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Bases bromatológicas de Mangifera indica L.

Bromatological bases of *Mangifera indica L.*

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Abstract:

Certain foods are shared between continents and closely between countries, according to the food groups of each place, they must be described depending on the number of macronutrients and micronutrients. These contribute or harm individuals, according to their use or abuse in the intake. Some fruits and vegetables are known that can help in the search for optimal health, it will depend on the biological use of food. One of the many fruits valued for its flavor, texture, smell, consistency, and color, is the mango. Regardless of its sensory analysis, the bromatological aspect of the fruit is ideal for health, it will depend on the recommended serving. Consumption implies benefits in health sciences, the correct thing is to define each nutritional component and relate it according to current scientific studies. The perspective before the basic and health sciences are necessary to infer and develop specific and regional investigations.

Keywords:

Mango, Mangifera indica L., phenolic compounds, antioxidant, bromatology

Resumen:

Ciertos alimentos son compartidos entre continentes y cercanamente entre países, de acuerdo con los grupos de alimentos de cada lugar, se deben describir dependiendo la cantidad de macronutrientes y micronutrientes. Estos, aportan o perjudican a los individuos, de acuerdo con su uso o abuso en la ingesta. Se conocen algunas frutas y verduras que pueden ayudar a la búsqueda de la salud óptima, dependerá de la utilización biológica alimentaria. Una de las tantas frutas valorada por su sabor, textura, olor, consistencia, y color, es el mango. Independientemente de su análisis sensorial, el aspecto bromatológico del fruto es el ideal para la salud, dependerá de la ración recomendada. El consumo implica beneficios en las ciencias de la salud, lo correcto es definir cada componente nutricional y relacionarlo de acuerdo con los estudios científicos actuales. La perspectiva ante las ciencias básicas y en salud, son necesarias para inferir y desarrollar investigaciones específicas y regionales.

Palabras Clave:

Mango, Mangifera indica L., compuestos fenólicos, antioxidante, bromatología

Acronym:

Antioxidant capacity (AC), Antiproliferative capacity (CAP), Mango peel (MPe), Phenolic compounds (PC) and Mango pulp (MPu).

Introduction

Recently, various scientific studies have proven that the influence of diet on the prevention and treatment of chronic diseases is becoming more evident every day.

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This is attributed to the fact that certain foods have beneficial substances that act on the intermediate and xenobiotic metabolism 1. The fruits are foods that have various substances which provide benefits to the body, among these substances are those with antioxidant capacity (AC), which neutralize or inactivate free radicals, thereby preventing the development of diseases related to stress oxidative like diabetes mellitus II, cardiovascular diseases and cancer 2.

Mango (*Mangifera indica L.)* is one of the fruits with great contribution of substances with high antioxidant capacity (AC) and has also shown antiproliferative capacity (APC) in human cancer cell lines. Research has shown that this is due to the presence of various phenolic compounds and provitamins whose type and quantity depend on various factors such as the variety of the fruit and part of the plant, its state of maturity and its pre and post-harvest handling 1.

General elements

Mango (*Mangifera indica L.)* is a tropical fruit originating in Asia, introduced to the continent by the Spanish in the 17th century. It stands out for its particular flavour and aroma; it has a wide acceptance and a growing demand in international markets. Despite not being a native crop of the American continent, it has come to occupy a primary place in its production and consumption 1. It belongs to the *Anarcaridiaceae* family, which include around 600 members, which comprise approximately 50 species native to Southeast Asia. Taking third place in terms of area planted in Mexico within fruit trees, with coffee being the main one, followed by orange. Being one of the products with the greatest economic potential abroad, representing for Mexico a great source of foreign exchange 3.

Originated in the Indo-Burmese region and is one of the most popular and important tropical fruits in the world for its production, cultivated area and popularity, it is considered the king of fruits. In ten years, export volumes grew by more than 172%; for 1995, 366.9 thousand tons were exported, while for 2004 it was 916.9 thousand tons 3.

The outstanding participation of Mexico in the world mango market is due to the fact that it has the climatic and geographic conditions suitable for the proper development of this crop. Mexico ranks sixth in mango production worldwide and the state of Michoacán stands out for being the main exporting state and one of the most important producers of mango nationwide; contributes with 13.2% of the planted surface, after Sinaloa and Veracruz with 7.8% of the total production 3.

One of the properties that make this fruit of great importance is its great contribution of natural antioxidants, which are widely distributed in fresh plant-based foods, among other compounds that provide vitamin E (tocopherol), vitamin C (ascorbic acid), carotenoids and phenolic compounds, especially flavonoids 3-4.

Its optimal growth temperature is approximately 24 ° -27 ° C, in soils whose pH is around 5.5-7-5. (Being the neutral pH is 7) 3. It grows in tropical areas at heights of 4,000 ft. Above sea level, and at 2,000 ft. in areas where the seasons are heavily marked. It is a climacteric fruit that in a ripe state is ideal for consumption, lasting a few days. In Mexico there are various varieties such as: “Tommy, Haden, Ataulfo, Manila, Irwing, Apple, Pineapple Canary”.

The size of the fruit varies from 2.5-30 cm long, its shape is oval or round, with a significant bone (seed) inside, it presents varieties of size and its colour depends on the region where it is grown, it includes a mixture of Green, yellow and red colours, it grows on evergreen trees 2.

Nutritional value

Table 1. presents the nutritional composition (per 100 g) of the average mango reported in the National Nutrient Database for Standard References. The pulp (MPu) and mango peel (MPe) have a high percentage of humidity (74-87%) and carbohydrates (15-23%), but low protein content (0.40-0.80%) and lipids (0.3- 0.10%) 2.

MPu and MPe Ataulfo contains approximately 14 and 8 g / 100g of simple carbohydrates (mainly fructose). The lipid content in a dry base is particularly higher in the MPu than in the MPe (around 50% more), which justifies its differences in caloric content (102 and 68 kcal / 100g), at least for the case of Ataulfo mango 2.

Although mango is not a fruit with a high protein content, proteomic studies have recently been carried out which report that there are several trace peptides with a great diversity of functions for the plant, so much so that some protein binding proteins occur in MPe. DNA, transferases, regulatory transcription, transport, and various metabolic regulators; In MPu there are proteins involved in carbohydrate metabolism, function in chloroplasts, peroxidases, oxidative esters, and others that occur in the peel and pulp of the fruit 2, 4.

Mango is also a good source of dietary fiber, particularly it is soluble in MPu (pectins, starches) and insoluble in MPe (lignins and hemicellulose). Apart from its high content of simple carbohydrates (glucose, fructose, sucrose), the pulp is recognized as a source of

heteropolysaccharides of uronic acid and neutral sugars (pectins) for the food industry where citrus pectins are commonly used 4.

Finally, mango is also characterized by having a high content of vitamins and minerals such as ascorbic acid (vitamin C), thiamine (vitamin B1), riboflavin (vitamin B2), niacin (vitamin B3) and β-carotenes. One hundred grams of MPu is enough to cover 146, 69 and 45% of the recommended daily intake of ascorbic acid in Mexicans aged 4-8, 9-18 and 19-50 years respectively. However, there is great variability in the nutritional composition of the mango as a result of edaphological, climatic factors, state of maturity, variety, and even the position of the fruits on the same tree 2, 4.

Table 1. Average nutritional composition of mango (per 100 g).

Macronutrients (g)		*Minerals (mg)*		*Vitamins (mg)*			
Water	83.5	Ca	11	Ascorbic acid	36.4	A, (EqR)	54
Protein	0.8	Fe	0.16	Thiamine	0.03*)*	A (IU)	1082
Fat	0.4	Mg	10	Riboflavin	0.04	E (*mg*)	0.9
Carbs	15.0	P	14	Niacin	0.67	K (*ug*)	4.2
Fiber	1.6	K	168	Pyridoxine	0.12	D (*ug*)	0
Sugars	13.7	Na	1	Folates (ug)	43	B12 (*ug*)	0
Energy (Kcal)	60	Zn	0.09				

Reference: Raw Mango (Food Data Central Search Results, United States Department of Agriculture, USDA (#09176)). Web page USDA. Consult, april 17, 2020; 5

The main phenolic (PC) compounds found in the pulp include approximately 154.5 mg / 100g chlorogenic acid, gallic acid and protocatein, in order of abundance. Likewise, gallic acid derivatives were found in the MPe, mostly hydrolyzable tannins of between 5 and 13 units in addition to mangiferin 2.

Hydrolyzable tannins and condensed tannins play a role of great importance since they act as defences in plants against predators or microorganisms; while in humans they fulfil various nutraceutical functions in conjunction with other PCs, such as mangiferin, which is also present in MPe 2.

A factor of great importance is that the distribution of these compounds (flavonoids and antioxidant vitamins) is found in greater quantity in the MPe compared to the MPu, not to mention the increase directly proportional to the maturation of both parts of the mango. It is worth mentioning that the variety of the mango is an important factor in the phenolic PC and the antioxidant capacity (AC) of the fruit 2, 4, 6.

However, the functional potential of the mango peel or pulp will depend largely on the bioavailability, that is, the amount of PC released from the food matrix, the bioavailability (absorption and biotransformation) of the PC from the mango 4.

It has been verified and it is known that the type and characteristics of the dietary fiber and starchy carbohydrates of mango cause an entrapment of its phenolic compounds that, if they do not inhibit the corresponding interactions, cause a good part of the antioxidant contribution of MPe and remain associated with these complex carbohydrates and are not absorbable in the small intestine. The solubility in gastric juices, chewing, enzymes, as well as pH, positively influence the bioavailability of PC. However, several PCs have inhibitory capacity on several key enzymes in carbohydrate hydrolysis such as α-amylase and α-glycosidase 4.

Health effects

Various scientific studies have verified that the PCs contained in the mango include the regulation of the metabolism of nutrients, as well as the reduction of inflammations and cardiovascular risk.

Consuming 1 whole or fresh-cut mango daily for 30 days has been shown to help reduce the level of circulating VLDL triglycerides by 37-38% in normolipidemic young people. This benefit results from the possible synergistic action of the antioxidant load of the plasma, this together with the simultaneous ingestion of fatty acids and phytosterols present in the MPu. [6] Another interesting fact is that the pulp of the mango provides protection to the DNA and with this the risk of neoplasms is decreased 2.

In the case of diabetes, the possible mechanisms of antioxidants are related to the inhibition in the intestine of the digestion of carbohydrates, in particular glucose, they could also stimulate the secretion of insulin in the pancreas and activate the receptors of the same and somehow activate the recapture of glucose in the target tissues for the hormone. [6] Bioactive compounds in mango have been reported to exert antidiabetic effects, one study showed that exocarp extracts from mango have the ability to improve diabetes by administering different doses of these extracts to diabetic rats induced by streptozotocinα, a significant decrease in blood glucose levels resulted, an increase in plasma insulin level, this effect may be due to the presence of polyphenolic acids

such as chlorogenic and ferulic acid, which have been shown to inhibit the activities of α-amylase and α-glucosidase enzymes that hydrolyze carbohydrates and thus slow the absorption of glucose 7.

Regarding cancer, it is pointed out that if free radicals affect DNA (deoxyribonucleic acid) it can generate mutations that later transform into cancer cells. It is related to gastric cancer, which derives from the presence of *Helicobacter pilori* (a bacterium that causes chronic gastritis and leads to pre-cancerous lesions related to oxidative stress) 6. Some in vitro studies have indicated that the chemical components of mango have antiproliferative activity (APC), for example in a study carried out with extracts of the mango bark showed cytotoxic effects in pancreatic cancer cells that are related isolated compounds 8. Derived from experimental observations open the opportunity to opt for its use as supplements or nutritional ingredients.

It is stated that frequent and systematic practice of physical exercise is recommended for health and the increase of antioxidant defences. However, exercise increases the production of free radicals that affect muscle tissue, liver, blood, among others. It is possible that isolated exercise increases oxidative damage, contrary to systematic and regular training, reduces such effects, but without subjecting the body to excessive exercise and overtraining that lead to a state of oxidative stress. Some studies indicate that including antioxidant-rich foods in the diet of trained athletes reduced oxidative stress. In addition, the production of lactic acid during exercise can convert superoxide (low-harm radical) to hydroxyl (highly harmful to the body) 6.

Conclusion

Mango (*Mangifera indica L.)* is a tropical fruit of plant origin with a high value of antioxidants, which are substances that are part of everyday food, which help neutralize and reduce excess free radicals during activity. oxidative, characteristic of the organism 6. Likewise, they reduce the oxidative deterioration that affects food, and have turned out to be beneficial for the organism, reducing the risk of cardiovascular diseases, diabetes, cancer, among other pathologies 4.

Mango has been underestimated in the health area, because its peel turns out to be an excellent source of phenolic compounds and fiber, as well as the pulp. There are two ways to protect the body from free radicals, enzymatic and non-enzymatic (endogenous and exogenous) and their interaction can be intracellular or extracellular. The exogenous route is those that are acquired through the daily diet, while the endogenous route is produced in the body 6.

Free radicals are released during human metabolism, they are also produced by environmental pollutants (atmospheric, aquatic, soil) radiation (ultraviolet, gamma,) among others 2. It is usually related to the consumption or use of toxic substances such as alcohol, tobacco, drugs, a poor diet, poor lifestyle, and exposure to fertilizers or pesticides. The metabolism of some chemicals and the high level of physical and mental stress are also included.

As part of a good balanced, balanced and functional diet, eating the whole mango (peel and pulp) turns out to be more beneficial than consuming the minimally processed pulp. As a source of nutraceutical compounds, both have a profile for the treatment of pathologies due to the product of their differences in bioavailability and bioavailability.

A good diet, a diet rich in antioxidants, a good lifestyle and the regular and systematic practice of exercise help to reduce oxidative stress, thus reducing the chances of suffering chronic pathologies, thanks to the physicochemical properties of food, in especially those of plant origin.

The perspective of a nutritionist or an expert in basic sciences (chemist in pharmacology) and also in public health; it is necessary for the development of "new food products" that are inclined to the acute and chronic benefit of the individual. Despite the macronutrients and their micronutrients, they need to be understood from a lexicon appropriate to the area. The research and dissemination proposals on the subject are potentially suitable for undergraduate university education and mainly for postgraduate education.

When carrying out projects, protocols and proposals for interventions or research on certain food issues, and specifically on such popular and seasonal foods, they should be focused and designed by experts on the subject and with a multidisciplinary group. Remembering that global health, and in particular the health of a region, must be studied from the society that has food at its disposal, be it timeless or temporary.

Referencias

[1] Ballinas, D. E. J., G. Vela, G., E. J. López, Z., O. A. Aguilar, N., A. Caballero, R., P. I. Meza, G., A. Pérez, J., L. E. Flores, G. y J. M. León, G (2013) Mango: Cultivo, Tratamiento Pre y Postcosecha. Propiedades Nutrimentales y Funcionales. Editorial UNICACH. Universidad de Ciencias y artes de Chiapas. Tuxtla Gutiérrez, Chiapas, México. P 73.

[2] Wall-Medrano Abraham, Olivas-Aguirre Francisco J., Velderrain-Rodríguez Gustavo R., González-Aguilar A., Rosa Laura A. de la, López-Díaz José A. et al . El mango: aspectos agroindustriales, valor nutricional/funcional y efectos en la salud. Nutr. Hosp.

[3] Ayala-Garay, A. V., Almaguer-Vargas, G., De la Trinidad-Pérez, N. K., Caamal-Cauich, I., & Rendón, R. (2009). Competitividad de la producción de mango (*Mangifera indica L.)* en Michoacán. Revista Chapingo. Serie horticultura, 15(2), 133-140.

[4] Maldonado-Astudillo Yanik I., Navarrete-García Heidi A., Ortiz-Morales Óscar D., Jiménez-Hernández Javier, Salazar-López Ricardo, Alia-Tejacal Irán et al. Propiedades físicas, químicas y antioxidantes de variedades de mango crecidas en la costa de Guerrero. Rev. fitotec. Mex.

[5] USDA, (2020) Raw Mango (#09176), Food Data Central Search Results. United States Department of Agriculture. Web page USDA. Consult, april 17, 2020

[6] Coronado H Marta, Vega y León Salvador, Gutiérrez T Rey, Vázquez F Marcela, Radilla V Claudia. Antioxidantes: perspectiva actual para la salud humana. Rev. chil. nutr. [Internet].

[7] Gondi, M. y Prasada, R. (2015). Ethanol extract of mango (*Mangifera indica L.)* peel inhibits α-amylase and α-glucosidase activities, and ameliorates diabetes related biochemical parameters in streptozotocin (STZ)-induced diabetic rats. *J. Food Sci. Technol.* 52, 7883–7889.

[8] Nguyen, X.H., Do, T.N., Le, T.H., Nguyen, M.T., Nguyen, N.T., Esumi, H., Awale, S. (2016). Chemical Constituents of *Mangifera indica* and Their Antiausterity Activity against the PANC-1 Human Pancreatic Cancer Cell Line. *J. Nat. Prod.* 79, 2053–2059