and basal stems of the plant. On the other hand, Duffield and his group employed methane chemical ionization gas chromatography/mass spectroscopy in their studies. By this technique, they were able to essentially confirm earlier studies and also identified human urinary metabolites and a number of previously unknown trace compounds of kava (Duffield and Lidgard, 1986; Duffield, Lidgard and Low, 1986; Cheng et al., 1988; Duffield et al., 1989). To date, the pharmacological activities of these new compounds have not been determined and their role in the overall effects of the kava beverage remains to be elucidated.

Despite earlier claims (Lavialle, 1889; Winzheimer, 1908; Scheuer and Horigan, 1959) that alkaloids were present in the roots, all attempts at their isolation were unsuccessful until 1971 when two amides in trace amounts were reported (Achenbach and Karl, 1971). More recently, the isolation and structural determination of a novel alkaloid, pipermethystine (Fig. 18), a major constituent of the leaves, has been achieved by Smith (1979). This compound is also present in small amounts in the stems and roots of the plant, but because of its instability on standing and to most separation techniques, it had not previously been reported.

In an effort to assign biological activity to one or other portion of the molecule, a number of



Pipermethystine

Fig. 18. Chemical structure of the alkaloid pipermethystine.

structural modifications of the active constituents have been carried out. Pharmacological assays of the analogs in various test systems suggest certain structure-activity relationships (Klohs, 1967). For instance, shortening or lengthening the two-carbon bridge between the rings of the dihydrokawain molecule decreases the fungistatic activity of this compound. Elimination of the 2-carbon bridge generally leads to a decrease in biological activity, as measured by the compound's ability to provide the test animal with protection against the convulsive effects of strychnine. On the other hand, the introduction of hydrogen in the pyran 5-6 position of yangonin leads to the appearance of some narcotic effects in the compound (Werny and Hansel, 1963). For more detailed accounts of the chemistry and structure-activity relationships, the reader should consult reviews by Keller and Klohs (1963) and Shulgin (1973) and the more recent papers of Duve's and Duffield's groups.

### Pharmacology

The first pharmacological evaluation of the kava pyrones was published in Lewin's (1886) admirable monograph but because only very limited quantities of pure compounds — methysticin and yangonin — were at his disposal, his data must now be considered to have only historical significance. In any case, they are worth noting here. Methysticin was found to be inactive when injected intraperitoneally in doses of up to 2 g in both warm- and cold-blooded animals. Yangonin, being available in even smaller quantities, could be tested only in two frogs in oral doses of 0.05 g with no observable effects.

The bulk of Lewin's experiment was carried out on the resin remaining after the crystallization of methysticin and yangonin. It produced paralysis in frogs and exhibited a local anaesthetic action. In experiments with a bat, a sparrow and a pigeon, it

caused the loss of use of the wings and the animals appeared to be deeply sedated. Subcutaneous administration of the material in cats resulted in a deep sleep with obvious local anaesthetic activity, but when given orally, only salivation and vomiting were noted.

Borsche and Blount (1933) came to the conclusion that none of the kava pyrones known at that time (i.e. methysticin, dihydromethysticin, yangonin, dihydrokawain and kawain), possessed the biological activities reputed to be present in the crude preparation. The possibility that the active principle might be present in the unsaponifiable fraction could not be substantiated, as the solubility characteristics of the fraction did not allow for biological testing. In a pharmacological investigation carried out about this time, Schübel (1924) found the kava resin to have a weak narcotic action, to paralyze sensory nerves and to first stimulate, then paralyze smooth muscles. The hydrolysis products of this resin also showed similar actions. The local anaesthetic action was attributed to compounds containing benzoic and cinnamic acid residues. In experiments in the isolated frog heart, Schübel showed that incubation of the kava root with human saliva increased the potency of kava extract. He attributed the increase in activity to the enzymatic breakdown of starch in the root, which in turn led to a more efficient extraction of the active materials. However, Schübel was unable to demonstrate any pharmacological activity when the pure compounds yangonin and methysticin were administered to rabbits, pigeons or frogs.

Van Veen (1938) employed pigeons, monkeys and rice birds to follow the active principles of kava in his isolation procedures. Preliminary results indicated that rice birds were overly sensitive to the crude extracts and monkeys too resistant. Pigeons were thereafter used for routine assays. Eight to fifteen minutes after administration of the extract, the pigeons became sleepy and atactic; a deep sleep then set in lasting from 2 to 10 h. The birds appeared to be fully recovered upon awakening. Monkeys required three to five times the dose used in pigeons. An effective dose caused initial loss of limb control, followed by sleep within 15-30 min minutes which lasted for 15 h or longer. Van Veen found that purified fractions gave a maximal effect when administered in an oil or lecithin-water emulsion and consequently proposed that chewing the root and admixing saliva only served to bring about emulsification and thus promote activity.

Van Veen succeeded in isolating an active fraction from which he reported a crystalline material and which he called *marindinin* after the Marind-Anim district in New Guinea, now known as Kolepom. He subsequently demonstrated that marindinin was a slightly impure form of dihydrokawain, a compound found by Borsche to be physiologically inactive. Van Veen also tested the purified dihydrokawain and showed that the physiological activity he had earlier demonstrated was indeed due to this refined material and not to the impurity.

More recently, work in several laboratories has confirmed the activities of the kava pyrones. Hansel and Beiersdorff (1959) showed that dihydrokawain and dihydromethysticin both appeared to be active in causing sleep in white mice and white rats when administered orally by a stomach tube as an emulsion. Meyer, Oberdorf and Seifen (1960) reported that dihydrokawain and dihydromethysticin had sedative activity when administered intraperitoneally or orally to mice, rats, rabbits and cats. Higher doses led to a marked ataxic phase followed by loss of the righting reflex. When administered to mice as peanut oil solutions, both dihydrokawain and dihydromethysticin produced sedation, hypothermia and a corresponding reduction in total oxygen consumption. In unanesthetized rabbits, blood pressure was only slightly reduced (Meyer, 1962). These findings, however, could not be duplicated by Keller and Klohs (1963) and are reminiscent of the contradictory evidence of Borsche and Van Veen as mentioned earlier.

Later, Meyer (1967) demonstrated that the most characteristic central nervous action of all kava pyrones was their ability to produce a mephenesin-like muscular relaxation in all species of laboratory animals. The pyrones have also proved to be considerably more effective than mephenesin in protecting mice from convulsions and death caused by toxic doses of strychnine. Thus, these compounds might represent a new group of potent, centrally acting skeletal muscle relaxants, probably the first of natural origin. Larger doses produced ataxia and an ascending paralysis without loss of consciousness, followed by complete recovery. In doses causing muscular relaxation, the pyrones did not possess a curare-like action on the neuromuscular function (Meyer, 1966). Death after large oral or i.p. doses was the result of respiratory failure. In addition, the pyrones reduced the oedema produced by formalin, serotonin, dextran and carrageenin. Contractions of isolated

ileum or uterus produced by histamine, barium ions, acetylcholine, bradykinin, serotonin or nicotine were inhibited by the pyrones in concentrations  $1:10^6$  to  $1:10^5$  (Meyer, 1967).

Klohs et al. (1959b) studied the effects of the ground root of kava, a chloroform extract obtained therefrom and several of its crystalline constituents, on the central nervous system as determined by their ability to antagonize clonic strychnine convulsions and death in mice, cause fall-out in roller cage experiments and potentiate sodium pentobarbital-induced sleeping time. The crude extract, methysticin and dihydromethysticin were particularly effective in affording protection against the lethal effects of strychnine, while yangonin and dihydroyangonin were practically without effect. Kawain and dihydrokawain were only moderately effective. All of the compounds increased pentobarbital-induced sleeping time with dihydromethysticin being the most potent agent. Using 'fall-out' from revolving (roller) cages as an index, none of the crystalline compounds had significant activity. This was in sharp contrast to the ground root and the crude extract. On the basis of these results, Klohs et al. (1959b) proposed the presence of a synergistic action for the individual compounds when administered in combination. An indication of a synergistic effect was also found by testing a mixture of kawain, dihydrokawain, methysticin, dihydromethysticin, yangonin and dihydroyangonin against strychnine convulsions and death. The amounts of the compounds tested were in the ratio in which they were isolated from the crude extract. The mixture showed a potency similar to that of dihydromethysticin. Since this agent represented only about 5% of the mixture and since the other constituents were less potent or inactive, a synergistic effect of the mixture appears the most likely explanation. In agreement with Klohs et al. (1959b), Meyer (1967) reported that the activity of yangonin and desmethoxyyangonin (administered intraperitoneally) in preventing mice from maximal electroshock seizure was markedly increased when given in combination with the other kava constituents.

Recently Keledjian et al. (1988) have measured the rate of uptake into mouse brain tissue of kawain, dihydrokawain, yangonin and desmethoxyyangonin, all of which are reported to be active as anticonvulsants against maximal electroshock seizures when tested in mice (Meyer, 1967; Kretschmar and Meyer, 1969). They found that maximal brain concentrations of kawain and dihydrokawain occurred 5 min after their intraperitoneal

injection. Previously, Meyer (1967) showed that the peak effect of the two compounds in protecting mice from maximal electroshock seizure occurred after 10 min. Therefore, the brain concentrations correlated well with the centrally mediated pharmacological actions.

Duffield's group (Duffield, Jamieson and Duffield, 1989) showed that both pyrone-free and lipid soluble kava resin fractions reduced amphetamine-reduced hypermotility and conditioned avoidance responses in rats and mice. However, the kava effects were slight compared to that of the standard antipsychotic drugs chlorpromazine and haloperidol. This group (Jamieson et al., 1989) also found that the anticonvulsant effect of the aqueous extract against strychnine was very slight. The kava resin produced hypnosis, analgesia and a local anesthetic action. Overall, the pharmacological effects of kava appeared to be mainly due to the activity of the compounds present in the lipid soluble resin fraction. In the cat, the preferential site of action of the kava extract and the pure compound *d,l*-kawain appears to be the amygdala complex (Holm et al., 1991). According to them, the participation of these structures in modulating emotional processes may explain the promotion of sleep by kava.

Frater (1958) also observed the effects of kava on the nervous system of human subjects. Following the consumption of six pints of an infusion over a 2-h period, the subjects looked sleepy, their eyes were slightly bloodshot and definitely watery, with the pupils enlarged and reacting only slowly to light. Speech was only slightly affected. The subjects were able to walk in a straight line and could still run up the stairs two at a time. In an effort to assess the effects on alertness and on speed of access of information in long-term memory, Russell, Bakker and Singh (1987) showed that kava has no effect on the reaction times or errors in two groups of naive drinkers who consumed doses thought usual or greater than those associated with social functions. In a study on the visual effects produced by kava, Garner and Klinger (1985) noted a reduced near point of accommodation and convergence, an increase in pupil diameter and disturbance to the oculomotor balance. However, no changes were recorded in visual or stereoacuity, or in ocular refractive error.

The local anesthetic action of the pyrones originally observed by Lewin (1886), Schübel (1924) and others early this century has been re-investigated. Frater (1958) showed that a thin paste of kava powder, when applied to the mucous

membrane of the lip, produced a slightly burning sensation and a feeling of numbness. With a pin-prick test there was a slight impairment of feeling as compared with the rest of the lip. When some root was chewed for 15 min, however, the degree of anesthesia was greater leading him to conclude that there was a definite local anesthetic effect. In another study most of the kava pyrones inhibited frog heart contraction (Meyer and May, 1964). These actions were compared with those of cocaine which showed a similar protection against ventricular fibrillation through its local anesthetic effectiveness. More recently, Singh (1983) examined the effects of whole kava extract on muscle contractility and neuromuscular transmission, using twitch tension and electrophysiological techniques. He found that the extract caused muscle paralysis by mechanisms similar to local anesthetics like lidocaine.

The antimycotic properties of some of the pyrones have been investigated (Hansel, Weiss and Schmidt, 1966; Hansel, 1968). A large number of Gram-positive, Gram-negative, pathogenic and non-pathogenic bacteria were found to grow uninhibited in nutrients containing the pyrones, indicating they are not bacteriostatic in nature. However, some of the pyrones showed remarkable fungistatic properties against a wide genera of fungi, including some which are pathogenic to humans.

Since the bulk of the pharmacological work has concentrated on the water-soluble pyrones, Buckley, Furguele and O'Hara (1967) investigated the biological activity of the water-soluble fractions of kava obtained by steam distillation. They found that the two fractions so obtained contained biologically active materials which were relatively free of any pyrones. These materials suppressed spontaneous activity in test animals and at higher doses led to muscular relaxation previously seen with the pyrones. In addition, one of the two fractions exhibited an anti-serotonin activity similar to that of dihydromethysticin.

Mathews and coworkers (Mathews et al., 1988) have assessed the effect of kava usage on the physical health status of a group of Australian Aborigines. There was a very good correlation between the extent of kava usage and a number of abnormal medical symptoms in these individuals, including scaly skin rash, increased patellar reflexes, underweight, reduced levels of albumin, plasma protein, urea and bilirubin, decreased platelet and lymphocyte count, shortness of breath and pulmonary hypertension. On the basis of the

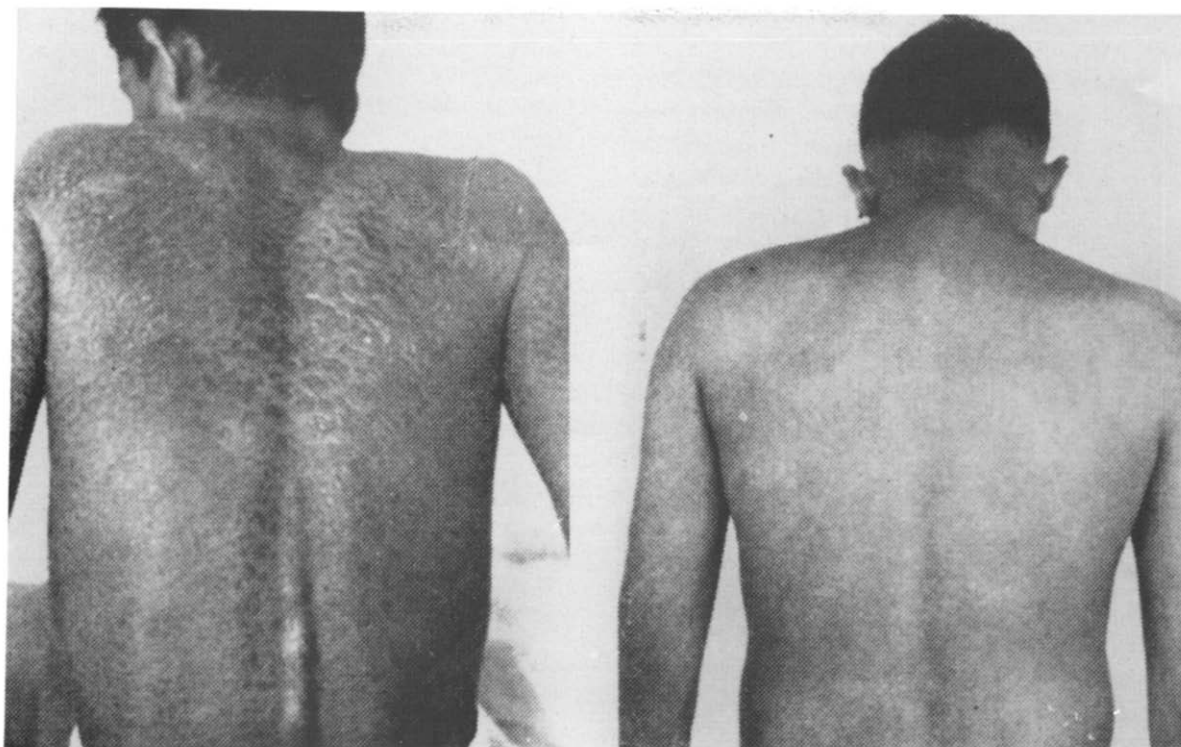


Fig. 19. Before and after pictures of a case of the skin lesion, called *kani* in Fijian, on the back of a chronic kava drinker. Note the virtual absence of the scaly appearance in the right picture after a reduction in kava consumption and a balanced diet. Reproduced from Frater (1958) by permission of the Fiji Society.

above observations, these workers recommended urgent social action to improve the health in Aboriginal communities by reducing kava consumption and improving nutritional status of kava users.

Although the effect of chronic kava drinking on the skin has been mentioned in many reports (e.g. Beechey, 1831; Thomson, 1908; Fornander, 1916–1920; Titcomb, 1948), there have been only two reported attempts, those of Frater (1958) and Ruze (1990), to understand the pharmacological basis for it and to search for a cure. The lesion in question, called *kani* in Fijian, requires regular, almost daily, consumption of kava before it appears, and takes from a few months to a year or more to develop. The skin becomes dry and covered with scales, especially the palms of the hand, the soles of the feet and the forearms, back and shins (Fig. 19). Frater, working with Fijian subjects, came to the tentative conclusion that *kani* was caused by an interference by kava of the normal uptake and assimilation of some members of the B group vitamins. The condition could be reversed, even in the most serious cases, by a

reduction in kava consumption and a balanced diet (Fig. 19).

In her study, Ruze selected 29 male Tongan kava drinkers, all of whom showed the characteristic skin lesions. Fifteen of these individuals were randomized to receive a dose of niacin (or nicotinamide) vitamin, while the remaining 14 received a placebo containing no active ingredient. After 3 weeks, clinical improvement was observed in five members from each group. These findings led Ruze to conclude that niacin vitamin deficiency was not responsible for the skin condition associated with excessive kava consumption since treatment with the vitamin did not produce an effect significantly different from control.

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## References

- Achenbach, H. and Karl, W. (1971) Inhaltsstoffe des Rauschpfeffers. III. Untersuchung der Sauren des Rauschpfeffers (*Piper methysticum* Forst.), *Chemische Berichte* 104, 1468–1477.
- Bascom, W.R. (1965) *Ponape, a Pacific Economy in Transition*, University of California Press, Berkeley, pp. 41–42.
- Beckwith, M.W. (1940) *Hawaiian Mythology*. Reprinted by University of Hawaii Press, Honolulu, p. 94.
- Beechey, F.W. (1831) *Narrative of a Voyage to the Pacific and Bering's Strait*. Colburn and Bentley, London. Reprinted by N. Israel, Amsterdam, 1968, pp. 120–122.
- Borsche, W. and Blount, B.K. (1933) Untersuchungen über die Bestandteile der Kawawurzel. XIII. Mitteil. über einige neue Stoffe aus technischem, *Chemische Berichte* 66, 803–806.
- Borsche, W. and Bodenstein, C.K. (1929) Untersuchungen über die Bestandteile der Kawawurzel. IX, Die Synthese der Yangonins, *Chemische Berichte* 62, 2515–2523.
- Brewster, A.B. (1922) *Hill Tribes of Fiji*, Seeley and Service, London, pp. 17–22.
- Brown, F.B.H. (1935) *Flora of Southeast Polynesia. III. Dicotyledons*, Bishop Museum Bulletin, No. 22, Honolulu, pp. 18–19.
- Brown, G. (1910) *Melanesians and Polynesians*. Macmillan, London, p. 137.
- Brunton, R. (1989) *The Abandoned Narcotic. Kava and Cultural Instability in Melanesia*. Cambridge University Press, Cambridge.
- Buck, P.H. (1930) *Samoan Material Culture*, Bishop Museum Bulletin, No. 75, Honolulu, pp. 147–164.
- Buck, P.H. (1944) *Arts and Crafts of the Cook Islands*, Bishop Museum Bulletin, No. 179, Honolulu, pp. 18–20.
- Buckley, J.P., Furguiele, A.R. and O'Hara, M.J. (1967) Pharmacology of Kava, In: D.H. Efron, B. Holmstedt and N.S. Kline (Eds.), *Ethnopharmacologic Search for Psychoactive Drugs*, U.S. Department of Health, Education and Welfare, Publ. No. 1645, Government Printing Office, Washington, D.C. pp. 141–151.
- Bu'Lock, J.D. and Smith, H.G. (1960) Pyrones. Part 1, Methyl esters of tautomeric hydroxypyrones and the structure and yangonin. *Journal of the Chemical Society Pt 1*, 502–506.
- Cargill, D. (1841) *Memoirs of Mrs. Margaret Cargill*, John Mason, London, pp. 223–224.
- Cawte, J. (1985) Psychoactive substances of the South Seas: betel, kava and pituri. *Australian and New Zealand Journal of Psychiatry* 19, 83–87.
- Cawte, J. (1986) Parameters of kava used as a challenge to alcohol. *Australian and New Zealand Journal of Psychiatry* 20, 70–76.
- Cheng, D., Lidgard, R.O., Duffield, P.H., Duffield, A.M. and Brophy, J.J. (1988) Identification of methane chemical ionization gas chromatography/mass spectroscopy of the products obtained by steam distillation and aqueous acid extraction of commercial *Piper methysticum*. *Biomedical and Environmental Mass Spectroscopy* 17(5), 371–376.
- Christian, F.W. (1899), *The Caroline Islands*, Methuen, London, pp. 188–193.
- Churchill, W. (1916a), *Sissano: Movements of Migration within and through Melanesia*, Carnegie Institution, Washington, DC, pp.124–144.
- Churchill, W. (1916b), Samoan kava custom, In: *Holmes Anniversary Volume: Anthropological Essays Presented to William Henry Holmes*, J.W. Bryan Press, Washington, DC, pp. 56–58.
- Churchward, N.B. (1887) *My Consulate in Samoa*, W. Bentley, London, pp. 47–59.
- Codrington, R.H. (1891) *The Melanesians*, Clarendon Press, Oxford.
- Collocott, E.E.V. (1927) Kava ceremonial in Tonga, *Journal of the Polynesian Society* 36, 21–47.
- Cook, J. (1785), *A Voyage to the Pacific Ocean Undertaken by the Command of His Majesty, H. Nicoll and T. Cadell*, London, 3rd edn., Vol. 1, pp. 318–319.
- Cook, J. (1813). *The Voyages of Captain James Cook Round the World*. Printed verbatim from the original editions, London. Vol. 3, pp. 180, 222.
- Cumming, C.F.G. (1881) *At Home in Fiji*, Blackwood, Edinburgh, p. 305.
- Cuzent, M. (1861) Composition chimique de la kavahine, *Comptes Rendus Hebdomadaires des Seances de L'Academie des Sciences* 52, 205–206.
- Degener, O. (1949) *Naturalist's South Pacific Expedition: Fiji. Paradise of the Pacific*, Honolulu, pp. 234–245.
- Deihl, J.R. (1932) Kava and kava-drinking, *Primitive Man* 5(4), 61–68.
- Duffield, A.M. and Lidgard, R.O. (1986) Analysis of kava resin by gas chromatography and electron impact and methane negative ion chemical ionization mass spectroscopy. *Biomedical and Environmental Mass Spectroscopy* 13, 621–626.
- Duffield, A.M., Lidgard, R.O. and Low, G.K.C. (1986) Analysis of the constituents of *Piper methysticum* by gas chromatography methane chemical ionization mass spectroscopy. *Biomedical and Environmental Mass Spectroscopy* 13, 305–313.
- Duffield, P.H., Jamieson, D.D. and Duffield, A.M. (1989) Effect of aqueous and lipid-soluble extracts of kava on the conditioned avoidance response in rats. *Archives Internationales de Pharmacodynamie et de Therapie* 301, 81–90.
- Duffield, A.M., Jamieson, D.D., Lidgard, R.O., Duffield, P.H. and Bourne, D.J. (1989) Identification of some human urinary metabolites of the intoxicating beverage kava. *Journal of Chromatography* 475, 273–282.
- Duve, R.N. (1981) Gas-liquid chromatographic determination of major constituents of *Piper methysticum*. *Analyst*, 106, 160–165.
- Duve, R.N. and Prasad, J. (1983) Changes in chemical composition of yaqona (*Piper methysticum*) with time. *Fiji Agriculture Journal* 45, 45–50.
- Duve, R.N. and Prasad, J. (1984) Efficacy of extraction of con-

- stituents in the preparation of yagona beverage. Part 1: General constituents. *Fiji Agriculture Journal* 46, 5–9.
- Duve, R.N. and Prasad, J. (1984) Efficacy of extraction of constituents in the preparation of yagona beverage. Part 2: Major active constituents. *Fiji Agriculture Journal* 46, 11–16.
- Efron, D.H., Holmstedt, B. and Kline, N.S. (Eds.) (1967) *Ethnopharmacologic Search for Psychoactive Drugs*, U.S. Department of Health, Education and Welfare, Publ. No. 1645, Government Printing Office, Washington, DC.
- Ellis, J.A. (1984) Looking at kava as an export crop. *Pacific Islands Monthly* 55(2), 27–28.
- Ellis, W. (1828) *Polynesian Researches*, Fisher, Son and Jackson, London, Vol. 1, pp. 229–231.
- Emerson, O.P. (1903) The awa habit of the Hawaiians, *Hawaiian Annual*, pp. 130–140.
- Erskine, J.E. (1853) *Journal of a Cruise among the Islands of the Western Pacific, including the Feejees and others Inhabited by the Polynesian Negro Races, in Her Majesty's Ship Havannah*. J. Murray, London, pp. 48–49.
- Firth, R. (1970) *Rank and Religion in Tikopia*, George Allen and Unwin, London, pp. 199–232.
- Ford, C.S. (1967) In: D.H. Efron, B. Holmstedt and N.S. Kline (Eds.), *Ethnographical Aspects of Kava*. pp. 162–173.
- Fornander, A. (1916–20) *Fornander Collection of Hawaiian Antiquities and Folklore*, T.G. Thrum (Ed.), Bishop Museum Press, Honolulu.
- Forster, J.G. (1777) *A Voyage round the World in his Britannic Majesty's Sloop, Resolution*, J. White, London, Vol. 2, pp. 406–408.
- Fox, C.E. (1924) *The Threshold of the Pacific*, Oxford.
- Frater, A.S. (1958) Medical aspects of kava. *Transactions and Proceedings of the Fiji Society* 5(2), 31–39.
- Freund, P. and Marshall, M. (1977) Research bibliography of alcohol and kava studies in Oceania: update and additional items, *Micronesica* 13, 313–317.
- Friedlander, J. (1899) *Zeitschrift für Ethnologie* 31, 50.
- Garner, L.F. and Klinger, J.D. (1985) Some visual effects caused by the beverage kava. *Journal of Ethnopharmacology* 13, 307–311.
- Gajdusek, D.C. (1967) In: D.H. Efron, B. Holmstedt and N.S. Kline (Eds.), *Recent Observations on the Use of Kava in New Hebrides*, pp. 119–125.
- Gifford, E.W. (1924) *Tongan Myths and Tales*, Bishop Museum Bulletin, No. 8, Honolulu, pp. 71–75.
- Gifford, E.W. (1929) *Tongan Society*, Bishop Museum Bulletin, No. 61, Honolulu, pp. 156–170.
- Gobley, M. (1860) Recherches chimiques sur la racine de kava, *Journal de Pharmacie et de Chimie* 37, 19–23.
- Guiart, J. (1956) *Un Siecle et demi de Contacts Culturels a Tanna, Nouvelles Hebrides*, Publication de la Societe des Oceanistes, No. 5, Musee de l'Homme, Paris, pp. 246–254.
- Handy, E.S.C. (1927) *Polynesian Religion*, Bishop Museum Bulletin, No. 34, Honolulu.
- Handy, E.S.C. (1940) *The Hawaiian Planter. Volume I: His Plants, Methods and Areas of Cultivation*, Bishop Museum Bulletin, No. 161, Honolulu, pp. 201–205.
- Handy, E.S.C. and Handy, E.G. (1972) *Native Planters in Old Hawaii: Their Life, Love and Environment*, Bishop Museum Bulletin, No. 233, p. 190.
- Hansel, R. (1968) Characterization and physiological activity of some Kava constituents, *Pacific Science* 22, 293–313.
- Hansel, R. and Beiersdorff, H.U. (1959) Zur Kenntnis der Sedativen Prinzipien des Kava-Rhizoms, *Arzneimittel-Forschung* 9, 581–585.
- Hansel, R. and Klaproth, L. (1966) Isolierung von 11-methoxy-yangonin aus der Kawawurzel, *Archiv der Pharmazie* 299, 503–506.
- Hansel, R., Ranft, G. and Bahr, P. (1963) Zwei Chalkonpigmente aus *Piper methysticum* Forst. Zur Frage der Biosynthese der Kawalaktone, *Zeitschrift für Naturforschung* 18(b), 370–373.
- Hansel, R., Sauer, H. and Rimpler, H. (1966) 11-methoxy-yangonin aus einer botanisch nicht beschriebenen Piperart Neu-Guineas, *Archiv der Pharmazie* 299, 507–512.
- Hansel, R., Weiss, D. and Schmidt, B. (1966) Fungistatische Wirkung der Kawadrogen und ihrer Inhaltsstoffe, *Planta Medica* 14, 1–9.
- Harrison, T.H. (1937). *Savage Civilization*, Gollancz, London, pp. 275–280.
- Henry, T. (1928) *Ancient Tahiti*, The Museum, Honolulu. Printed verbatim by Kraus Reprint, New York, 1971.
- Herbst, D., Mors, W.G., Gottlieb, O.R. and C. Djerassi (1959) Naturally occurring oxygen heterocyclics. IV. The methylation of pyronones. *Journal of the American Chemical Society* 81, 2427–2430.
- Hocart, A.M. (1929) *Lau Islands, Fiji*, Bishop Museum Bulletin, No. 62, Honolulu, pp. 59–70.
- Holm, E., Staedt, U., Heep, J. Kortsik, C., Behne, F., Kaske, A. and Mennicke, I. (1991) Untersuchungen zum Wirkungsprofil von D,L-Kavain. *Arzneimittel Forschung* 41, 673–683. (English abstract).
- Holmes, L.D. (1967) The function of kava in modern Samoan culture. In: D.H. Efron, B. Holmstedt and N.S. Kline (Eds.) (1967) pp. 107–118.
- Holmes, L.D. (1974) *Samoan Village*, Holt, Rinehart and Winston, New York, pp. 35–38.
- Holmes, L.D. (1979) The kava complex in Oceania. *New Pacific* 4(5), 30–33.
- Hood, T.H. (1862) *Notes on a Cruise in H.M.S. "Fawn" in the Western Pacific*, Edmonston and Douglas, Edinburgh, pp. 20–21, 166.
- Humphreys, C.B. (1926) *The Southern New Hebrides: an Ethnological Record*. Cambridge University Press, Cambridge, pp. 81–83.
- Jamieson, D.D., Duffield, P.H., Cheng, D. and Duffield, A.M. (1989) Comparison of the central nervous system activity of the aqueous and lipid extracts of kava (*Piper methysticum*). *Archives Internationales de Pharmacodynamie et de Therapie*, 301, 66–80.
- Jarrett, L.H. (1933) *Hawaii and its People*, Honolulu, pp. 127–128.
- Johnson, I. and Johnson, E. (1955) South Seas' incredible land divers, *National Geographic* CV11 (1), 77–92.
- Keledjian, J., Duffield, P.H., Lidgard, R.O. and Duffield, A.M. (1988) Uptake into mouse brain of four compounds present in the psychoactive beverage kava. *Journal of Pharmaceutical Sciences* 77, 1003–1006.
- Keller, F. and Klohs, M.W. (1963) A review of the chemistry and pharmacology of the constituents of *Piper methysticum*. *Lloydia* 26, 1–15.
- Klohs, M.W. (1967) Chemistry of kava. In: D.J. Efron, B. Holmstedt and N.S. Kline (Eds.), pp. 126–132.
- Klohs, M.W., Keller, F. and Williams, R.E. (1959a) *Piper methysticum* Forst. The synthesis of dl-methysticin and dl-dihydromethysticin. *Journal of Organic Chemistry* 24, 1829–1830.
- Klohs, M.W., Keller, F., Williams, R.E., Toekes, M.I. and Cronheim, G.E. (1959b) A chemical and pharmacological in-

- vestigation of *Piper methysticum* Forst. *Journal of Medicinal and Pharmaceutical Chemistry* 1, 95–99.
- Kramer, A. (1902) *Die Samoa-Inseln*, Stuttgart. Reprinted by McMillan, Papakura, 1983.
- Kretzschmar, R. and Meyer, H.J. (1969) Vergleichende untersuchung uber die antikonvulsive Wirksamkeit der Pyronverbindungen aus *Piper methysticum* Forst. *Archives internationales de pharmacodynamie et de therapie* 177, 261–277.
- Krieger, H.W. (1943) *Island Peoples of the Western Pacific*, Smithsonian Institution, Washington, DC, p. 22.
- La Pérouse, J.F.G. de (1798) *Voyage de La Pérouse autour du Monde*, Paris. Vol. 3, pp. 225, 256.
- Lavialle, M. (1889) La kavaine, *L'Union Pharmaceutique* 30, 5.
- Lebot, V. and Cabalion, P. (1988) *Kavas of Vanuatu. Cultivars of Piper Methysticum Forst.* Technical Paper No. 195, South Pacific Commission, Noumea.
- Ledyard, J. (1783) *John Ledyards' Journal of Captain Cook's Last Voyage*, N. Patten, Hartford, p. 239.
- Lemert, E.M. (1967) Secular use of kava in Tonga, *Quarterly Journal of Studies on Alcohol* 28, 328–341.
- Lester, R.H. (1941) Kava drinking in Vitilevu, Fiji, *Oceania* 12, 97–121, 226–254.
- Lewin, L. (1886) *Uber Piper Methysticum (Kawa)*, A. Hirschwald, Berlin.
- Macierewicz, Z. (1950) Synthesis of the lactone of the mother substance of yangonin. *Roczniki Chem.* 24, 144–166.
- Mangeret, R.P. (1884) *Monsieur Bataillon et les Missions de l'Océanie Centrale*, Vitte et Perrussel, Lyons, Vol. 1, pp. 119–126.
- Mariner, W. (1827) *An Account of the Natives of the Tonga Islands in the South Pacific Ocean*, John Martin, Edinburgh, Vol. 2, pp. 150–189.
- Marshall, M. (1974) Research bibliography of alcohol and kava studies in Oceania, *Micronesica* 10, 299–306.
- Mead, M. (1930) *Social Organization of Manu'a*, Bishop Museum Bulletin, No. 76, Honolulu, pp. 102–112.
- Metraux, A. (1940) *Ethnology of Easter Island*, Bishop Museum Bulletin, No. 160, Honolulu, p. 159.
- Meyer, H.J. (1962) Pharmakologie der Wirksamen Prinzipien des Kawa-rhizoms (*Piper Methysticum* Forst.), *Archives Internationale de Pharmacodynamie et de Therapie* 138, 505–536.
- Meyer, H.J. (1966) *Pharmakologie der Kawa-Droge-Zugleich ein Beitrag zum Problem des Kawa-Trinkens*, Habilit and Schrift, Freiburg.
- Meyer, J.J. (1967) Pharmacology of kava. In: D.H. Efron, B. Holmstedt and N.S. Kline (Eds.), pp. 133–140.
- Meyer, H.J. and May, H.U. (1964). Lokalanesthetische Eigenschaften natürlicher Kawa-Pyrone, *Klinische Wochenschrift* 42, 407.
- Meyer, H.J., Oberdorf, A. and Seifen, E. (1960) Pharmakologische Untersuchungen über die Wirkstoffe van Kawa-Kawa (*Piper Methysticum*, *Naunyn-Schmiedebergs Archiv für experimentelle Pathologie und Pharmakologie* 238, 124–125.
- Morrison, J. (1935), *The Journal of James Morrison*, Golden Cockerel Press, London, p. 151.
- Mors, W.B., Magalhaes, M.T. and Gottlieb, O.R. (1962) Naturally occurring aromatic derivatives of monocyclic <sup>1</sup>-pyrones, *Fortschritte der Chemie Organischer Naturstoffe* 20, 131–164.
- Moyles, W. (1983) Aboriginal community use of kava as alcohol substitute. *Aboriginal Training and Cultural Institute*. Balmain, Sydney, quoted in Cawte (1985).
- Muller, K. (1970) Land diving with the Pentecost Islanders. *National Geographic* 138(6), 799–817.
- Newell, J.E. (1895) Notes on the Tokelau Islands, *Transactions of the Australian Association for the Advancement of Science* 6, 605–607.
- Newell, W.H. (1947) The kava ceremony in Tonga, *Journal of the Polynesian Society* 56, 364–417.
- Nölting, E. and Kopp, A. (1874) Sur la racine de kava, *Moniteur Scientifique du Chimiste et du Manufacturier*, pp. 920–923.
- O'Brien, I.E. (1971) Missionaries on Ponape: induced social and political change, *Australian National University Historical Journal* 8, 53–64.
- Parham, B.E.V. (1935) Wilt disease of yangona. *Fiji Agricultural Journal* 8, 2–8.
- Parkinson, S. (1784) *A Journal of a Voyage to the South Seas in His Majesty's Ship, the Endeavour*. S. Parkinson, London, p. 37.
- Percy Smith, S. (1920) Kava drinking ceremonies among the Samoans and a boat voyage round 'Upolu Island, Samoa. *Supplement to the Journal of the Polynesian Society* 29 (114) 10–13.
- Pfeiffer, C.C., Murphree, H.B. and Goldstein, L. (1967) Effect of kava in normal subjects and patients. In: D.H. Efron, B. Holmstedt and N.S. Kline (Eds.) (1967), p. 155.
- Porter, D. (1823) *A Voyage to the South Seas in the Years 1812, 1813 and 1814 with Particular Details of the Gallipagos and Washington Islands*. R. Philips, London, pp. 94–95.
- Prescott, J. and McCall, G. (Eds.) (1988) *Kava: Use and Abuse in Australia and the South Pacific*. National Drug and Alcohol Research Centre, University of New South Wales, Sydney, Monograph No. 5.
- Pritchard, W.T. (1863–4) Notes on certain anthropological matters respecting the South Sea Islanders. *Memoirs of the Anthropological Society of London*, 1, 122.
- Pritchard, W.T. (1866). *Polynesian Reminiscences or, Life in the South Pacific Islands*, Chapman and Hall, London, pp. 121–24.
- Ray, W. (1894) quoted in W.H.R. Rivers (1914), Vol. 2, p. 244.
- Rivers, W.H.R. (1914) *The History of Melanesian Society*, Cambridge University Press, Cambridge, Vol. 1, pp. 82–86; Vol. 2 pp. 243–257.
- Russell, P.N., Bakker, D. and Singh, N.N. (1987) The effects of kava on altering and speed of access of information from long-term memory. *Bulletin of the Psychonomic Society* 25(4): 236–237.
- Ruze, P. (1990) Kava-induced dermatopathy: A niacin deficiency? *Lancet* (North American edition), 335(8703), 1442–1445.
- Sauer, H. von and Hansel, R. (1967) Kawalaktone und Flavonoide aus einer endemischen Piper-art Neu Guineas, *Planta Medica* 15, 443–458.
- Scheuer, P.J. and Horigan, T.J. (1959) A new carbonyl compound from *Piper methysticum* Forst., *Nature* 184, 979–980.
- Schübel, K. (1924) Zur Chemie und Pharmakologie der Kawa-Kawa (*Piper methysticum*, Rauschpfeffer, *Naunyn-Schmiedebergs Archiv für experimentelle Pathologie und Pharmakologie* 102, 250–282.
- Serpenti, L.M. (1969) On the social significance of an intoxicant. *Tropical Man* 2, 31–44.
- Shulgin, A.T. (1973) The narcotic pepper: the chemistry and pharmacology of *Piper methysticum* and related species. *Bulletin on Narcotics* 25, 59–74.
- Singh, Y.N. (1983) Effects of kava on neuromuscular transmission and muscle contractility, *Journal of Ethnopharmacology* 7, 267–276.



- Singh, Y.N. (1986) *Kava: a bibliography*, Pacific Information Centre, University of the South Pacific, Suva.
- Smiles, S. (1987) Kava, the alcohol alternative (and why it's stronger in Vanuatu). *Islands Business*. May 1987, p. 32–33.
- Smith, R.M. (1979) Pipermethystine: a novel pyridone alkaloid from *Piper methysticum*, *Tetrahedron Letters* 35, 437–439.
- Steinmetz, E.F. (1960) *Piper methysticum* (kava). Published by the author, Amsterdam.
- Sterly, J. (1970) Heilpflanzen der Einwohner Melanesiens. Beitrage zur Ethnobotanik des Sudwestlichen Pacifik. Hamburger Reihe zur Kultur und Sprachwissenschaft 6. Hamburg. Munchen.
- Thomson, B. (1902) *Savage Island: an Account of a Sojourn in Niue and Tonga*, J. Murray, London, pp. 95–97.
- Thomson, B. (1908) *The Fijians: a study in the decay of custom*. Heinemann, London, pp. 341–351.
- Thomson, W.J. (1889) *Te Pito te Henua, or, Easter Island*, Smithsonian Institution, Washington, D.C., p. 464.
- Titcomb, M. (1948) Kava in Hawaii, *Journal of the Polynesian Society* 57, 105–171.
- Torrey, W. (1848) *Torrey's Narrative, or the Life and Adventures of William Torrey*, A.J. Wright, Boston, pp. 117–118.
- Turner, G. (1861) *Nineteen years in Polynesia*, J. Snow, London, pp. 122–123.
- Van Veen, A.G. (1938) Over the bedwelmende stof vit de kawakawa of wati-plant (*Piper methystium*), *Geneeskundig tijdschrift voor Nederlandsch-Indie* 78, 194–195.
- Van Veen, A.G. (1939) Isolation and constitution of the narcotic substance from kawakawa. *Recueil des Travaux Chimiques des Pays-Bas* 58, 521–527.
- Waqavonovono, M. (1980) *Traditional Medicine and Practices: an Alternative Health Care System for Women*, Centre for Applied Studies in Development, University of the South Pacific, Suva.
- Wendt, S. (1969), We want real kava ceremonies or nothing, says Fiji. *Pacific Islands Monthly* 40(12), 40–41.
- Werny, F. and Hansel, R. (1963) Die Hydrierung von 6-Styryl- $\alpha$ -Pyromen zu Wirkstoffen von Typus der Kawalaktone (aus *Piper Methysticum*), *Naturwissenschaften* 50, 355.
- Williams, T. (1858) *Fiji and the Fijians*, Heylin, London, Vol. 1, pp. 141–146.
- Williamson, R.W. (1939) *Essays in Polynesian Ethnology*, Cambridge University Press, Cambridge, pp. 51–112, 274–275.
- Wilson, J. (1799) *A Missionary Voyage to the Southern Pacific Ocean, 1796–1798, in the Ship 'Duff'*, London.
- Winzheimer, E. (1908) Uber die Identität von Methysticol und Piperonylenaceton, *Chemische Berichte* 41, 2377–2383.
- Young, R. (1855) *The Southern World: Journal of a Deputation from the Wesleyan Conference to Australia and Polynesia*, Hamilton Adams, London, 2nd Ed., pp. 249–151.
- Young, R.L., Hylin, J.W., Plucknett, D.L., Kawano, Y. and Nakayama, R.T. (1966) Analysis for kava pyrones in extracts of *Piper methysticum*, *Phytochemistry* 5, 795–798.