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Tulyehualco Amaranth Production as a Source of Life, Hope, and Energy

47% of children in Mexico City between 6 and 12 years old are overweight and or obese. Based on data from the National Health Survey 2000 in Mexico it is estimated that 28.6 % of boys and 30.1% of girls of school age suffer from obesity and overweight, the capital city and the northern areas being the most affected, with 28.6% and 29.6% of obese child population, respectively. (esmas, Bien contigo, 2004) Obesity is associated with the development of killer diseases such as cardiovascular problems and diabetes mellitus type 2, first and third leading cause of death in our country in adulthood. Childhood obesity is considered by the World Health Organization and the authorities of Mexico a public health problem because about 80% of obese adolescents in our country will remain the rest of their life as such. (publica, 2006)

Dr. Blanca E. Del Rio Navarro (Mexican College of Pediatrics, Allergy, and Clinical Immunology Specialists) said that "obesity in childhood and adolescence is the result of a complex interaction between dietary factors such as high fat intake and low energy expenditure are also vital in the evolution of obesity in teenagers." (esmas, Bien contigo, 2004

Amaranth

Amaranth comes from Asia and Africa equatorial. Flowers can be red, pink, orange or yellow, among other colors. They begin to appear in the spring and retain their color after drying.

Global Biomedical Research assigned excellent nutritional qualities to amaranth in terms of calorie and protein content and micro-nutrients, like vitamins and minerals. Several research institutions and public sector agencies in Mexico have endorsed the effectiveness of amaranth when used as a source of food support for the nutritional recovery of malnourished children. (Escamilla, 2001)

For example, the following chart (Miguel, 2006) shows us the nutritional facts of amaranth campared with some vegetables containing high nutricional levels: spinach, chard, and cabbage.

ANALYSIS	AMARANTH	SPINACH	CHARD	CABAGGE
PROTEIN	46.5%	34.4%	26.9%	32.6%
FAT	6.8%	3.2%	3.4%	5.4%
FIBERS	11.1%	46.2%	51.7%	51.0%
ASH	35.4%	16.1%	18.0%	10.9%

Amaranth has high protein quality because it is the only plant of its kind that contains all the essential aminoacids the body cannot produce, such as leucine, lysine, valine, methionine, phenylalanine, threonine, and isoleucine. (Miguel, 2006)
These essential aminoacids are for good health, and are found in greater proportion in amaranth protein than in those of many other cereals, such as wheat, rice, corn, oats, etc. In fact, almost all grains have a deficiency of essential aminoacid lysine and therefore become the limiting aminoacid for many of the proteins of plant origin. (Miguel, 2006)

Amaranth contains twice as much lysine as wheat protein, three times that of maize, and it is comparable to the protein content of cow milk. Amaranth is, therefore, an optimal and balanced nutritional supplement in comparison with conventional cereals. Amaranth also has high lipid content when compared to other cereals. Among the fatty acids contained, amaranth includes linoleic acid, also known as omega 6, which is present in a small proportion. (Miguel, 2006)
Besides having the essential fatty acids mentioned, amaranth contains a large amount of squalene, which is an important intermediary in the synthesis of steroids in the human body. Among the minerals found in amaranth are calcium, phosphorus, iron and zinc, which are of the greatest nutritionalsignificance. Amaranth contains, surpassing traditional cereals and human milk, 162mg/100g calcium, phosphorus 455mg/100g, iron 10mg/100g. (Miguel, 2006)

Amaranth contains vitamins, such as riboflavin, niacin, folic and ascorbic acid, thiamine, biotin and b-carotene. In general, vitamin deficiency always involves the presence of diseases, and the presence of amaranth in the diet can prevent the onset of these diseases by vitamin deficiency. (Ensure, 2000).

Amaranth is a C4 (organic compound, produced in photosynthesis, that has 4 carbon atoms) plant, like sorghum, millet and sugar cane. Such plants conduct photosynthesis in a very efficient way under high temperature and low water availability. The combination of the anatomical characteristics of amaranth and its type of metabolism, which is C4, results of an increase in the efficiency of CO_2 under a wide range of water and temperature stresses, which contributes to its widespread distribution and capacity to adapt to diverse environmental conditions. (Schulz-Schaeffer, 1993)

Chemical Composition

The following two charts show us the chemical composition of the major amaranth componentes, the leaf and the grain.

Chart 2

Grain			
Calorie	358g	Calcium	247mg
Water	13g	Phosphorus	500mg
Protein	13g	Iron	3.4mg
Grease	7g	Thiamine	0.14mg
Carbohydrate	65g	Riboflavin	0.32mg
Fiber	6.7g	Vitamin B3	1mg
Ash	2.5g	Vitamin C	3mg
		Vitamin A	0mg

(Escudero, 1999)

Chart 3

Leaf			
Calorie	42g	Calcium	313mg
Water	86g	Phosphorus	74mg
Protein	4g	Iron	5.6mg
Grease	0.8g	Thiamine	0.05mg

Carbohydrate	7.4g	Riboflavin	0.2mg
Fiber	1.5g	Vitamin B3	1.2mg
Ash	2.1g	Vitamin C	65mg
		Vitamin A	1.6mg

Amaranth as a good alternative

The total amount of water required by the amaranth seeds through their life cycle is only 60% of water compared to wheat or barley, so the amaranth seed is an ideal crop for dry regions. Therefore, due to all of the mentioned factors, amaranth is a good alternative crop for Mexico, especially in difficult areas and even for semi-arid areas if appropriate methods of cultivation are used. That is why in Xochimilco and Tulyehualco amaranth is a major source of income. (Ariosa, 2000)

The economic performance of amaranth in rain fed and irrigated crops is higher than other traditional species, as short-cycle crops resistant to drought and high nutritional value. For example, in recent years in terms of profitability, the market price of amaranth grain is superior to other grains (maize $115.38dollar/ton; $230.76dollar/ton beans, wheat $69.23dollar/ton and $265.38 dolllar / ton) with a yield per hectare from 1.00 to 2.00 ton, without irrigation. In commercial terms, the cultivation of amaranth represents higher profitability than traditional cereal crops because of its higher market price. The strategies for the promotion, production, and exporstion of amaranth and its products, established a production cost of $147,498.23 dollars gross income from the sale of the production of $242,307.69 dollars and a gross profit $94,810.15 dollars. (Guia del Emprendedor, 2003)

In a short period of 150 to 180 days, amaranth is produced, depending on species and variety. It withstands low and erratic rainfall. Amaranth only needs moisture when panted and until the seedlings appear. Amaranth grains grow well with little water, moreover, it can grow in dry conditions. Occasionally it needs manure to fertilize the land, whose cost is $38.46 dollars per truckload. (Guia del Emprendedor, 2003)

Given its nutritional, agricultural, industrial and economic, qualities amaranth is one of the most profitable "pseudo-cereal" markets in relation to certain traditional crops grown in the central part of Mexico. The commercial price of amaranth, in recent years, is two times higher than corn, one more than bean, and three times more than wheat. The yield per hectare (10,000m^2) ranges between 1.0 and 2.0 ton (with no irrigation), allowing the farmer to ensure increased profitability of the land by 100-200%. Regarding the industrialization of amaranth as competitive activity, development has been very slow. The transformation process of the grain has been made mostly by hand, which has meant creating niche markets like health food and energizers such as "Alegrias" (Mexican snack elaborated with amaranth and honey), candy, flour, "tortillas", vegetables, snack bars, biscuits. (Guia del Emprendedor, 2003)
After harvesting and threshing the seed, it is necessary to dry before storing to prevent fermentation, mold, insect damage and the development of bad taste due to moisture. This is done particularly in areas where the harvest is still high relative-humidity or the leaves of the plants are not yet dry in rainy seasons. Drying is done directly with the sun or by artificial drying. (Guia del Emprendedor, 2003)

Before storage, it is necessary to classify the grain, for which you can use a sieve with holes 2 mm in diameter to remove large impurities and a 1.1 mm in diameter sieve to separate the premium finer grain wheat and dust that remain as byproducts of second quality. Stored grain if pest- and-

disease free, as well as retains its nutrients between 5 and 7 years, if kept in a dry, cool and ventilated place, (Guia del Emprendedor, 2003)

With sun abundant and the amaranth can grow better. It is sensitive to low temperatures. Irrigation should be every 3 days, although this plant is very noble and does not need much water. To promote the growth of lateral branches and a greater number of flowers we can cut the extreme of the youngest flowers. It reproduces by seed in seedbeds sheltered from late winter. Amaranth can be planted indoors about six weeks before the last frost; so you can cultivate amaranth in your home, and as soon as the temperature is stabilized, it should be transplanted to a bigger place with sun; the flowers will appear approximately 10 to12 weeks after planting. (Morales, 2002-2009)

Proposal

The idea is to exploit the properties of amaranth, its nutrients, its bioactive ingredients, to create a line of products with functional properties, such as cereal bars, cookies, pancakes, biscuits and candy that can benefit health by helping to lower cholesterol. Only can the seed of amaranth be used, but the blade which, like the seed, has many nutrients and vitamins. This can be used to make drinks for children, soups, juice and more. Also, from the comfort of our homes, we can cultivate amaranth as we grow parsley and coriander, among others. So, in these way, our diet is enriched and healthier because amaranth is one of the best food stuffs of plant origin for human consumption. The problem of high fat intake which mainly comes from eating potato chips, soda, candy, and food scraps would be solved mainly because amaranth can be eaten as like "Alegria" bars, porridge, pancakes, and biscuits, as well as amaranth mixed with chocolate, soups, stews, etc. ..Because it is a plant that has high nutritional content, quality, and high yield and resistance capabilities and since, like most seasonal crops in Mexico, amaranth makes farming a viable option in Mexico with emphasis on highly variable rain fed options and on low or no modern technology. But not only in Mexico, it could be in other countries, such as Guatemala, Peru, Haiti, Cuba, Venezuela, Brazil, land in all of and Latin America because everywhere the need for food exists, as well as exist the problem of malnutrition and obesity. So amaranth could be a beam of hope for all these peoples.

Also, another option could be to incorporate amaranth protein into the industry of snack products, such as cereals and bakery: Barcel, Sabritas, Kellogs, Bimbo, Tia Rosa, Wonder, etc. Which are an extension of traditional markets and specialized mass markets.

Does amaranth provide a way of diversifying the farming business, assuming a competitive advantage in the marketplace? Because the grain or amaranth is a tiny seed whose diameter varies between 0.9mm and 1.7mm and its kernel weight is equivalent to 0.6 g. approximately its handling becomes easier. Its estimated production in the farming areas of Mexico in Tulyehualco, with the transplant system are from 1000 to 2000 kg/ha.

Amaranth is a small and great treasure crop with agricultural and nutritional advantages. Amaranth applications can go farther and farther and are no longer limited solely to the use of seeds or leaves. Other possibilities are artificial colors, flour, drinks, candy and tamales, among others. The introduction of amaranth in rain fed areas could be a lifeline for small holders.

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