MATE (PARAGUAY TEA)

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ANOTATED BIBLIOGRAPHY ON MATE (PARAGUAY TEA)¹

**GENERAL**


American Consul, São Paulo, Brazil, report, June 25, 1929. Mate propagandists claim for it unusual powers of stimulation without a subsequent reaction (similar to the claims for coffee, tea and related beverages). Considered useful in maintaining the health of those on an otherwise exclusive meat diet, as the cattle ranchers of southern Brazil, Uruguay, and Argentina. Mate seems to enable the drinker to go a considerable time without food, and to assist in withstanding extraordinary physical exertion, as on long marches. Widely advocated as an acceptable substitute for alcohol, for which reason it is hoped by the producers that it may find an increasing market in the United States. Quotes conclusions of the French Society of Hygiene, Paris, July 9, 1909: "Mate elevates the morals, sustains the muscular system, and augments the strength, permitting the endurance of long privations; it is, in a word, a valuable aid. Mate is destined to be soon the preferred drink of the laborers of all categories and nationalities." Quotes Gustav Peckolt, German scientist who lived for a number of years in Brazil: "It is an excellent stimulant which permits the laborer to recuperate his strength, spent by fatigue; the soldier, to support long marches exposed to inclemencies of the weather and to rude privations; the workman, to support undernourishment; and for the sick person it constitutes, further, a valuable medicine." Gives the analysis of mate leaves made by Theodore Peckolt, and his son Gustav Peckolt, as follows: Quantitative analysis of 1,000 grams of first quality *Ilex paraguayensis* mate from Paraná, obtained on the market in Rio de Janeiro. (Translated from *Ilex Mate*, p. 70.)

<table>
<thead>
<tr>
<th>Item</th>
<th>Grams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>146.463</td>
</tr>
<tr>
<td>Essential Oil</td>
<td>0.226</td>
</tr>
<tr>
<td>Pure Caffeine</td>
<td>5.550</td>
</tr>
<tr>
<td>Resinous Acid</td>
<td>25.000</td>
</tr>
<tr>
<td>Chlorophyll and Soft Resin</td>
<td>6.102</td>
</tr>
<tr>
<td>Mateanin Acid</td>
<td>10.784</td>
</tr>
<tr>
<td>Pyro-mateanin Acid</td>
<td>1.485</td>
</tr>
<tr>
<td>Crystallised Viridinio Acid</td>
<td>0.254</td>
</tr>
<tr>
<td>Gummy Substances, extractive material, dextrine, etc.</td>
<td>15.610</td>
</tr>
<tr>
<td>Saccharine extractive material, pyroacetic acid, phenol derivatives, etc.</td>
<td>1.570</td>
</tr>
<tr>
<td>Inorganic salts (ashes)</td>
<td>58.212</td>
</tr>
<tr>
<td>Cellulose, etc.</td>
<td>723.973</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1,000.069</td>
</tr>
</tbody>
</table>

The above table shows 5.550 grams of caffeine per thousand grams of first-class prepared Paraguayan mate leaves. However, the ordinary commercial grades of mate contain much less of the alkaloidal principle here classed as caffeine, but often called theine, or mateine, the proportion often falling to one or two grams per thousand grams of leaves.

Table prepared by Gustav Peckolt showing the general average of important chemical constituents of green tea, black tea, coffee, and mate. (Translated from *Ilex Mate*, p. 79). Quantities in grams in 1,000 grams of the substance.

¹ Prepared in response to numerous requests.
Principal Chemical Constituents of Green and Black Tea, Coffee and Mate, in Grams per Thousand

<table>
<thead>
<tr>
<th></th>
<th>Green Tea</th>
<th>Black Tea</th>
<th>Coffee</th>
<th>Mate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Essential oil</td>
<td>7.900</td>
<td>6.000</td>
<td>0.410</td>
<td>0.010</td>
</tr>
<tr>
<td>Chlorophyl</td>
<td>22.200</td>
<td>18.140</td>
<td>13.060</td>
<td>12.000</td>
</tr>
<tr>
<td>Resins</td>
<td>22.200</td>
<td>33.400</td>
<td>13.060</td>
<td>20.500</td>
</tr>
<tr>
<td>Tannic substance</td>
<td>73.000</td>
<td>136.800</td>
<td>16.380</td>
<td>12.300</td>
</tr>
<tr>
<td>Theine or caffeine</td>
<td>4.300</td>
<td>4.600</td>
<td>2.660</td>
<td>2.510</td>
</tr>
<tr>
<td>Ashes</td>
<td>175.800</td>
<td>198.800</td>
<td>174.530</td>
<td>139.000</td>
</tr>
</tbody>
</table>

In commenting on this table, Gustav Peekolt states that tea, coffee, and mate are quite similar in their chemical properties, mate most resembling coffee. He adds that from the chemical point of view the alkaloid found in mate is absolutely identical with that found in coffee, tea, guarana, and cola.

Carrizosa, Eduardo: La yerba mate, Rev. Nac. de Agricultura, Colombia, 467-601, July, 1939. Discusses the history of mate (Fernando Arias de Saavedra, 1592-94, first governor of Paraguay, noted the use by the Guarani Indians of a stimulating beverage from the “caá” leaves); geographical distribution of the wild and cultivated plant (natural distribution Eastern Paraguay, Misiones in Argentina, Matto Grosso, Parana, Santa Catalina, and Rio Grande in Brazil; also present between Santa Cruz de la Sierra, Bolivia and Novo, Uruguay, including S. Paulo, Rio de Janeiro, Minas Gerais, Matto-Grosso-Bolivian border, and southern Peru. Exploitation in Brazil and Paraguay of wild plants; in Argentina largely from cultivated yerba mate); description of plant (similar in appearance to the orange tree, in height from 3 to 4 meters to 10 or 20; greenish white, very small flower; blooms from October to November; fruiting from January to April; leaves dull light green below, brilliant dark green on upper surface. Gathered by cutting branches with machete or shears; thus pruned every year in Argentina, under cultivation; every three or four years in wild state. True yerba mate (there are more than 70 species of Ilex) is the *Ilex paraguayanensis* St. Hilaire. Branches dried over a fire, reducing the moisture content, to avoid loss of vital elements by oxidation; then dried still more on a rack over a hearth; the leaves are then ground, seasoned, ground again, selected and packed for consumption); nutritive value and chemical composition: (historical review; mentions Escudero’s findings, q.v.); possibilities of extraction of caffeine and of chlorophyl (for use as colorant) considered very encouraging; consumption: (Argentina principal consumer, followed by Uruguay, Paraguay, Chile and Brazil. Some interest of late in the United States and some European countries, especially Germany, it still being sold in drugstores in the latter.)

Connecticut Agricultural Experiment Station, New Haven, Bull. 372, 36th Report on Food Products and 27th Report on Drug Products, 1934, p. 505. Mate, or Paraguay tea, is the beverage prepared from the dried cured leaves of various species of Ilex, the most acceptable quality being derived from *I. paraguayanensis*. The shrub, an evergreen, abounds in Brazil, Argentina and other South American countries, where the beverage is highly prized and consumed in enormous quantities. The leaves are dried but not fired, and are marketed in a coarse-ground condition. The beverage is an infusion prepared somewhat like tea. It is sucked through a tube of silver or bamboo from a gourd called a “mate” from which the beverage gets its name. The shrub is not adapted to the climate of North America, although a related species, *Ilex cassina* is grown in some of the southern states. There is some consumption of mate in the United States and those who have acquired a taste for it find it a palatable and stimulating beverage. Woodard and Cowland (Analyst 60, 134, 1935) conclude that mate contains no true tannin, but obtained evidence indicating the presence of caffetannin or a closely related pseudotannin. Caffeine, to which the stimulating effects of the beverage are largely due, is in about the same proportion as in coffee. Caffeine is higher in commercial tea, ranging from 1.9 to 3.6 percent. Tea will yield from 35 to 40 percent of hot water extract; the two samples of mate examined yielded 42.6 to 44.7 percent. Analysis of two commercial brands of mate and for comparison, two samples of cassina, are given in the following table:

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Preparation

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Moisture (%)</th>
<th>Ash (%)</th>
<th>Protein (%)</th>
<th>J extract (%)</th>
<th>Total Ash (%)</th>
<th>Water-soluble ash (%)</th>
<th>Acid-soluble ash (%)</th>
<th>Acid-labile P2O5 (%)</th>
<th>Insoluble P2O5 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yerba Mate</td>
<td>16.04</td>
<td>5.90</td>
<td>48.45</td>
<td>2.31</td>
<td>0.39</td>
<td>0.21</td>
<td>0.38</td>
<td>0.21</td>
<td>0.39</td>
</tr>
<tr>
<td>Joya Mate</td>
<td>16.00</td>
<td>5.90</td>
<td>48.45</td>
<td>2.31</td>
<td>0.39</td>
<td>0.21</td>
<td>0.38</td>
<td>0.21</td>
<td>0.39</td>
</tr>
<tr>
<td>Cassina, black</td>
<td>21.51</td>
<td>5.80</td>
<td>31.00</td>
<td>2.25</td>
<td>0.35</td>
<td>0.21</td>
<td>0.38</td>
<td>0.21</td>
<td>0.39</td>
</tr>
<tr>
<td>Cassina, green</td>
<td>21.51</td>
<td>5.80</td>
<td>31.00</td>
<td>2.25</td>
<td>0.35</td>
<td>0.21</td>
<td>0.38</td>
<td>0.21</td>
<td>0.39</td>
</tr>
</tbody>
</table>


Jauréguy, M. A.: Rol gáletóforo de la yerba mate, An. Fac. Med. Montevideo, 67, 6, Oct, 1936. Composition: According to Collin (Matirre Méniscale), mate contains caffeine, a form of tannin called metatannin, a little essential oil, resin and proteins. The proportion of caffeine varies considerably, Macquaire having extracted 0.88 percent and Dauber 3.40 percent. Tannin ranged from 5.2 percent (Dauber) to 10-16 percent (Robbins). Ernest von Basswitz ("O Mate") states that mate contains more resinous matter than coffee or green tea and less than black tea. "Its action depends on variations in the chemical composition of the plant, the amount used and the individual condition of the person who uses it" ("Le Mate, Moreau de Tours). Jauréguy could not detect clinically or chemically any milk-producing properties in mate for nursing mothers. In his opinion many of the alleged medicinal qualities of mate are based on suggestion and popular belief.

Lerena, Albert: Use of mate in the Argentine army, Res. San. Militar, Arg., 443, July-Aug., 1928. "Yerba mate is the leaf of a plant (Ilex paraguayensis) which is a real succedaneum of tea; some people even think it has superior qualities ... it is a neuromuscular stimulant."

Moreau de Tours, A.: Le Maté. Etude historique, chimique et physiologique, Steinheil, Paris, 1904. 79 pp. illus. An old authority. A study of its History, physiology. First advanced idea that alkaloid is not caffeine-called it mateina. Lists comparative results with and various reagents in parallel columns. 4 pages on therapeutic value. Conclusions: 1. from the alimentary point of view it has its place. 2. In food economy it can replace coca and kola, leaving the same effect but without their objectional qualities. 3. In medical practice, it renders a real service, having an action totally different from caffeine; it possesses its advantages without its objectionable qualities. His analysis of mate (1897) follows: (taken from Apolo, 1938).

Moisture .................................. 9.1710  
Ash ....................................... 5.3400  
Total Nitrogen ........................... 1.0560  
Nitrogenous material ................... 1.4285  
Tannin .................................... 6.0890  
Mateine ................................... 1.8200  
Resin ..................................... 1.5600  
Cellulose and fiber ..................... 21.5000  
Starchy material ......................... 155.5000  
Iron (Fe2O3) ................................ 0.3650  
Aluminum (Al2O3) ......................... 0.1474  
Muscate ................................... 1.5000  
Water-soluble ash ....................... 1.3880  
Water-insoluble ash, soluble in ........ 2.2000  
Water-insoluble ash, soluble in ........ 0.0100  
HCl ........................................ 3.3620

Paladino, Francisco, and Rodriguez, Sebastian: Consideraciones generales sobre algunas propiedades terapeuticas de la yerba mate, Bol. Soc. Med.-Quir. Centro de La Rep., Florida, Uruguay, 919-122, June, 1934. Discusses the effects of mate, as reported by various workers, on the muscular and nervous systems, the digestive system, and in nutrition, and on the circulatory and urinary systems. Conclusions: mate is an excitant or stimulant of the muscular and nervous systems; an "economizing" food, reducing the effects of fatigue; it has galactogenous properties; contains vitamins A, B, and C; is useful in certain dyspeptic conditions; has laxative and diuretic effects; affords a safeguard against water-borne diseases since it is made with boiling water;
and may be useful as a substitute for coffee and tea, since it is less toxic in its effects, although similar in action; and as a substitute for alcohol. The authors feel that certain harmful effects of mate may be due to excessive use, or to drinking it too hot. They urge the substitution of individual drinking vessels for the ubiquitous custom of everyone using the same mate and bombilla.


Soler, F. L.: Plan de trabajo para estudiar los efectos del "Mate," Prensa Méd. Arg., 1841-1844, July 7, 1937. Soler, declaring that "mate" is apt to consist today of anything having green leaves, whereas the true mate is the Ilex paraguayensis St. Hil. proposes that some organization or institution such as the Medical Association, the University, of Argentina, Paraguay, or Brazil, be assigned to produce a standard type of mate to be used for experimental studies.


**Special Phases**

Apolo, E.: La intoxicación mateina como factor de acufenos. An. Oto-Rino-Laringol., Uruguay, 187-195, 1938. After mentioning the enormous consumption of mate in South America (Uruguay imports some 20 million kilograms of yerba mate annually, as against 2 million kg. of coffee and 200,000 kg. of tea); the chemical composition of mate (giving Moreau de Tours' analysis); and reported harmful effects; Apolo discusses the reasons which lead him to consider the consumption of mate to have a toxic effect on the auditory apparatus, evidenced by a sensation of ringing in the ears (acustic murmurs). He reports three cases.


Bonotino, Udando C., Gofialons, y Carrulla: La acción de la yerba mate sobre la secreción gástrica, Prensa Méd. Arg., No. 6, 55-59, 1920.


Comisión Reguladora de la Yerba Mate, Argentina. Ley No. 12,238, del 4 de octubre de 1935. Creation of a Commission to regulate the cultivation, production and sale of Yerba Mate; regulate prices; set up standards of quality; ensure hygienic conditions of production and elaboration; compile statistics on production, preparation and consumption; encourage the use of mate at home and abroad.

Cuttica, P. J.: Método de evaluación de calidad de yerba mate. (Publicado en la monografía "Yerba Mate" de A. Ceriotti, No. 7, p. 92.)

Escudero, Adolfo: Sagantame, Marie; Senra, Ricardo A., and Tantoria, Juan H.: Sobro la presencia de ácido ascorbico (vitamina C) en la yerba mate (Ilex paraguayensis), Semana Méd., Arg., 1888-91, Dec. 31, 1938. The authors conclude that commercial yerba mate contains vitamin C and that infusions and ground yerba mate contain vitamin B, but that the quantity of vitamin C varies: different commercial brands have different amounts; and the same sample releases different amounts of vitamin C in water, according to whether several infusions of hot water, (mate), cool water (tereré) or a single infusion of hot water (mate cocido) are used. Commercial samples contained from 15.0 to 31.0 milligrams vitamin C per 100 grams; in regular mate from 44 to 78 percent of the vitamin content was extracted; in tereré, from 48 to 89 percent, and in mate cocido, from 35 to 50 percent. They note that exposure of mate to air causes loss of vitamin C.

Escudero, Pedro: El mate es un alimento, Rev. Centro Estudiantes Fac. Ciencias, Med., Farm. y Ram. Mon., 40-45, Jan-Feb. 1937. Reviews the history of mate—the claims and counter-claims; the attribution to mate of virtues not explicable by the chemical analysis; the charges that it produces, either spontaneously or experimentally, gastritis, unfavorable changes in gastric secretions, nervous disorders, and even digestive asphyxia; and the attribution of all its good and bad effects to the hot water with which it is made rather than to the mate itself. Notes that the work of Escudero and associates has demonstrated that mate contains a considerable amount of vitamin C (most of it being exhausted by the first five infusions of a given amount of mate)—thus affording scientific proof of the old hypothesis that the Argentine gauchos, with their almost exclusive meat diet, were kept free from scurvy by their custom of drinking mate in great quantities. (Essentially a "popularization" of the information in the article by A. Escudero et al. in Semana med., Dec. 31, 1936.)
OFICINA SANITARIA PANAMERICANA

Diciembre

FARMACOPEA LATINO-AMERICANA, (Herrera, A. L.), México, 1921, p. 456: Mate. Emetic in concentrated doses; stimulant and diuretic.

FARMACOPEA PARAGUAYA, proyecto, Tomo II, Asunción, 1929, p. 22-3.: Yerba mate. Nerve, muscle and digestive stimulant. Active principles: caffeine (0.50 to 1.50 percent), resin, glucoside, tannin acid.


Gatti, C., and Kassinsky, A.: La vitamina C en la yerba mate. Arch. Uruqu. Med. Cir., 263-267, March, 1933. Studying Tillmans's reaction for vitamin C (on which Escudero's results were based), the authors conclude that it is not specific for vegetable products rich in tannin, and that when the tannin is removed from commercial yerba mate the mate does not reduce the dichlorophenolindophenol in Tillman's reaction.

Gatti, C.; Menesoud, P., and Kassinsky, A.: El factor antiescorbútico en la yerba mate, Rev. Soc. Med. Paraguay, No. 65, pp. 2-11, 1935; El escorbuto y la carne, Idem, No. 69, pp. 2-8, 1935; Influence of mate on an outbreak of scurvy in the Paraguayan army. Arch. d'hygiène. opér. 63: 37-41, Aug. 1, 1936; Influencia de la carne y de la yerba mate sobre un brote de escorbuto humano y sobre el escorbuto experimental, Novena Reunión Soc. Arg. Farmacol. Regional, 2: 824-826, 1937. The authors conclude as a result of observation during the Chaco war and experiments with animals, that yerba mate, whether as mate (made with hot water) or tereré (made with cold water) has no effect in preventing scurvy; whereas fresh meat, even though boiled for a considerable time (several hours) in open receptacles does have such an effect. Their conclusions are challenged by Escudero (Semana méd., Dec. 31, 1936) and supported by Monda (Rev. Inst. Bact., Argentina, Dec. 1935).


Krause, F., Klecker, E., and Kollath, D.: Caffeine content of mate. Z. Unters. Lebensm., 1923, 98, 340-354. Journ. Soc. Chem. Ind., B.C.A., 62: 561 (Dec. 29, 1933) Chem. Abstr. 28: 1410, 3-3-34. Anl. 30: 768, 12-23. Am. J. Pharm. 179: 438-440. 1933, 0.3 to 1.5% caffeine. It appears, therefore, inadmissible to speak of "mateína" or of caffeine-free mate. The product isolated was identified as caffeine by its composition and melting point, but whether therefore, inadmissible to speak of "matein" or of caffeine-free mate. The authors conclude as a result of observation during the Chaco war and experiments with animals, that yerba mate, whether as mate (made with hot water) or tereré (made with cold water) has no effect in preventing scurvy; whereas fresh meat, even though boiled for a considerable time (several hours) in open receptacles does have such an effect. Their conclusions are challenged by Escudero (Semana méd., Dec. 31, 1936) and supported by Monda (Rev. Inst. Bact., Argentina, Dec. 1935).


Lagasse, J.: Mate growing in Argentina. Month. Bull. Agr. Sci. and Practice, 28: 730-733. Feb. 1924. The active constituent of mate is mateína (also called cafeína, paraguarína, theine or ilicína), an alkaloid similar to the caffeine contained in coffee and the theine contained in tea, the proportion of which varies according to the part of the plant and the method of preparation, from 0.5 to 1.75%. Caffeine (mateína), 0.7478% in leaves, 0.3679% in twigs.

la yerba mate (Adulterante de mate) Pub. No. 35 del Instituto de Botánica y Farmacología, Buenos Aires, 1917.


Marodía, C. I.: Acción de las infusiones de yerba mate sobre el quimismo del músculo y del hígado en animales en reposo y después de ejercicio. Rev. Inst. Bact., Buenos Aires, XII, 1934, p. 584-593. (As the result of experiments with pigeons and rats, the author concludes after experiment that an infusion of yerba mate acting on the normal small intestine produces a regular stimulation of peristalsis; and that this effect is by stimulus of the muscular fiber.

Martins, Rosario: Hier-Mate (Chá Sul-Americano), Curitiba, 1923. P. 159, quotes opinion of Langlet, President of the International Pure Food League, Paris: "The dominant characteristic of the influence of mate on a normal organism appears to be a stimulating action exercised on the cerebral-spinal and sympathetic nervous system. Taken preferably in the morning, before breakfast, sweetened, it produces a lively sensation of well-being, increases the resistance to fatigue, and increases mental activity... It seems to diminish the sensation of hunger without destroying the pleasure of eating; etc."


Mendtive, Jorge R.: Sobre la presencia de ácido ascórbico en la yerba mate del comercio. Rev. Inst. Bact., Buenos Aires, 8: 400-411, December, 1938. The authors tried numerous methods for the determination of the ascorbic acid (vitamin C) content in commercial yerba mate, including Tillman's method as used by Escudero et al., but were unable to isolate it. They conclude as a basis of the test that the quantity of ascorbic acid in commercial mate must be extremely small. They feel that the favorable results obtained by Escudero were due to some other factor in mate capable of reducing the Tillman's reagent, and not to a high content of vitamin C.


Oficinas Químicas Nacionales, Ministerio de Hacienda, Argentina: Leyes, Decretos y Resoluciones, 1ª serie, 1934, p. 57, Decreto del Poder Ejecutivo Nacional del 11 de agosto de 1931; p. 78, Decreto del P. E. N. del 29 de junio de 1933 (modificaciones al del 11 de agosto de 1931); p. 80, Decreto del P. E. N. del 29 de junio de 1933; p. 82, Método de análisis aplicado por las Oficinas Químicas Nacionales.


Pharmacopéa dos Estados Unidos do Brasil, São Paulo, 1928, p. 567-709. (Official since August 15, 1929) Mate. To contain a minimum of 1.5 percent caffeine. For use as a diuretic. Powdered mate.

Miscellaneous

Preloni, Pedro J.: Contribución al estudio de la composición química de la Yerba Mate, trata de barbacués y en instalaciones modernas. Rev. Centro Estud. Form. & Beq., Buenos Aires, Año 27, No. 13-16, p. 322-344, 1938. Botanical description of mate; description of its preparation for commerce; analysis of mate prepared by the old method of drying (barbacués—a sort of grate over a hearth or system of pipes) and the mechanized dryer (seccadero). He concludes that mate dried in the modern plant shows less humidity; that the aqueous infusion is richer with the new method, etc.


Saunders, W. Paraguay tea. Rept. Commissioner of Agr., p. 69, 1876.

Samañiego, C. C.: "Preloni, Pedro J.: Contribución al estudio de la composición química de la Yerba Mate, tratada en barbacués y de instalaciones modernas.


