

Herbal Medicines in Hawaii From Tradition to Convention

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*The stories of kava and chaulmoogra demonstrate the importance of herbal products in ancient and recent Hawaiian medicine. Kava is a psychoactive beverage that has been used ceremonially for millennia throughout the Pacific. It is a nonfermented depressant that causes tranquil intoxication in which thoughts and memory remain clear. Its broad pharmacologic activity led to use in Hawaii to treat skin disorders and later in Germany to treat gonorrhoea. Kava is now available outside the Pacific basin as a relaxant, emerging as a popular, albeit deritualized, natural product. In the late 19th century, the main treatment for leprosy was chaulmoogra, extracted from *Hydnocarpus* seeds. Chaulmoogra had been a traditional treatment for skin diseases in Ayurvedic and Chinese medicine. Chaulmoogra from Asian markets was expensive and usually adulterated so the USDA decided to plant *Hydnocarpus* in Hawaii. Joseph Rock, a botanist at University of Hawaii, trekked through southeast Asia collecting fresh seeds to plant on Oahu. Rock's trees provided chaulmoogra for leprosy patients on Molokai and elsewhere until it was replaced by dapsone. Chaulmoogra, once the treatment for leprosy worldwide, is now nearly forgotten; kava, once poorly known outside the Pacific, is now a widely-used alternative medicine. Hawaii will probably continue its role in the transition of plants from traditional use to conventional use.*

Introduction

The Hawaiian Islands emerged from the Pacific seafloor over the past several million years. Each island arose as a volcano and passed

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through its geologic maturation, activity, dormancy, senescence, extinction, and subsidence. The island chain has no land connections; therefore all forms of life arrived here as colonists. Wind, water, and airlifts of seabirds brought the founding members of Hawaii's flora and fauna. In Hawaii's isolation, the ancestral plants and animals evolved into unique species, often quite different from their ancestors. Relatively few ancestral species acquired a foothold on Hawaii and from few, we now have many descendant species. Hawaii has the world's most richly endemic flora; nevertheless it is a depauperate flora.

Many of the plants that outsiders most closely associated with Hawaii are introduced. There are few native orchids, for example, and coconut palms were introduced by the ancient Polynesian voyagers who settled Hawaii. The Polynesian settlers brought with them 30 or so plants that were eminently useful in the ancestral homeland.^{1,2} These include the staples for consumption, construction, clothing, art, and medicine, such as breadfruit, taro, sweet potato, coconut, banana, sugarcane, hala, and noni (Table 1). Many of these have become naturalized and are now fully a part of the Hawaiian landscape, such as coconut palms, wild ginger, and the state tree, the kukui.²

Kava

One of the thirty or so plants brought by the settlers, kava, has pharmacological activity that led to its use in both traditional ceremonies and in traditional medicine.³ Kava refers to both the plant and the beverage that is made from the plant. The kava beverage has psychoactive effects that produce a calm, tranquil effect but thoughts and memory remain clear. The plant probably originated in Vanuatu (the former New Hebrides) but, as Pacific peoples migrated, they carried their most useful products with them.⁴ Kava became widely used in rituals throughout the Pacific's three ethnogeographic regions: Polynesia, Micronesia, and Melanesia. The plant has become naturalized on many high islands with rich soils but it is absent from coral atolls and from temperate islands such as Aotearoa (New Zealand).

Western scientific attention to kava started with the Forsters, father and son, who served as the naturalists on Cook's second voyage.^{5,6} They prepared the proper Linnean binomial, *Piper methysticum*, which means "intoxicating pepper." Kava is in the family Piperaceae, meaning it is a true pepper closely related to black pepper and to the pepper leaf used in preparing betel quids.

Kava is a shrubby plant with jointed stems and heart-shaped leaves. There are perhaps two-hundred varieties of the kava plant in the Pacific, based mostly on differences in stem morphology. The varieties also differ in their potency. The psychoactive components are most concentrated in the lower stems and upper roots of the plant.

Traditional Kava Preparation and Ceremonies

There are several traditional ways to prepare kava, differing by ethnogeographic region. The parts of the plant with the greatest concentration of active ingredients are the lower stems and upper roots. These portions were gathered and prepared into the kava beverage according to the practices of the ethnogeographic region. In Polynesia, for example, a group of young people, selected for their strong teeth, chewed the roots and collected the macerated root pulp in a kanoa or kava bowl. Water was added and the turbid mixture was strained through the inner bark of the hau tree⁴ (although in Hawaii, the pounded fibers of a sedge, 'ahu'awa, were used²). Nowadays chewing is uncommon outside parts of Vanuatu. Kava is still prepared by young people, but using Western tools such as this mortar and pestle made from a steel drum and a car axle or food processors. At night in traditional villages in Fiji, Tonga, and other islands, one hears the thumping of kava being pounded, albeit with modern modified techniques.

The traditional kava ceremony, on the other hand, has remained relatively unchanged for millennia. It is a ritual attended only by men, usually those of the higher castes. All members sit, usually barefoot and cross-legged, on the ground. The presiding members and honored guests have their places, as do the men who prepare, mix, and serve the kava. Cups of kava are filled, passed to an individual for consumption, returned, and refilled in several-to-dozens of rounds in an evening. The first Western illustration of a kava ceremony was prepared by John Webber, illustrator on Cook's third voyage.

Kava is a powerful symbol of traditional culture in Pacific society.³ This is reflected in the flag of the State of Pohnpei in the Federated States of Micronesia where the kava (sakau) cup is central item. The watermark on Western Samoa's paper currency is the tanoa, or ceremonial kava bowl. But in this century, kava has been deritualized. On many Pacific islands, kava is no longer restricted to men of a certain class or for consumption during specified occasions. It is a social beverage consumed with those with whom you wish to have warm social interactions. It is still consumed in a group setting; there are no solitary drinkers. The calming effects of the beverage distinguish it from alcohol that is often accompanied by disinhibition and violence, often severe domestic violence. For this reason, kava was introduced by Fijian missionaries into some Australian aboriginal communities to replace alcohol and the frequent social hazards that stem from alcohol in that community.⁷

Kava's neuropharmacologic properties are that of a spinal depressant. Overindulgence in kava can cause transient ataxia or an uncoordinated walk because it depresses both the movement and sensory functions of the spinal cord. Coordinated walking may become difficult because one has diminished control over one's muscles and because of the difficulty in sensing where one's feet are. Because of this ataxia, some societies grade the beverage's potency as a one-day, two-day, or three-day kava, based on duration of lingering effects.

Kava Dermopathy

Kava dermatopathy is a side effect that interests me, as a dermatologist, greatly. Kava dermatopathy is an acquired reversible ichthyosis³ – or scaly skin eruption. It arises after prolonged and excessive consumption of kava and appears as a generalized, shiny, scaly skin resembling a cracked porcelain glaze. On some islands at the time

of Western arrival, this skin disorder was a mark of prestige for only a few noble were able to spend their days in the consumption of kava. Commoners, instead, fished or worked in the fields but some members of the highest castes participated in daily kava circles. In many Pacific societies, traditional healers induced kava dermatopathy to other skin diseases, most likely superficial fungal infections and psoriasis. People with skin diseases were instructed to drink kava until their skin became scaly; then the kava was withheld. The kava eruption reversed and the scales would shed, descending from the head.⁸ As the dermatopathy resolved so did, according to traditional practice, the other skin disease.

The cause of kava dermatopathy is unknown. Several explanations, some traditional, some modern, have been proposed. In Samoa and Tonga, the explanation recounts a Tui Tonga (King of Tonga) who sailed to an outer island afflicted by drought and famine. The islanders had no food to offer as a gift so the local chief sacrificed his beautiful but leprous daughter. The Tui Tonga was honored by the sacrifice but declined to eat the flesh of the young girl. Instead, he instructed the girl's father to bury her body behind her house. From the burial site, the first kava plant emerged. Today, those who drink the beverage made from kava will acquire the girl's scaly, leprous skin.^{3,9} Western explanations are less colorful but no more supported by scientific evidence. Suggestions that kava dermatopathy is a form of pellagra (a dietary deficiency of niacin or tryptophan), a photoeruption, or an acute allergic dermatitis are disproved by skin histopathology and other studies. Ruze suggested that kava may interfere with cholesterol metabolism necessary for proper keratinocyte formation.¹⁰ This hypothesis warrants further investigation as a better understanding of cholesterol metabolism might influence the management of many more serious medical conditions.

Pharmacology of Kava

Kava extract contains about fifteen compounds called kavalactones, all of which are structurally and pharmacologically unique.⁴ Kava's neuropharmacologic effects are also unique which explains why early Western descriptions of kava are so often muddled. Kava is non-narcotic, non-opiate, nonfermented, nonalcoholic, nonhallucinogenic, and physiologically nonaddicting. The word narcotic, by the way, has both pharmacologic and legal definitions, neither of which apply to kava. Kava's range of pharmacologic actions was recognized by traditional healers and the beverage was used for more than just its relaxant, calming effects. Kava was used to treat skin disorders (as described above), to treat asthma and other lung disorders, and to treat urologic problems.¹¹

Kava in the West

Kava was first adopted into a Western pharmacopoeia in Germany where kava once served as a standard treatment for gonorrhea. Germany's interest in kava began with its colonization of the western Pacific around the turn of the century. German-occupied islands where kava was consumed ritually include what is now American Samoa in Polynesia, Papua New Guinea in Melanesia, and Pohnpei in Micronesia. German biochemists, finest in the world a century ago, extracted and identified the constituents of kava. German physicians used kava preparations to treat gonorrhea until the advent of penicillin.

In recent decades, kava has been used to control experimental

seizures in laboratory animals and to attempt control of psychosis in humans. Trials with kava in people were stopped because kava dermatopathy developed.¹²

Kava is, nevertheless, widely available in the West. In Germany and France, it is a prescribed medicine. In the United States, it is available at many health food stores and so-called nutrition centers. Kava is available as tablets, alcohol tincture, powder, and unprocessed root. Most kava products are marketed towards non-traditional users. Pacific islanders living in the United States, may now purchase boxes of instant kava in which root powder wrapped in a muslin bag is steeped in water to prepare the beverage for ceremonial and deritualized use.

A 1996 *Newsweek* cover story entitled "The Natural Drug Culture: From Herbal Ecstasy to Melatonin: What are The Risks?" quoted an herbal medicine entrepreneur, Shayan, who remarked that, "Kava is the next big thing. We think it can be as big as coffee."¹³ There is considerable financial interest in the kava-growing Pacific and among entrepreneurs to introduce kava widely into western society. Marketing efforts, in most cases, accent the allure of tranquil life on a Pacific island because the scant amount of kavalactones in these preparations is unlikely to produce physiologic effects.

In addition to its emergence in the botanicals industry, kava may make the leap from traditional Pacific medicine to conventional Western therapeutics. Conventional pharmacologists and physicians continue to study kava for its neuropharmacologic and psychoactive effects. Kava's effect on the skin also deserves further study as it is probably due to subtle interference in cholesterol metabolism.

Chaulmoogra

The history of modern medicine in Hawaii is closely associated with leprosy or Hansen's disease (HD). The disease was introduced to the islands by Chinese peasants brought in to work in the canefields. The native Hawaiian population was vulnerable to the disease which then ravaged native populations. People with visible stigmata of leprosy were isolated for life in the Kalawao settlement on Molokai. The fear historically associated with HD comes from the disfigurement caused by the disease and the notion that it was an incurable and highly contagious condition. There was little hope for effective treatment until the 1850s when several promising reports emerged from the British Medical Service in India. The reports claimed that a local herbal medicine, chaulmoogra oil, could control the disease.¹⁴ This brought chaulmoogra out of the realm of traditional medicine and into the mainstream Western pharmacopoeia.¹⁵ Chaulmoogra quickly became the treatment of choice for HD worldwide yet very little was known about it. All of the chaulmoogra oil used in western medicine was purchased from native bazaars in Burma and Siam. The demand for chaulmoogra was enormous but the supplies were insufficient, often adulterated, and always expensive.

University of Hawaii and Chaulmoogra Production

Chaulmoogra was considered so important that the United States Department of Agriculture (USDA) decided to break the Asian chaulmoogra cartel. In 1920, they hired Joseph Rock for the job.¹⁶ Rock taught botany and Chinese languages at the University of Hawaii and was one of the premier botanists on the islands, having

written *The Indigenous Trees of Hawaii* in 1913. For months, Joseph Rock trekked through the rainforests of Siam and Burma in search of chaulmoogra trees. This was no simple task as the tree was scarcely known to Western botanists and it grew in just a few relatively inaccessible mountainous regions. But after a year, Rock had gathered enough seeds to return to Hawaii.^{17,18} The USDA used the seed to start a chaulmoogra plantation on 30 acres in the Waiahole Valley on Oahu. After a decade, the young chaulmoogra trees were producing enough seeds to supply oil for American leprosaria, such as the ones at Carville and Molokai.

The chaulmoogra tree is *Hydnocarpus kurzii* but the obsolete name generic name, *Taraktogenus*, appears in much of the older literature. There are about 40 species in *Hydnocarpus*, mostly in southeast Asia.¹⁹ Medicinal oils were extracted from the seeds of three species. The tree stands about 40 feet tall and has shiny green leaves. The fruits are about the size of an orange with a thick velvety-textured skin. Inside the fruits are dozens of hard, angular, marble-sized seeds. To make the oil, the seeds are crushed and subjected to pressure extraction. The resulting amber-colored oil is a mixture of two fatty acids based on a cyclopentane ring that differ slightly in their chemical composition.²⁰ These acids were named chaulmoogric and hydnocarpic acids after the common and scientific names of the plant. The best method of extracting oils was developed by Dr Arthur L. Dean, second president of University of Hawaii.²¹ Dean's derivative, as it was called, was the mainstay of chaulmoogra production around the world for many years.

Medical Uses of Chaulmoogra

The chaulmoogra products were further refined into oral, topical, and parenteral forms. But all reports indicate that the best treatment was with parenteral chaulmoogra, usually injected subcutaneously. Treatment called for 15cc of oil to be injected, twice weekly, for multiple 10-week courses until the disease was cured or went into remission.²² It was a painful regimen and a survey of patients showed that many would prefer to have their disease left untreated than to continue the mandatory therapy.

It was thought that chaulmoogra could indeed cure lepromatous disease and so for more than 50 years, chaulmoogra was hailed as the only effective treatment for HD. Burroughs-Wellcome and Bayer were the largest commercial producers of chaulmoogra and made several products (Alepöl, Moogrol, and Antileprol) that were available until the 1940s.

Pharmacology

The mechanism of action of chaulmoogra is not known. A theory proposed in the 1930s suggested that chaulmoogra activated host lipases that subsequently destroyed all foreign lipids, including both the chaulmoogra oil and the lipophilic cell wall of the Hansen's bacillus. The other theory invoked counter-irritation, a sort of chemotaxis in which the irritation caused by the injections drew phagocytes toward the lepra bacilli.²² In truth, we simply don't know whether chaulmoogra had any effect whatsoever on HD. No proper therapeutic trial with chaulmoogra was ever conducted.

In the 1940s, sulfones (such as dapsone) were developed and shown successful in the treatment of HD. Still, some proponents of chaulmoogra resisted change. In the 1940s, an article in *Lancet* advocated combination therapy with sulfones and chaulmoogra

Table 1.—Hawaiian Plants Mentioned in text

| Common name | Hawaiian name | Linnean binomial | Family |
|--------------|---------------|------------------------------|----------------|
| breadfruit | 'ulu | <i>Artocarpus altilis</i> | Moraceae |
| taro | kalo | <i>Colocasia esculenta</i> | Araceae |
| sweet potato | 'uala | <i>Ipomea batatas</i> | Convolvulaceae |
| coconut | niu | <i>Cocos nucifera</i> | Arecaceae |
| banana | mai'a | <i>Musa paradisiaca</i> | Musaceae |
| sugarcane | kō | <i>Saccharum officinarum</i> | Poaceae |
| pandanus | hala | <i>Pandanus spp.</i> | Pandanaceae |
| noni | noni | <i>Morinda citrifolia</i> | Rubiaceae |
| wild ginger | 'awapuhi | <i>Zingiber zerumbet</i> | Zingiberaceae |
| candlenut | kukui | <i>Aleurites moluccana</i> | Euphorbiaceae |
| kava | 'awa | <i>Piper methysticum</i> | Piperaceae |
| sea hibiscus | hau | <i>Hibiscus tiliaceus</i> | Malvaceae |
| sedge | 'ahu' awa | <i>Mariscus javanicus</i> | Cyperaceae |
| wormwood | 'ahinahina | <i>Artemisia spp.</i> | Asteraceae |

because their properties were viewed as complementary.²³ Nevertheless, the U.S. Public Health Service declared in 1942 that “the oil has little or no curative value, and its unpleasant side effects probably outweigh any advantage it could possibly offer.”²⁴

And so chaulmoogra, once the standard of care, has been dropped from our formularies and from our memories. In the 1930s, the branch of *Hydnocarpus* was the symbol of the International Congress of Leprology but by the 1950s, better treatments allowed us to abandon chaulmoogra therapy and, more importantly, to abandon the concept of isolating patients in leprosaria.¹⁶

Current Military Interest in Plant-Derived Medicines

The conveners of the conference asked me to include a brief discussion on current American military interest in plant-derived medicines. During the Gulf War, considerable attention was given to plant-derived medications, such as atropine and physostigmine (from *Atropa belladonna* and *Physostigma venenosum*, respectively), that can prevent or reverse the effects of nerve agents. Historians and physicians, however, remind military leaders that the greatest threat to deployed soldiers is disease, not battle injury. The most abruptly debilitating diseases are acute infectious diseases, particularly those that are arthropod borne. Throughout much of the world, mosquito-borne diseases, such as dengue and malaria, hamper military operations. Consequently, the development of antimalarials for both prophylaxis and treatment greatly interests the Department of Defense. The customary therapy for malaria has always been quinine or quinine derivatives, obtained from several members of *Cinchona* in the coffee family, Rubiaceae. The early history of Peruvian bark as an antimalarial and febrifuge is well known. At the beginning of World War II, quinine supplies became a strategic military concern because of the Japanese occupation of the Dutch East Indies, now Indonesia, where much of the world's quinine was produced. During World War II, the War Department

sent botanists the jungles of South America to search for other rubiaceaceous plants for the fight against malaria. The co-leader of the Department of Economic Warfare's cinchona mission was Ray Fosberg, a botanist trained at University of Hawaii and who later returned to the Pacific to become one of the premier botanists in Hawaii and Micronesia.²⁵

Fortunately, quinine's chemical structure had been known since the work of Pelletier and Caventou in the 1820s. When quinine was scarce, quinine-like products were synthesized and soon several of these were also used in the prevention and treatment of malaria (chloroquine, quinidine, atabrine, primaquine, and mefloquine). In much of the world today, malaria is resistant to chloroquine so many non-quinine products, such as doxycycline, are now used to manage malaria.

Nevertheless, the Army is still interested in plant-derived treatments for malaria. The Walter Reed Army Institute of Research (WRAIR), Division of Experimental Therapeutics, is interested in qinghaosu (or artemisinin), a medicine derived from *Artemisia annua* of the sagebrush genus. Several derivatives of qinghaosu are used widely in China (and experimentally elsewhere) to disrupt the life cycle of the malarial protozoan.²⁶ *Artemisia* has many species in temperate regions of the northern hemisphere but only a few are known to have antimalarial activity. Three members of the genus are native to Hawaii but their antimalarial activity has not been assessed.

Conclusion

The stories of two substances, kava and chaulmoogra, demonstrate the importance of herbal products in both ancient and recent Hawaiian medicine. When the USDA needed someone to obtain chaulmoogra seeds, they turned to a University of Hawaii botanist, Joseph Rock, who could venture successfully in the Pacific Rim. The only place where soils and climate were suitable for chaulmoogra plantations was also in Hawaii. And finally, another member of University of Hawaii, Arthur Dean, developed the extraction technique to enable chaulmoogra to serve as the treatment of choice for leprosy for several decades. Remember that Dean was not simply a staff member at the university, but its president, providing testimony to the level of involvement at this institution. Kava, once poorly known outside the Pacific, is emerging as a widely-used alternative medicine, in great part due to the interest generated in this state. Hawaii, with its agricultural sophistication, salubrious climate, and heritage of accepting plant-derived medicines, will probably continue its role in the transition of plants from traditional use to conventional use.

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Notes of Interest:

The first Western illustration of kava was prepared by Sidney Parkinson, ship's artist on James Cook's first voyage to the Pacific. On this voyage, Cook was sent to Tahiti to observe the transit of Venus, a planetary eclipse, in an attempt by the Astronomer Royal to calculate the distance from the earth to the sun. Other observations were made from stations in South Africa and Greenwich to allow triangulation of the distance.⁹ On Ralatea, near Tahiti, Parkinson prepared a watercolor that, once back in England, was transferred to copper plates which were then stored, nearly forgotten for two centuries, in the archives of the British Museum. Parkinson's 743 illustrations were resurrected in the magnificent work called the *Banks Florilegium*. Only 50 sets of the 34-volume *Florilegium* were printed. University of Hawaii has a copy in the Special Collections of the Hawaii Pacific Reading Room at the Hamilton Library.

Rock described several of his Asian expeditions in articles published in *National Geographic*. Photographs from Rock's Tibetan expeditions were collected in *Lamas, Princes, and Brigands* by Michael Aris, husband of Aung San Su Kyi. Rock's chaulmoogra plantation was in Oahu's Waiahole Valley (best known for the Waiahole Poi Factory). The only remaining chaulmoogra trees (*H. kurzi* and *H. anthelmantica*) in the United States are at the Foster Botanical Gardens in Honolulu.

Military Medicine

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for full tuition and a stipend during medical school, and allows for up to 6 weeks of training per year in a Military Medical facility during Medical school. Medical Students thus have the opportunity to visit Military Residency training programs prior to application. Application for first year graduate medical education (internship) training is accomplished through the American Association of Medical Colleges (AAMC) Electronic Residency Application Service (ERAS). Positions are available only for those applicants with a HPSP or USUHS obligation. The Military "match" program takes place earlier than the civilian match. In early December the positions are matched with the applications, similarly to the Civilian process. Announcements are made in late December or January. Military bound fourth year students have "matched" months earlier than their civilian classmates. They generally have a much more relaxed spring semester!

While the curriculum in Military GME programs is based upon the standards and requirements of the ACGME, there are additional curricular topics which have been termed a "Military Unique Curriculum" These topics are topics which are of special importance to the Military Physician. Some such topics may be indeed unique (e.g. management of radiation injuries, and aerospace medicine), and others may be included in standard residency curriculums yet require special emphasis (e.g. tropical medicine and wound management). The curriculum development process for Military residencies includes a number of common Military Medicine topics for all disciplines. Included are the Advanced Trauma Life Support (ATLS) course and ACLS. Integrated into the routine residency training are topics such as medical management of burns, infectious diarrhea, trauma surgery, transfusion medicine, and sexually transmitted diseases. There is special emphasis placed on some such subjects, and focused intensive training through specialized courses is provided in Chemical and Bio-

logical casualty management, and Tropical Medicine. Other specialized courses in Aviation Medicine, Diving Medicine, Environmental Medicine, and Hyperbaric Medicine are taught during residency, or after primary residency training is completed. Other topics which are of particular importance to all Military physicians include heat and cold injuries, post-operative care, closed head injury, altitude related illness, disaster medicine, and vaccination strategies for deployment.

The development of a specialized residency curriculum in Military Medicine is an ongoing project which includes field experiences in addition to the didactic and clinically based experiences. The important concepts of public health and field hygiene are learned through didactic sessions and opportunities to participate in training exercises, medical relief missions, and formal military field training courses. Residents from Tripler Army Medical Center have participated in field experiences in Micronesia, Mongolia, Japan, Samoa, and in the Mainland U.S. Residents routinely participate in the Aeromedical Evacuation of patients to and from Hawaii. The combination of didactic training and operational experience give the Military Resident an enhanced knowledge of Militarily relevant medical issues, and a singular knowledge of Militarily unique topics. The practice of medicine in the Military is geographically dispersed. The medical conditions encountered may be particular to geography, occupation, or battle. The training of Military physicians must encompass the spectrum of diseases and management strategies that are common to all practice environments, in addition to those aspects of practice which are unique to the Military practice. The U.S. Army GME system is in the process of defining and implementing a Military Unique Curriculum, which will serve to assure that Military Physicians are trained for the practice environment that lies ahead.

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