

THE THERAPEUTIC VALUE OF COCA IN CONTEMPORARY MEDICINE*

ANDREW T. WEIL

Botanical Museum, Harvard University, Cambridge, MA 02138 (U.S.A.)

Summary

Coca appears to be a useful treatment for various gastrointestinal ailments, motion sickness, and laryngeal fatigue. It can be an adjunct in programs of weight reduction and physical fitness and may be a fast-acting antidepressant. It is of value in treating dependence on stronger stimulants. Coca regulates carbohydrate metabolism in a unique way and may provide a new therapeutic approach to hypoglycemia and diabetes mellitus. With low-dose, chronic administration it appears to normalize body functions. In leaf form coca does not produce toxicity or dependence. Coca can be administered as a chewing gum or lozenge containing a whole extract of the leaf, including alkaloids, natural flavors, and nutrients.

For several reasons, physicians and patients are becoming interested again in traditional botanical drugs. First of all, the toxicity of potent synthetics is more and more obvious; by relying exclusively on these preparations we pay a heavy price in adverse reactions. Secondly, there is a growing demand from patients for more natural forms of treatment. Thirdly, much of the modern pharmaceutical industry is petroleum-based. As oil becomes more and more expensive, other sources of remedies become more attractive.

Coca is an ancient medicinal plant, used continuously through the centuries for treating a variety of ailments. South American Indians still rely on it as a remedy in addition to using it as a stimulant and social drug (Martin, 1970; Mortimer, 1974). Recent observations and experiments suggest that coca should be tested for medical efficacy and reintroduced into modern therapeutic usage.

Many of the folk medicinal uses of coca concern its gastrointestinal effects. Indians use the leaves to relieve any source of stomach distress,

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especially pain or spasm, nausea, and indigestion. They use it to treat both constipation and diarrhea and say it corrects imbalances of tone in the intestinal musculature. They also say it helps them assimilate more nourishment from their food, whatever their diet.

Traditionally, coca is considered an excellent restorative that combats physical fatigue and stimulates cardiac and respiratory functions in a useful way. For this reason, many Indians use it as an aid to physical work. In Andean towns coca is still regarded as the best treatment for the nausea, dizziness, and severe headache of altitude sickness (*soroche*), and tourist hotels routinely serve hot-water infusions of the leaves to new arrivals from the lowlands.

Coca leaves are also commonly applied to sores in the mouth because they are believed to promote healing of oral lesions. They are used both to relieve toothache and as a prophylactic to keep teeth white and resistant to decay.

European and American physicians did not take much interest in coca until about 1860*. Then a number of coca tonics appeared on both sides of the Atlantic. One product, a wine infused with an extract of coca, manufactured in Paris and dispensed on medical prescription, became enormously popular. It was used in the treatment of many conditions, especially digestive disorders, and had a strong reputation as an effective tonic and restorative when taken regularly**.

It is difficult to evaluate the successes of coca in Western medicine of the late nineteenth century because the isolation of cocaine, also in 1860, soon changed everything. Early pharmacologists represented this alkaloid as the sole active constituent of the leaf and taught that it embodied all the therapeutic virtues of coca in a more concentrated and easily administered form. In this belief, the medical profession touted cocaine as a new wonder drug, especially after discovery of its utility as a topical anesthetic in 1884. Physicians prescribed cocaine quite indiscriminately and excessively for many ailments, including dependence on alcohol and opiates (Ashley, 1975; Grinspoon and Bakalar, 1976).

Enthusiasm for cocaine as a panacea greatly diminished scientific interest in the whole leaf. To this day we know less than we should about other components of coca because pharmacologists and physicians have

*The event responsible for European interest in coca was the appearance of P. Mantegazza's *Sulle virtio igieniche e medicinale della coca*, a widely circulated prize essay by the Italian neurologist, published at Milan in 1859. An English translation of some of this essay is included in G. Andrews and D. Solomon (eds.), *The Coca Leaf and Cocaine Papers*, Harcourt Brace Jovanovich, New York, 1975, pp. 38 - 42.

**This was the famous Vin Mariani à la Coca du Pérou. See *A. Mariani, Coca and Its Therapeutic Applications* (translated by J. N. Jaros from the original French edition of 1888), New York, 1896. See also *The Mariani Album* (1884 - 1913) in Andrews and Solomon, op. cit., pp. 243 - 246; and references to Angelo Mariani in W. G. Mortimer, *History of Coca*, 2nd/Or Press, San Francisco, 1974. For more about nineteenth century medicinal uses of coca, see W. Martindale, *Coca, Cocaine, and Its Salts: Their History, Medical and Economic Uses, and Medicinal Preparations*, London, 1886.

been so fascinated by cocaine. But indiscriminate prescription of cocaine soon produced some disturbing cases of acute toxic reactions and chronic dependence, the latter typically in persons already dependent on opiates. Sensational publicity about these cases led, by the turn of the century, to a rejection of cocaine by the medical profession and, unfortunately, to a belief that coca leaf was the source of all the trouble (Ashley, 1975; Grinspoon and Bakalar, 1976). Although cocaine remains in the modern pharmacopeia for its topical anesthetic properties, coca has been dropped, ignored, and forgotten.

Uses for coca in modern therapeutics

On the basis of my observations of coca users, my studies of the coca literature, and my own clinical experience, I would recommend using the leaf in the following ways:

(1) In painful and spasmodic conditions of the entire gastrointestinal tract. Coca appears to restore proper tone of the smooth musculature of the gastrointestinal tract. It may be superior to belladonna, atropine, and other parasympathetic blocking drugs in that it produces no uncomfortable side-effects; in fact, the "side-effects" of coca leaf are usually perceived as desirable.

(2) As a substitute stimulant for coffee in persons who consume much coffee and suffer exacerbations of gastrointestinal conditions from that drug. Coffee is strongly irritating to the gastric mucosa and powerfully stimulating to the intestines. Coca can provide useful CNS stimulation yet is a traditional remedy for gastrointestinal disorders. Moreover, coffee can produce serious dependence with physiological components. Dependence on coca is much less common.

(3) As a fast-acting antidepressant. Coca has definite mood-elevating properties, especially when set and setting are supportive. The effect comes on within minutes of administration and does not leave patients feeling drugged or intoxicated. By contrast, current antidepressant medications (the tricyclics) may not produce an effect for weeks, have significant toxicity, and may make patients feel drugged.

(4) As a treatment for acute motion sickness.

(5) As adjunctive therapy in programs of weight reduction and physical fitness. Coca is anorexic and stimulating, unlike amphetamines, it provides some nutrients (Duke *et al.*, 1975) and does not produce toxicity or dependence.

(6) As an energizer for persons engaged in heavy physical work, including certain athletes.

(7) As symptomatic treatment of toothache and sores in the mouth.

(8) As a laryngeal tonic in persons who must use their voices more than usual, such as professional singers and public speakers.

(9) As a substitute stimulant to wean users of amphetamines and cocaine from those drugs, which are more dangerous and have much higher potentials for abuse.

(10) As a normalizer of carbohydrate metabolism and treatment for hypoglycemia and diabetes mellitus.

(11) As a tonic and normalizer of body functions.

In proposing these therapeutic uses of coca I should cite my own experiences with the leaf. During several years' residence in the coca-using regions of Colombia and Peru, I had an opportunity to treat a number of patients with this plant. These patients were non-Indian Colombians and Peruvians and visiting North Americans. I prescribed coca first as a hot-water infusion and then as a chew, in the traditional Indian manner, with a native ash preparation or sodium bicarbonate as the alkali. In giving the whole leaves I taught patients to chew them as I had learned from native *coqueros*.

I found that a hot-water infusion, though it may be soothing in cases of mild gastric distress, is much less powerful than a quid of leaves retained in the mouth with alkali for about 45 minutes. The more alkali used, the stronger is the effect. The usual dose of leaves I prescribed as a chew was 5 - 10 g, repeated as often as every 4 hours during the day but not within 4 hours of retiring to avoid possible wakefulness.

Of the 250 patients I have treated with coca, all but 12 found the flavor of the leaves pleasant; one of those 12 reported some nausea after beginning to chew. Some had difficulty mastering the technique of retaining the leaves in the mouth and swallowing only the juices. A few found the alkaline ash preparation irritating. All liked the sensation of topical anesthesia in the mouth. Most patients reported agreeable sensations in the stomach. I saw no adverse reactions of any kind and no untoward aftereffects.

I observed relief of the symptoms of indigestion, acute gastritis, peptic ulcer, gastroenteritis, ulcerative colitis, and chronic constipation. I noted marked relief of acute motion sickness in several instances. I also used coca successfully as an adjunct to weight-reduction programs, encouraging several persons to chew leaves in place of one daily meal and to use the stimulation as motivation for physical exercise. A number of healthy individuals found coca useful as an energizer during such activities as running, swimming and hiking. I found that coca relieved toothache and the pain of oral sores. It also relieved the hoarseness of laryngeal strain and laryngitis. Several professional singers reported that it extended their vocal range temporarily. I found that coca improved the symptoms of hay fever but did not provide symptomatic relief of upper respiratory infection or cough.

I have followed one striking case of the normalizing function over time. A 68-year-old man suffering from coronary insufficiency, hypertension, pulmonary congestion, prostatic hypertrophy with difficulty in urination and complete sexual impotence, and severe rheumatoid arthritis of the hands began ingesting about 15 g of coca a day after reading Mortimer's book. He used Trujillo coca (*Erythroxylum novogranatense* var. *truxillense* (Rusby)

Plowman), grinding the dried leaves to a powder, stirring the powder into water, and drinking it. He felt no stimulation or euphoria, but after three months of daily usage his urinary difficulties disappeared, and he recovered full sexual potency. Over the next three months his arthritis subsided, and he regained full use of his hands. His chest pains also disappeared, enabling him to resume vigorous physical activity. He continues to take his daily dose of coca and today, at 71, is a picture of health, which he attributes to the leaf. His case is especially interesting because his ailments were well-documented medically. He received no benefit from conventional treatments. His case will be reported in detail in a future paper. The patient says that he has started a number of friends, all elderly men, on his regimen.

Mechanisms of actions of coca

Although the pharmacology of all the components of coca leaf remains unstudied, the actions of cocaine must be central. Cocaine certainly stimulates the nor-adrenergic pathways of the nervous system and probably the dopamine pathways as well. Cocaine differs from amphetamines in possessing local anesthetic properties and having a much shorter duration of action. It is possible that human beings respond so differently to cocaine and amphetamines because of this difference in duration of action. Cocaine might not provoke a significant tolerance, for example, simply because it disappears from the body very quickly. In fact, the human liver has a remarkable ability to detoxify cocaine, being able to metabolize a lethal dose every 30 minutes (Byck and van Dyke, 1977; Woods, 1977; Jeri, 1980). An unusual aspect of cocaine and other coca alkaloids, frequently overlooked, is that they belong to the tropane series and may exert some atropinic effects on smooth muscles and glands. Atropinic actions of coca alkaloids may be relevant to their use in disorders of digestion and sugar metabolism.

Recent pharmacological studies of coca chewers clearly establish that cocaine enters the blood as cocaine when leaves are consumed (Holmstedt *et al.*, 1979; Paley *et al.*, 1980). But the clinical effects of coca leaf and cocaine must be kept distinct. Users of illicit cocaine dose themselves intranasally or intravenously with material that may be 60% pure. Chewers of coca leaf use material containing an average of 0.5% cocaine by a route of administration that causes a gradual increase in blood levels over the better part of an hour. Persons who ingest coca do not experience a "rush" of stimulation that results from rapid increases of cocaine in the blood, nor do they experience a "crash" into lethargy when the period of stimulation ends. Also, the user of coca ingests a family of related alkaloids; it is likely that a synergism of all the active compounds explains any therapeutic effects. Finally, the user of coca receives nutritional benefit from other components of the leaf.

The observed beneficial effects of coca on gastrointestinal disorders are sometimes dismissed as "merely topical anesthesia". Even if the primary ac-

tion of coca on the stomach is anesthetic, it should not be considered unimportant. Gastrointestinal illnesses are universally acknowledged to have prominent psychological components. Nerve pathways between the gastrointestinal tract and the CNS, including the higher brain, are extensive. It is likely that one pathological mechanism underlying many gastrointestinal disorders is a vicious cycle of feedback between stomach or intestine and the CNS, in which the discomfort of any actual lesion leads to worsening dysfunction of the gastrointestinal musculature and consequent progression of the lesion. Interruption of this cycle with a safe topical anesthetic might allow the musculature to assume normal tone and function, thus favoring healing of the lesion. Possibly, the antimotion-sickness action of coca is also due to interruption of a feedback cycle from the equilibrium receptors to the brainstem and stomach.

Of course, other mechanisms may be at work, too. Coca certainly stimulates oral secretions and probably changes secretion in other parts of the gastrointestinal tract. Ecgonine may relax intestinal smooth muscle directly (Montesinos, 1965). The use of alkaline materials with coca would produce improvement of certain conditions, such as functional hyperacidity and peptic ulcer. And the nonalkaloidal components of the leaf, especially the volatile oils responsible for coca's pleasing odor and flavor, may have soothing gastrointestinal effects of their own.

As an adjunct to weight-reduction programs, coca has several advantages. Chewing the leaves provides considerable oral gratification. Like other adrenergic agents, the alkaloids of coca produce definite but temporary anorexia. Patients who wish to get more exercise are easily encouraged to use the mild stimulation of coca as an opportunity for the sort of physical activity that burns up fat. Chewing coca and going for a run in place of eating lunch or dinner is helpful in losing excess weight. And coca does not produce the dependence associated with amphetamines.

It is, perhaps, impossible to know how much of the reputed effect of coca as a physical energizer is pharmacological and how much is an active placebo effect due to cultural, social, and individual expectation. Isolated cocaine can enhance short-term physical performance, but the dose of this alkaloid received in a chew of coca is low. If coca makes a person feel well and strong, that change alone could provide better motivation than usual for physical activity. A change in motivation rather than true pharmacological stimulation might best explain the association of coca with an enhanced capacity for physical exertion. In any case, the association is there, and physicians can take advantage of it by encouraging receptive patients to use coca as an aid in building up good habits of exercise.

The effects of coca on oral hygiene make interesting speculation. South American Indians believe that regular chewing keeps the teeth white and strong and the gums healthy. There is no hard evidence on this point, but, probably, the mechanical stimulation of the gums is beneficial, and regular use of alkalis would tend to harden dental enamel and retard the formation of caries. On the other hand, leaf particles caught in the teeth might be

irritating to the gingival membranes, and chronic use of caustic alkalies might be a factor in the development of oral cancers (Dunham, 1968). We do not know what coca alkaloids do to the oral mucosa; the healing of oral lesions reported by coca users may simply be symptomatic relief due to topical anesthesia.

Effects of coca on carbohydrate metabolism must be investigated. Typically, Indians who use coca do so in conjunction with intake of foods high in starch. As Burchard and others have shown, it is erroneous to think that coca replaces food (Burchard, 1980). If food is present, coca users ingest the two together, often following a high-starch meal with a chew of leaves. The Andean Indian population appears to carry a genetic predisposition to diabetes mellitus that is expressed only if individuals move to other environments, begin eating more fat and sugar, and leave off chewing coca.

Preliminary work by Burchard indicates that coca protects against development of hyperglycemia and reactive hypoglycemia following oral glucose loads in Andean Indians (Burchard, 1980). Moreover, preliminary biochemical work by Vitti in rats suggests that cocaine mixed in feed will shift the metabolic profile of animals on simulated Andean diets (high starch, low protein) in a direction mimicking a normal protein, normal carbohydrate diet (Vitti, 1979). The mechanisms for these metabolic effects are completely unknown but may involve atropinic effects of the alkaloids, since atropine can increase blood sugar.

The importance of research in this area should be clear, because it may result in a new approach to the management of diabetes as well as to a method of improving food utilization in populations on high starch, protein-deficient diets.

The tonic and normalizing functions of coca are difficult to discuss because modern therapeutics has no place for tonics. In other cultures and in other times they have been much esteemed. For example, ginseng (*Panax ginseng*) is so regarded in much of east Asia. It is valued for its chronic effects of balancing body functions. In Western medicine today we have come to expect and rely on dramatic, acute effects of treatments. This attitude may make it hard for us to notice, appreciate, and study more subtle effects of low doses of drugs that tend to restore normal functions over months or years.

Forms of administration

Coca for medical use must be relatively fresh, of a good variety, and in good condition. Leaves will not retain flavor and potency for more than a few weeks unless they are properly dried, pressed, and stored. Loose leaves turn dark and develop an unpleasant flavor if they are exposed to high humidity; their cocaine content remains largely intact, but the secondary alkaloids and essential oils may change, and coca in this condition is unfit for therapeutic use.

Retaining coca leaves in the mouth in alkaline solution and allowing the active compounds to diffuse slowly into the bloodstream, partly through the oral mucosa and partly through the stomach, gives the best result in terms of immediate effects. Hot-water infusions of leaves are minimally active. Simply swallowing the leaves does not produce much stimulation and euphoria but may be a good method for use as a tonic or normalizing drug over time. Most components of coca are freely soluble in water and can easily be extracted for incorporation into solid or liquid preparations.

It is unreasonable to expect many persons in Western countries to accept medication in the form of a handful of dry leaves to be chewed into a quid and sucked. My proposal for a solution to the problem of how best to administer coca in contemporary medicine is a chewing gum or lozenge. Whole extracts of coca, containing all of the active compounds in standardized doses, as well as the natural flavors, vitamins, and minerals, can easily be incorporated into gums and lozenges. Several co-workers and I are working currently on such products.

Safety of coca and potential for abuse

Because many persons confuse coca with cocaine, and because cocaine is known as a "drug of abuse", it is necessary to stress again the differences between the whole leaf and the isolated alkaloid.

I have lived among coca-using Indians of the Andes and the Amazon basin in Colombia and Peru and have not seen any signs of physical deterioration attributable to the leaf. I have never seen an instance of coca toxicity. Nor have I observed physiological or psychological dependence on coca. Even life-long chewers seem able to get the effect they want from the same dose over time: there is no development of tolerance and certainly no withdrawal syndrome upon sudden discontinuance of use.

To be sure, there is considerable propaganda against coca from non-Indian officials in South American governments and international narcotics agencies, usually charging that *coqueros* are undernourished and unproductive (Granier-Doyeux, 1962, for example). My own observations, like those of others who have lived in Indian communities, are that excessive use of coca, when it occurs, is the result of social and economic deprivation rather than the cause of it. A frequent theme in the anticoca literature is that the leaf encourages Indians to work without food. My experience is that Indians eat quite adequately in addition to consuming coca if food is available.

In this regard it is interesting to compare Amazonian Indians who use coca with their Andean counterparts. Amazonian Indians are well nourished, live under better climatic and social conditions, yet some of them consume great quantities of powdered coca (Plowman, 1979). My own work among the Cubeos of eastern Colombia has convinced me that the problems associated with coca in the Andes are results of that environment and not of coca, for none of them exist in the Amazon.

Several factors mitigate against excessive consumption of coca. In the first place, the dose of cocaine received in an average chew of coca is small,

and it enters the body slowly. Second, one must do considerable work to get a reinforcing effect from chewing coca; chewing leaves is not nearly as easy as swallowing a pill or snuffing a powder. This requirement for work imposed by coca in leaf form is a natural safeguard against abuse that would be preserved in a medicinal chewing gum. I am not in favor of making coca available in the form of delicious alcoholic drinks, like those of the last century, or of tampering with the chemical composition of the leaf.

One objection to the reintroduction of coca to modern usage is that we already have drugs to treat the conditions for which coca seems to work and there is no need to introduce something else that can be abused. I do not agree that we currently have remedies for all of these ailments. Moreover, the abuse potential of some of the most widely prescribed pharmaceutical drugs — I would single out diazepam (Valium) as a prime example — seems to be much higher than that of coca.

Conclusions

There is growing demand for therapeutic agents that are more natural and less productive of adverse reactions. Coca leaf still appears safe and useful after thousands of years of human experience. It may be less toxic and more effective in the treatment of certain disorders than drugs now in common use. It may also treat some ailments for which we now have no satisfactory treatments and may exert a normalizing action on body functions quite unlike anything in the modern pharmacopeia.

In order to assess the efficacy of coca as a remedy, it is essential to have adequate supplies of material that is standardized at least for cocaine content and total alkaloid content and that has a reasonable shelf life. My colleagues and I are working on a whole extract of coca that will meet these requirements and can be supplied to interested pharmacologists and clinicians for testing in animals and humans.

If physicians will acquaint themselves with the unique properties of this valuable plant, we may find it to be a useful addition to the modern therapeutic repertory.

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