

Nutritional functional value and therapeutic utilization of Amaranth

Abstract

Amaranth is a rich nutrient pseudo cereal consumed since long time ago by ancient civilizations as the pre-Hispanic Mexicans who named it *Huautli* or *Xtes*. Today, Amaranth keeps being included in human diet because of its nutraceutical relevance. Amaranth is considered as a “super food” because it counts with high nutraceutical values such as: high-quality protein including several essential amino acids, unsaturated oils as omega-3 and omega-6, dietary fiber, squalene, tocopherols, phenolic compounds, flavonoids, phytates, vitamins and minerals. Amaranth compared to other crops, has higher amounts of protein, dietary fiber, calcium, iron, manganese and magnesium and is resistant to climate changes. This mini review provides information about the composition, antioxidant properties, and potential medical benefits of “Amaranth a new ancient super crop” with relevant and unique nutraceutical values.

Keywords: Amaranth spp, gluten-free, nutraceutical and super foods, therapeutic benefits, super crop

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Introduction

In the actuality, there is an increasing trend to consume healthy/super foods, such as Amaranth: a super crop of this millennium with high nutraceutical values. Amaranth can be considered as a “super food” because it is a gluten-free pseudo cereal that besides being a relevant source of vegetable protein, provides to the human diet, a balanced content of essential amino acids, significant amounts of calcium, dietary fiber, omega-3, omega-6, vitamins, minerals and antioxidants. The aim of this mini review is to provide insights into Amaranth’s health benefits such as helps to improve nutrition and health as it is a powerful vegetable protein source adequate to fight high cholesterol, avoids chronic inflammation, oxidative stress, osteoporosis, gastric problems, bad nutrition due to gluten intolerance, diabetes among others relevant diseases.

Amaranth’s brief history

This pseudo cereal “*Amaranthus* spp.” is commonly called Amaranth, its name comes from the Greek word *Amaranthus* that means eternal flower and it is considered as an important nutritional crop.¹ Amaranth has been included in the human diet since long time ago by the pre-Columbian Mesoamerican among other ancient civilizations.² The Aztecs called Amaranth “Huautli” and the Mayas named it “Xtes”. In the actuality, Mexicans make Amaranth sweets calling them “Alegría” meaning happiness. Now, around the World, Amaranth is being considered as a “super crop” as more evidence comes out demonstrating that is a rich nutrient pseudo cereal as shown herein. Around the 80’s, Amaranth was considered by the U.S. National Academy of Sciences like an “underexploited tropical plant with promising economic value”³ since then, research to know more about Amaranth properties has increased in order to gain insights into its nutritional and agronomic values.⁴ Amaranth can be easily recognized among other crops as each plant has an “immortal colorful

flower” that based in our own experience, contains around 1Kg of seeds as shown in Figure 1.

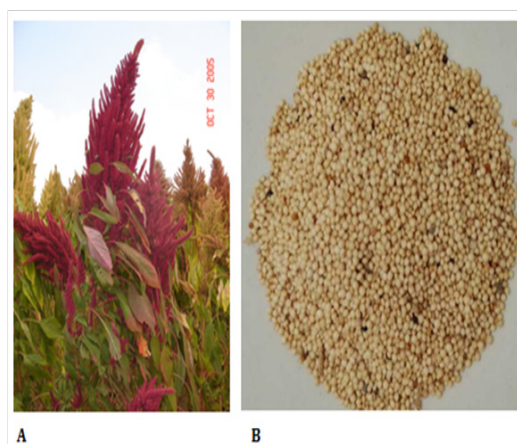


Figure 1 (A) *Amaranthus hypochondriacus* plant and (B) Amaranth seeds.

Nutritional properties: Amaranth is becoming to be a super food as its composition includes high quality of carbohydrates, dietary fiber, lipids as omega-3 and omega-6, essential amino acids and other important constituents, such as squalene, tocopherols, phenolic compounds, flavonoids, phytates, vitamins and minerals.

Amaranth’s nutritional composition: *Amaranthus* spp. belongs to *Amaranthaceae* family and produces a pseudo-cereal grain. Amaranth seeds contain significant amounts of high-quality proteins, lipids, carbohydrates, dietary fiber, vitamins and minerals, as shown in Figure 2 & Table 1.

An important nutritional fact is that besides containing a high amount of protein, Amaranth’s seeds help to have a balanced protein

diet because they provide several amino acids including those considered as essential that need to be taken from the diet (Table 2).⁵

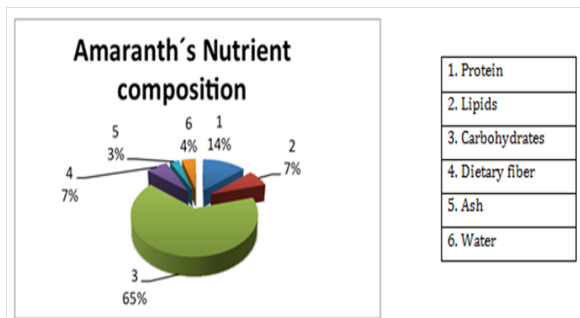


Figure 2 Nutrients composition.

Table 1 Minerals and vitamins of Amaranth seeds⁷

Minerals	Amarantha (g per 100g)
Calcium	159mg
Copper	0.53mg
Iron	7.61mg
Magnesium	248mg
Manganese	3.33mg
Phosphorus	557mg
Potassium	508mg
Sodium	4mg
Zinc	2.87mg
Selenium	18.7 mcg
Vitamins	
Ascorbic acid	4.20mg
Riboflavin	0.20mg
Folate	82mcg
Niacin	0.92mg
Thiamin	0.12mg
Vitamin A	2IU
Pantothenic acid, Vit. B5	1.46mg
Vitamin B-6	0.59mg
Vitamin E (alpha-tocopherol)	1.19mg
Vitamin E (beta-tocopherol)	0.96mg
Vitamin E (delta-tocopherol)	0.69mg
Choline	69.8mg
Betaine	67.6mg
Lutein	28mcg

Another relevant nutritional characteristic that recently makes athletes and persons with food allergies as vegans to consume Amaranth is that is a gluten-free pseudo cereal ideal for persons that born with celiac disease who are allergic to gluten and cannot eat cereals that contain it, also it is perfect for persons non-celiac gluten sensitivity

(NCGS). Amaranth also counts with the presence of unsaturated fats, like linoleic (or omega-6) fatty acid and alpha-linolenic (or omega-3) fatty acid (Table 3) and with several antioxidants⁶⁻¹² as shown in Table 4.

Table 2 Essential amino acid profile of Amaranth seeds⁷

Components	Amaranth (g per 100g)
Arginine	1.06
Histidine	0.39
Isoleucine	0.58
Leucine	0.88
Lysine	0.75
Methionine	0.23
Phenylalanine	0.54
Threonine	0.56
Tryptophan	0.18
Valine	0.68

Table 3 Fatty acid composition of amaranth (*Amaranthus hypochondriacus*) oil in seeds⁷

Component	Amaranth (value per 100g)
Palmitic acid (C16:0)	1.154
Stearic acid (C18:0)	0.223
Oleic acid (C18:1)	1.671
Linoleic acid (C18:2) ω-6	2.736
Linolenic acid (C18:3) ω-3	0.042

It is important to mention that Amaranth's seeds contain more protein than other crops as corn and rice¹³ and contain several essential amino acids as shown in Table 2,⁷ making from Amaranth a pseudo cereal that is a good option to consume.¹⁴ Also there is a high amount of protein in the Amaranth's leaves.¹⁵ In Amaranth's seeds, besides omega-6, omega-3, Oleic, Palmitic and Stearic acids (Table 3),⁸ also other nutraceutical constituents as squalene.¹⁶

Table 4 Phytonutrients in amaranth seeds⁸

Components	Amaranth seed (mcg/g)
Flavonoids (polyphenols)	
Quercetin	68a(18)
Nicotiflorin	6b(6)
Myricetin	-----
Rutin	6.15b(6)
Phenolic acids	
Ferulic acid	310c(9)
Gallic acid	41d(5)
Caffeic acid	6.5c(9)
p-Coumaric acid	1.2c(9)
Chlorogenic acid	-----
Epigallocatechin	-----
Anthocyanins	35.2e(17)

As shown herein through Table 1-4 Amaranth seeds contain in a balanced proportion several relevant nutrients for human diet,

therefore its starch has been used to prepare healthy food.^{17,18}

Amaranth's benefits

High source of protein: The high-quality protein that can be taken when Amaranth's seeds are consumed is important as it provides many of the essential amino acids which are key molecules that build new cells and tissues allowing proper neuronal function, helps immune system and recovery of muscles.¹⁹

Reduce inflammation: The intake of Amaranth could help to avoid diseases caused by inflammation because it has been described that extruded Amaranth protein hydrolyzates prevented inflammation by the activation of bioactive peptides that reduced the expression of several pro-inflammatory markers.²⁰ That is why the consumption of pseudo cereals helps to reduce inflammation.²¹ In this context, it is recommended to include Amaranth seeds in the diet in order to reduce inflammation and may help to prevent chronic diseases derived from inflammation.

Bone health: Calcium is a key player in the generation and maintenance of healthy bones as it supports mineralization.²² Amaranth contains more calcium than other seeds, which makes it a valuable food that helps to have a healthy development of bones helping to prevent osteoporosis.^{23,24} Therefore, the intake of extruded Amaranth products could help to improve the proper intake of calcium²⁵ to support healthier bones.

Lowers cholesterol: It has been proven that Amaranth's oil can reduce total and bad cholesterol (LDL) increasing good cholesterol as tested in animal's models by Berger et al.,²⁶ also it has been proven that Amaranth affects cholesterol metabolism.²⁷

Fights duodenal peptic ulcer: It has been found that duodenal peptic ulcer and chronic gastritis caused by *Helicobacter pylori* can be treated with Amaranth oil.²⁸

Fights diabetes: Another relevant benefit obtained when Amaranth is included in diet is that due to its high amount of manganese it represents a good option for regulating sugar levels in the organism as manganese helps during gluconeogenesis, in this way, when manganese is obtained in a sufficient amount by consuming Amaranth, it is possible to prevent diabetes.²⁹ Also manganese beside regulating blood glucose, it can boost the immune function.³⁰ Also it is known that manganese it is needed in adequate levels to avoid abnormalities in cholesterol levels, skin and bone health, in glucose³¹ and renal health.³² Diabetic mellitus type II patients have shown that glucose absorption is driven at regular intervals when Amaranth starch has been taken^{33,34} and their health heart is better when Amaranth oil is consumed.³⁵

Amaranth is gluten-free

Recently Amaranth has gained more relevance because it is a gluten-free pseudo cereal being an alternative option when cereals such as wheat that do contain gluten cannot be consumed in order to avoid allergies. Amaranth is also an excellent choice when healthier life and better performance are aims to be achieved by athletes, vegans, vegetarians and those persons that had acquired allergies or have celiac disease or problems of intestinal absorption.

Amaranth has become an excellent protein source for persons that are non-celiac gluten sensitivity (NCGS) who acquire gluten intolerance and also for those that born with Celiac disease.³⁶ Persons with Celiac disease cannot eat gluten a protein that is present in various cereals because their have a severe immunological reaction

causing in them problems to absorb nutrients because of a extended damage in their intestinal villi leading to chronic fatigue, diarrheas, poor memory, joint pain among other symptoms.^{37,38}

Helps pregnant women

Intake of Folic acid is suggested especially when women are pregnant in order to avoid spina bifid, heart defects.³⁹ In Amaranth grain is 88.0mcg of folate in (Table 1), which is a nutritional advantage because folate helps in the formation of new cells. Therefore, Amaranth folate⁴⁰ and bioactive peptides could help to decrease the presence of organism defects.⁴¹

Amaranth prevents constipation

Amaranth can contribute to avoid constipation because its starch binds water and also helps that insoluble fiber is present in a higher proportion (around 80%) than soluble fiber.^{42,43}

Amaranth's antioxidants against oxidative stress

Free radicals, although are normally produced in organisms during metabolic processes, can cause toxic effects when are accumulated in an abnormal way causing oxidative stress implicating damage to nucleic acids, lipids and proteins which can induce the appearance of diseases. The negative effects of oxidative stress can be prevented or limited by antioxidants that will protect cells, which capacity as antioxidant systems can be affected by the consumption of rich nutrients foods. In this context, Amaranth is an important weapon that can provide to aerobic organisms protection against oxidative stress as it is an excellent source of antioxidants like polyphenols, ascorbic acid, phenolic acids and tocopherols (Table 4).⁴⁴

Amaranth is a super food that improves good nutrition and health

As reviewed herein, Amaranth supports several biological processes acting as an anti-hypertensive, anti-oxidant, antithrombotic, anti-proliferative among others.^{45,46} Besides being an important vegetable protein with high quality nutrients, Amaranth is a crop that resist climate changes and it is produced at low cost and grows fast even under drastic conditions.¹ Thus, amaranth should be considered as a super crop that is perfect to achieve better nutrition and to avoid chronic inflammation, high cholesterol, bad nutrition due to gluten intolerance, diabetes among others relevant diseases.

Conclusion

Amaranth's seeds are becoming to be more included in the diet of kids, adolescents, adults and older people that suffer bad nutrition/poor diet because of poverty or because they have diseases as anorexia among others where protein must be fulfilled because it is a pseudo cereal that counts with several nutrients in a balanced proportion including dietary fiber, essential amino acids, relevant lipids, antioxidants and high amounts of calcium, manganese and iron. In this context, Amaranth can be considered as a main vegetable protein with high nutraceutical values converting it into a pseudo cereal that easily can compete at a nutritional level with other cereals or healthy foods. Therefore, as revisited herein, Amaranth can be considered as a "super food" as it is a rich nutrient gluten-free pseudo cereal that improves human health.

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None

Conflict of interest

Authors declare that there is no conflict of interest.

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