

# A Nutritious Grain of Mesoamerica

By James H. Brown

Chía is a generic term used to describe a variety of unique plants of Mesoamerica and the American Southwest. All species of “Chía” are members of the cosmopolitan mint family, Lamiaceae, and some are known as “sage”. Different species of Chía can be found from southern California to the high tableland of Mexico and further south through Central America into northern South America. Chía species can be found from California on the western coast of the USA ranging east into western Texas.

The specific “Chía” of this report is *Salvia hispanica* L., [sometimes known as *Salvia Chía* (Gillet)], an annual herb, whose grains are about 2 mm. long, oval, and brown to black with irregular, dark red-brown markings. Interspersed is fully mature Chía grain without pigmentation (white Chía). It is cultivated on deep, sandy clay soils. Chía has been cultivated in Mexico by the Aztec and their descendants (McVaugh) since well before the conquering Spanish recorded its use and benefits in the Florentine Codex (Anderson). Linguistic use of the word “Chía” by the Aztec as a root word to describe something with an oily character (Chíactic), something greasy (Chíaoacaio), something having “serious fluids” (Chíauizaio) is further evidence of a long and continuous use of Chía within this society (Truman). Small family farms in Jalisco still produce Chía, albeit on an irregular basis and usually intercropped with a commodity crop such as corn. Chía is cultivated commercially in Argentina, Bolivia, Colombia and Peru.

Insecticides are not required for chia cultivation. Techniques have been developed to cultivate Chía on a large scale using existing agricultural equipment (Ayerza, 1996). Chía has been successfully grown and harvested in the Argentine provinces of Salta, Jujuy and Catamarca (Ayerza 1995). The biomass of the plant is high in essential oils, which act as a natural repellent to insects. Cattle and other herbivores do not browse Chía.

Chía resembles flax in that the seed oil of both contain high levels of triglyceride rich in  $\alpha$  linolenic acid, an essential (omega-3) fatty acid. Chía contains none of the antinutritional cyanogenic glucosides or linatine (vitamin B<sub>6</sub> antagonist) of flax (Bhatty) which have undoubtedly limited the use of flax as a food staple. The Aztec knew flax yet it was never mentioned as a food source within this society. To the contrary, Chía was one of the staples of the Aztec diet (Ortiz de Montellano) and was so revered that it was used as tribute in political and religious ceremonies. The grain of Chía is smaller than flax and has more pleasant mouthfeel and “crunch” characteristics.

Chía is a food ingredient whose commercial potential remains untapped. Chía grain has pleasant organoleptic characteristics, and is a natural form by which commercially shelf stable omega-3 fatty acids can be delivered to consumers. The Chía grain is high in dietary fiber (+30%), is a good source of a high quality protein (+19%), is a botanical source rich in omega-3 fatty acids (200mg/gm), and contains natural antioxidants, vitamins and minerals. A variety of

enriched food products can be formulated for human consumption using Chía grain as a vehicle to deliver nutrients.

## Nutritional Content of Chía Grain

### *Chía as a Source of Essential Fatty Acids and Natural Antioxidants*

Chía grain contains about 34% lipid fraction composed of 60%  $\alpha$  linolenic (omega-3) and 20% linoleic (omega-6) essential fatty acids. There is a growing consensus that omega-3 fatty acids play an important role in controlling coronary heart disease. Although there is no “Daily Value” of omega-3 established for labeling purposes, studies have shown that an adult male should ingest enough omega-3 to contribute about 2% of his total daily calories. Using this guideline and assuming full metabolic availability, an individual consuming a 2200-calorie diet could achieve 100% of the recommended intake of omega-3 by consuming 24gm of Chía grain per day.

The high oil content of Chía (relative to other whole grains) gives it an energy value of 524 Kcal/100 GM (Weber). This energy value for Chía is higher than other natural grains such as wheat (403), corn (366), rice (405), oats (432), and barley (406) or amaranth (421).

Chía grain also contains natural antioxidants such as flavonol glycosides, chlorogenic acid and caffeic acid (Taga). These compounds help preserve the oil stored within the grain and prevent the development of rancidity.

### *Dietary Fiber*

Nutritionist recommend between 25 and 30 grams of dietary fiber should be consumed each day. Whole grain Chía contains approximately 33% total dietary fiber including both soluble and insoluble fiber (Weber). A serving of 24gm Chía grain will contribute more than 25% of the recommended dietary fiber per day.

Soluble dietary fiber is found in the grain coat of Chía. This soluble fiber forms mucilage when the grain is contacted with water. The polysaccharide exudate has been characterized with a molecular weight from 0.8 to  $2.0 \times 10^6$  Dalton.  $\beta$ -D-Xylose,  $\alpha$ -D-glucose, and 4-O-methyl- $\alpha$ -D-glucuronic acid units were reported in the respective ratios of 2:1:1 (Kuei-Ying Lin)(Whistler).

A beverage known as “Chía Fresca” is made by mixing Chía grain with water or juice, and sometimes sugar and lime for flavoring. This pleasant tasting mucilaginous concoction has been consumed for centuries as a daily “tonic” in the regions where Chía grain is cultivated in Mexico (Martinez). Chía Fresca is said to aid in digestion.

### *Protein*

Chía grain contains about 20% protein (Ting). The protein is of good quality and limited

by threonine (65%) lysine (72%) and leucine (85%) in a preschool child's diet (WHO-1985). There are no limiting amino acids for Chía protein in an adult diet. The protein content of whole grain Chía compares well to other cereals such as wheat (14%), corn (14%), rice (8.5%), oats (15.3%), barley (9.2%) and amaranth (14.8%). The Aztec consumed Chía mixed with other grains such as maize or amaranth forming an "Atole" which undoubtedly enhanced the nutritional contribution of each grain.

#### *Other Components of Chía Grain*

Chía grain is a source of Beta-Carotene (45 iu/100 gm) and other vitamins and minerals shown in Table 1. The phytic acid content of Chía is relatively high (2%) and is comparable to peanuts (1.9%), sunflower (1.9%) and wild rice (2.2%).

**Table 1**

<u>Nutrient</u>	<u>mg/100 gm grain</u>
Niacin	7.4
Thiamin	0.5
Riboflavin	0.3
Aluminum	2.0
Boron	1.4
Copper	2.1
Iron	16.4
Calcium	870
Magnesium	320
Manganese	5.8
Molybdenum	0.2
Phosphorus	930
Potassium	700
Sodium	2.0
Zinc	6.6
Phytic acid	2000

## **Bibliography**

Anderson, A.J.O. and Dibble, C.E., "An Ethnobiography of The Nahuatl", *The Florentine Codex*, (translation of the work by Fr. Bernardino Sahagun), Books 10-11, From the Period 1558-1569.

Ayerza, Ricardo, "Oil Content and Fatty Acid Composition of Chía (*Salvia hispanica* L.) From Five Northwestern Locations in Argentina", *JAOCs*. Vol. 72, no. 9, p.1079-1081, (1995)

- Ayerza, Ricardo, "Oil of Chía: New Source of Omega-3 Fatty Acid", unpublished, (1996)
- Bhatty, R. S., in "Flaxseed in Human Nutrition", edited by S.C. Cunnane and L.V. Thompson, AOCS Press, Champaign, IL pp 35-39, (1995)
- Kuei-Ying Ling, Daniel, J.R. and Whistler, R.L., "Structure of Chía Grain Polysaccharide Exudate," *Carbohydrate Polymers* 23(1994) p. 13-18
- Martinez, Maximino, "Chía" (with translation), *Plantas Utiles De La Flora Mexicana*, p. 198-203, (1959)
- McVaugh, Rogers, "Oiticica and Chía Oils" *Economic Plants of Interest to the Americas*, United States Dept. of Agriculture, Div. of Plant Exploration and Introduction, Internal Document, p. 8-13, (1943)
- Ortiz de Montellano, Bernard R., "Aztec Cannibalism: An Ecological Necessity?" *Science*, Vol. 200, no. 4243, p. 611-617, (1978)
- Taga, MS, Miller, E.E., Pratt, D.E., "Chía Grains as a Source of Natural Lipid Antioxidants", *JAOCS*, vol. 61, no.5 (May 1984), pp928-931
- Ting, I.P., Brown, J.H., Naqvi, H.H., Kumamoto, J., Matsumura, M., "Chía: A Potential Oil Crop for Arid Zones", *Proceedings of the First International Conference on New Industrial Crops and Products*, p. 197-202, (1990)
- Truman, Kathleen, "Chía: A Pre-Columbian Oilseed", unpublished.
- Weber, C.W., Gentry, H.S., Kohlhepp, E.A., McCrohan, P.R., "The Nutritional and Chemical Evaluation of Chía Grains", *Ecology of Food and Nutrition*, Vol. 26, p. 119-125, (1991)
- Whistler, R.L., BeMiller, J.N. in "Industrial Gums, Polysaccharides and Their Derivatives", edited by R.L. Whistler and J.N. BeMiller, Third Edition, Academic Press, Inc. New York, pp 230-232, (1993)