LEGACY

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Amaranth Update

by Rob Myers, Past-President, Amaranth Institute

I have been involved with amaranth at varying levels for 15 years now. It seems that each passing year brings new discoveries on the potential uses and health benefits of amaranth, and new interest in amaranth for one or more regions of the world. These developments have been positive and encouraging for the future use and success of this crop.

However, in the U.S., while there has been significant progress in amaranth research, there is little momentum with the crop. The U.S. production acreage has fluctated from year-to-year, but generally has been limited to a few thousand acres (less than 2000 hectares). In the short term, success will be dictated by the expansion of amaranth into new markets beyond the "health food" market niche it currently occupies.

Amaranth's current U.S. marketing opportunities are centered around the seed (grain) uses of the crop, even though there is potential for forage or vegetable use in the U.S. My office, the Jefferson Institute, is a non-profit organization (www.jeffersoninstitute.org) working on commercialization of several alternative crops. As part of our activities, we are working to contact mid-sized and larger bakeries to let them know of amaranth nutritional benefits, and the potential for use of this crop in food products. Other individuals have worked in this area from the private sector and made some progress, and perhaps as a non-profit we can facilitate further interest in the crop. We have also worked with a few farmers to develop a modest stored supply of ready-to-market amaranth grain, for use by food companies that show an interest. Our hope is to help create larger demand for this crop.

The two trends that may spur further interest in amaranth are the use of multi-grain products, and the interest in nutraceutical foods. A number of bread, cracker, and cereal makers are marketing multi-grain products. When the blend gets up to 9 or 10 grains, amaranth sometimes shows up in the mix, albeit at very low percentage. The relatively high price of amaranth compared to other grains hinders its use in these multi-grain products. Breeding higher yielding and more reliably performing varieties can make it feasible to sell amaranth at a somewhat lower price, and thus make it more possible for amaranth to be used in multi-grain food products.

The nutraceutical uses of amaranth, where it provides benefits above and beyond basic carbohydrates, proteins, and fats, may be less sensitive to price. Some of these health properties are described by other authors in this newsletter. Further research on these potential health responses to amaranth will be pivotal in establishing larger markets for amaranth.

I remain optimistic about the potential of amaranth to help with nutritional needs in many parts of the world, and hope that other partners and funders will emerge to help develop this promising and fascinating crop.

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Amaranth as a Nutritional Supplement for the Modern Diet

Dr. Danik M. Martirosyan, D&A Inc., Richardson, TX, USA

Amaranth came into use as a grain at least 6000 years ago in Central America. It is naturally resistant to weeds and can grow in poor soil and drought conditions, making it a promising crop in dry areas (including Texas and Arizona). Amaranth was used as a survival food by the Indians and is currently available in health food stores as nutty tasting grain. Amaranth is especially noted for its high concentration of lysine, the amino acid usually found in limited proportions in grains. And because amaranth is gluten-free, it is favored by individuals allergic to wheat and other gluten-containing grains. At this point, amaranth is a promising alternative crop for the modern diet. Ranging in color from purple-black to buff yellow, golden-colored seeds are the ones most often used for food. It is known that amaranth is best when cooked in less than 1:4 to 1:3 proportion with another grain. Usually, this fact limits the potential to use amaranth as a source for microelements and vitamins. It means that we have to use amaranth in combination with other grain.

To create a new formula high in fiber and rich in minerals and vitamins, we provide comparative biochemical analyses of 14 different traditional and non-traditional flours. It was found that the combination of amaranth, sesame and lentils is a good source for calcium (Table 1), iron and phosphorus. The combination of amaranth, sesame and buckwheat is the best source for magnesium. The combination of triticale, buckwheat and amaranth is a good source for vitamin E. Amaranth can be used as a good source for lysine, which is not normally found in plants. lysine has been found to be an excellent herbal cure for herpes, which according to some statistics, 70 % of all the people in the USA have already had it in some form. This problem greatly weakens the immune system. On the basis of this evidence, we created cholesterol-free recipes rich with vitamins (niacin equiv., thiamin), minerals (copper, iron, phosphorus, magnesium) and dietary fibers. In one product "Ancient Grains Pancake Mix", the value of dietary fibers is 10% of the daily value (Nutritional Facts 1). The removal of constipation with the help of the amaranth fiber is an important step against colon diverticulosis, hemorrhoids and colon cancer. The amaranth fiber is an advantageous addition to a gluten-free diet. Nutrition analysis has shown that amaranth is rich in vitamin B-1, copper (8.4%) and iron (6.3%). It is known that amaranth fiber is good for enrichment of a common human diet, and it may be effective for the prevention of serious diseases.

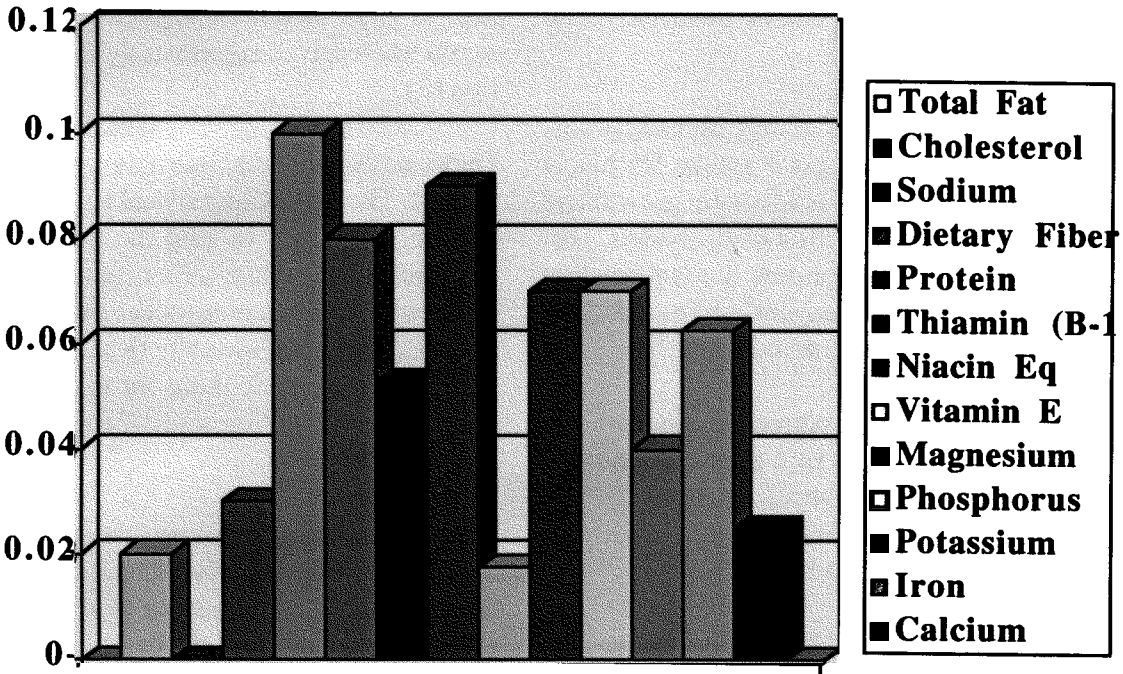
The U.S. Surgeon General has reported that 68% off all disease is diet related. A number of diseases, such as coronary heart disease, diabetes, cancer of the colon and rectum are common in

Amaranth Compared to the Different Grains

Based on 100 gr.

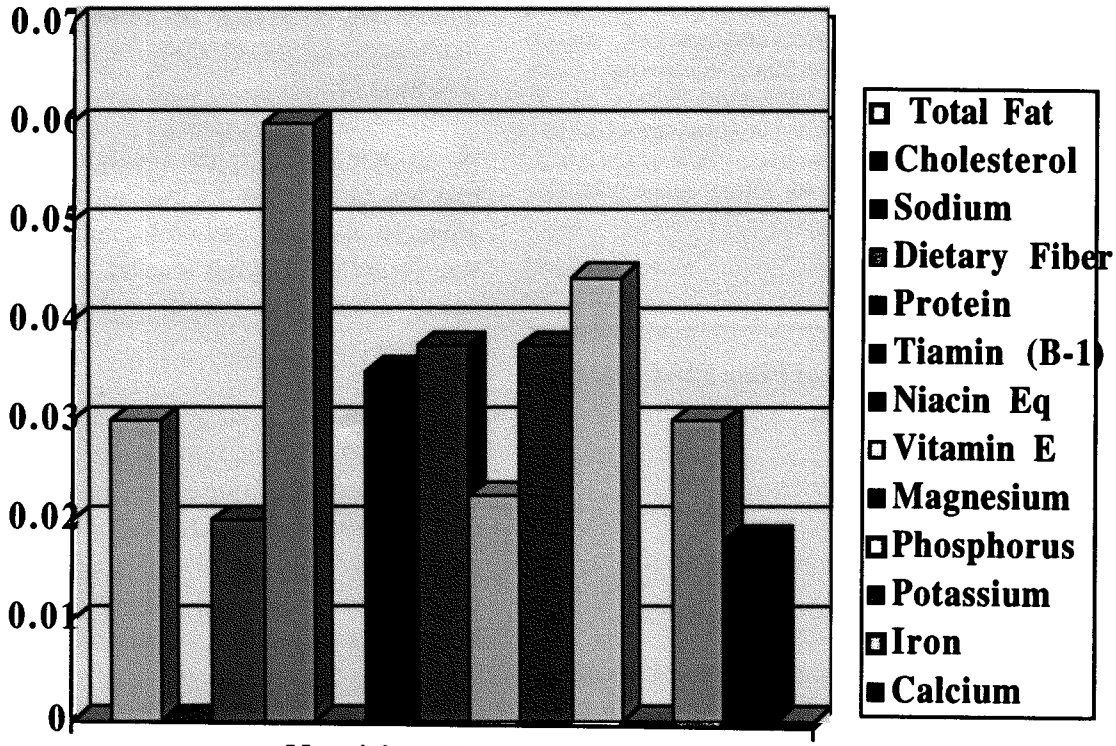
	Protein (g)	Total Lipid (g)	Calcium (mg)	Iron (mg)	Magnesium	Phosphorus	Potassium	Sodium	Vitamin E	Lysine (g)
Amaranth	14.45	6.51	153	7.59	266	455	366	21	1.03	0.75
Barley	9.91	1.16	29	2.5	79	221	280	9	0.13	0.37
Quinoa	13.1	5.8	60	9.2	210	410	740	21		0.73
Corn	6.9	3.87	7	2.39	93	272	315	5	0.25	0.2
Rye	9.39	1.77	24	2.12	75	207	340	3	1.33	
Sesame	50.14	1.75	149	14.22	338	757	397	39		
Rice	5.95	1.4	10	0.35	35	98	76	0	0.13	0.2
Buckwheat	12.62	3.1	41	4.06	251	337	577	11	1.03	
Millet	11.02	4.22	8	3	114	285	195	5	0	0.21
Lupins	36.17	9.74	176	4.36	198	440	1013	15		
Lentils	28.06	0.96	51	9.02	107	454	905	10	0.33	
Triticale	13.18	1.8	35	2.59	153	321	466	2	1.91	
Soy Milk	2.75	1.91	4	0.58	19	49	141	12	0.01	0.179
Wheat	10.33	0.98	15	4.64	22	108	107	2	0.37	0.23

Ancient Grains Pancake Mix



Nutrition Facts No. 1

Ancient Grains Muffin Batter



Nutrition Facts No. 2

Amaranth Product Nutritional Profiles: Above is the nutritional data generated by D&A Inc., of Richardson, TX, on two of their amaranth food products, an amaranth pancake mix and an amaranth muffin mix.

Americans, but are rare in people who live in developing countries. Scientific research studies have considered that this difference can be connected with dietary difference.

According to the evidence of our investigations, amaranth can be used as a good source for niacin (important for sex hormone production, growth and metabolism); lysine (production of antibodies, hormones and enzymes); phosphorus (bone formation and kidney function); and magnesium (blood sugar metabolism, smooth muscle relaxer.)

Amaranth can be used in an organic flour mix that is cholesterol free, low fat, has zero grams of saturated fat and is low in sodium (Nutritional Facts 2). The amaranth provides a beneficial amount of dietary fiber, vitamin E and vitamin B-1.

I believe that amaranth can be used to create new dietetic formulas, and medical products based on amaranth products, such as amaranth flour and amaranth grains.

Editors note: The author of this article, Danik Martirosyan, operates D&A Inc., which formulates amaranth food products inlcuding "Ancient Grain Pancake Mix" (nutrition data - table 1) and "Ancient Grains Muffin Mix" (nutrition data - table 2). His company is also working on use of amaranth leaves as a vegetarian pizza topping. You can contact him at D&A Inc., 580 W. Araphaho Road, Suite 130, 75080, phone: 972-918-0006, e-mail: danikm@juno.com.

A Study on the Silage Use of Plain and Combined Amaranth in Ontogenesis.

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After evaluating the evidence of amaranth's domestication, it has been concluded that amaranth came into use at least 6000 years ago in Central America (1). The oldest seeds found are those of *Amaranth cruentus*. Along with the seeds, amaranth leaves have been used in both human and livestock diets. When the leaves, stem and head are used for forage, the product will range from 15-24% protein (2). In contrast to grain amaranth, vegetable amaranth (green mass) has received significantly less research attention (3).

Opportunities for amaranth as animal forages appear to exist. The main Chinese and Russian use of amaranth is reportedly to feed the forage to hogs and livestock. Chinese researchers have reported 50,000 ha devoted to amaranth fodder production in 1991 (13). Kazan State University (Russia) asked the U.S. Department of Agriculture for technical assistance to plant 9 to 12 million acres of amaranth for animal fodder (14).

The use of amaranth leaves and grain in feedstuffs has been reviewed (4,5,6,7,8,9). Results indicate that the amaranth used for human food should be heated for maximum nutritional benefit, while gains of lambs fed amaranth fodder, were similar to alfalfa (10). For uses of amaranth as livestock feed, you can also see the review by Sanchez (11). While various species of grain and vegetable types can be distinguished, often both the grain and leaves are utilized from individual types for both human and animal food (5;12).

Nevertheless, during the recent centuries, the plant that was famous for it's fruitfulness, high content of albumen and balanced combination of amino acids was forgotten. During the last few decades, shortage of albumen has encouraged new interest in amaranth.

Many scientists in different countries of the world have actively studied amaranth, including ways of planting and utilization for fodder, food, pharmaceutical and other purposes. As a forage plant, amaranth is preferably used in green condition. Terms of preparation, utilization and usage are less studied. In contrast to grain amaranth, vegetable amaranth (green mass) has received significantly less research attention (3).

Ensilage is the most popular way of utilization of amaranth in Russia at the present time. The essence of this process is the preserving of squinted and

shredded greens with lactic acid. Lactic acid is reproduced by lactic acid bacteria in anaerobic conditions. Sugar is a source of nutrition for the bacteria and the amount of it determines siloing ability of the plant. One molecule of sugar produces two molecules of lactic acids during the process of fermentation. Nevertheless, silo contains substances that function as buffer or binding agents such as albumen and amino acids.

Therefore, the index that determines siloing ability of forage plants is a correlation of sugar and protein in a dry product.

The main purpose of our work was to study siloing ability of plain and combined amaranth. As a subject for siloing plain amaranth we chose *Amaranth caudatus*, *Amaranth cruentus*, amaranth cv. K-388, *Amaranth hybridus*, *Amaranth lividus*, *Amaranth mantegazzianus* and Amaranth spinach.

We used plants cut in the stages of budding, blossoming and fruiting. The content of crude protein, oil, ash, carotene, sugar, pH and acids was found by using general methods (15).

We investigated sugar protein correlation in the green mass of different types of amaranth in ontogenesis (Table 1).

Table 1. Sugar-protein correlation in green mass of different types of amaranth in ontogenesis.

Sample	Budding	Blossoming	Fruiting
A. caudatus	0.12	0.24	0.52
A. cruentus	0.18	0.22	0.48
A. cv K-388	0.06	0.12	0.32
A. hybridus	0.30	1.00	0.00
A. lividus	0.15	0.25	0.76
A. mantegazzianus	0.23	0.46	0.73
A. spinach	0.10	0.17	0.33

The results presented in this work demonstrate that the contents of sugar in the process of ontogenesis were increased. The highest sugar content was observed in the fruiting stage.

Scientific data about the influence of the correlation on siloing ability (16) is the following:
0.7 – good siloing
0.5 – 0.7 – fair siloing
under 0.5 – doesn't silo

Our evidence shows that *A. cruentus*, A. spinach and A. cv. K-388 doesn't make good silage because sugar-protein correlation is less than 0.5. *A. caudatus* silos fair (sugar-protein correlation is 0.5 – 0.6), and *A. mantegazzianus* and *A. lividus* silos good (sugar-protein correlation more than 0.7). There is some evidence that also confirms that amaranth is difficult siloing (17).

Medvedev (18) and Butakova (19) showed that it is possible to get a good quality amaranth silo: dry materials – 22,9%, raw protein – 13,1%, raw ash – 12,2%, pH - 4,2-4,6. In the blossoming stage we can silo *A. lividus*. So, we can conclude that the best time for siloing is at fruiting time and the most appropriate types for siloing are *A. hybridus*, *A. lividus* and *A. mantegazzianus*.

A. cruentus is one of most popular types of amaranth in Russia. For that reason we try to find a method for siloing *A. cruentus*. We investigated the chemical composition of *A. cruentus* silage and evaluated amaranth combined with other silage materials.

Factors which affect the intake value include dry matter, crude protein, oil, crude cellulose, biological active matter, raw ash, lactic acid, acetic acid and pH (Table 2).

Table 2. Chemical composition of silage (*A. cruentus*) in ontogenesis.

Index	Budding	Blossoming	Fruiting
Dry Matter	10.9	16.9	21.5
Crude Protein	16.5	13.0	10.7
Oil	4.2	2.90	2.10
Crude Cellulose	20.7	22.0	22.5
Bio. Active Matter	26.7	41.3	43.8
Raw Ash	21.1	13.6	12.0
Lactic Acid	0.166	1.109	1.431
Acetic Acid	1.169	2.404	1.558
pH	4.7-5.3	4.4-4.6	4.3-4.5

Dry Matter (DM) = This is the quantity of material left in a feed after all the water has been removed by drying. Wet silages tend to have DM contents of less than 20%. High DM silages have DM contents greater than 25%. The average DM content of a silage ration is around 35% (20).

Crude protein = This is the term used to describe the total level of nitrogen in a feed. Grass silage normally has a crude protein concentration between 10-16% of the DM. The overall crude protein concentration in a ration will vary between 12-18% of the DM depending on the level of production of the animal (20).

Oil – Levels of oil in a diet tend not to exceed 6% DM. Otherwise milk composition tends to be affected.

pH – This is a measure of the level of acidity within a silage. It will give an indication, in conjunction with the ammonia N content, of the level of preservation within a silage. Most silages have a pH between 3.8-4.2. Silages with a pH less than 3.6 are considered very acidic, while silages that have a pH greater than 4.5 may be poorly preserved (20).

Starch and sugar – Increases in the starch content of a diet will help to increase milk protein concentration. However, too much starch in the diet can cause problems with acidosis. Usual levels of starch and sugar in a total ration vary between 12-22% DM (20).

Lactic acid – This is the main acid produced by natural microorganisms in the grass during the silage fermentation. Well-preserved silages have high concentrations of lactic acid. Silages that have been wilted or treated with formic acid may have lower levels of lactic acid. Poorly preserved silages have low concentrations of lactic acid and higher levels of other acids such as acetic and butyric acid (20).

Ash – Gives an indication of the mineral content of a silage. Normally ash concentrations are less than 10% DM provided that there was no soil contamination of the grass at ensiling.

It was found that during the ontogenesis, the value of dry matter grew until 21.5% in the stage of fruiting. Also, it was shown that biological active matter increased from 26.7 - 43.8% in the process of ontogenesis.

The amount of oil, ash and crude protein have been decreased respectively. The differences between similar crops, such as the various cereal crops, is less than that between very different crops such as cereals compared to legumes (21).
Protein quality comparisons are:
Oats – 9% protein, barley – 10% protein, spring rye – 10% protein, sunflower - 12% protein, field peas – 18% protein, amaranth – 13.4% protein (on average).

The value of pH decreased from pH 5.3 to 4.3, which corresponds with normal pH for silage. The success of the ensiling process is closely associated with the pH of the fermented forage. The formation of acetic and lactic acids as well as the presence of ammonia and amines have some bearing on pH. In general, legume forages such as alfalfa and soybeans that have high buffering capacities are more difficult to ensile than corn and sorghum type forages. Such crops frequently require additives such as acids or carbohydrates for good fermentation to occur. A pH of 3.5 to 4.5 is needed for storing good silage (21). In our experience, the value of pH varied between 4.3 - 4.5 in the fruiting time.

By summarizing the evidence we can say the *A. cruentus* does not work as a silage without additional supplement.

The next step of our experiment was siloing *A. cruentus* with other plants. As a subject for siloing plain amaranth we chose *A. cruentus*. We used plants cut in the periods of budding, blossoming and fruiting. For combined siloing we used:
a) amaranth cut at fruiting period; b) sunflower; c) corn and d) sorghum-sudan hybrid. Correlation of contents –1:1 and 1:1.5. Silage was held in hermetically sealed units (Table 3).

Table 3.

The quality of silo prepared from amaranth commixture with other plants.

Index	Corn + Amaranth (1:1)	Corn + Amaranth (1:1.5)	Sorghum + Amaranth (1:1)	Control Amaranth	Sunflower
Dry Matter (%)	20.1	21.0	21.1	21.5	18.0
Raw Protein (%)	13.0	10.3	12.9	10.7	10.0
Carotene (mg/kg)	7.0	15.0	11.0	5.0	60.0
Raw Ash (%)	9.3	11.8	10.0	12.0	13.0
pH	4.2-4.4	4.3-4.4	4.2-4.4	4.3-4.6	3.9-4.3
Lactic Acid (%)	42.0	52.0	73.0	47.0	50.0
Oil	0.00	0.00	0.00	0.00	0.1

Duration of siloing is five months. Results of the chemical tests have shown that the best siloing of amaranth took place in a unit with amaranth that was cut during the period of fruiting. However, quality of this silo was low. It was predictable because the correlation of sugar and albumen in amaranth was 0.5. Therefore, plain amaranth has low siloing ability. At the same time, combined silo of 1:1 combination of amaranth and other forage plants, provided higher quality. It has comparative and exceeding parameters when compared to top quality sunflower and corn plant silos. The exceeding parameters are: content of the dry substance, amount of lactic acids, crude protein and carotene. Such a quality can be explained. Extra sugar was added to the green substance with other forage plants.

Experimental usage of the combined silo that was conducted in the Volga region, Urals and other regions of Russia displayed that it was well eaten by many kinds of cattle. It has improved their health condition. When a silage was replaced with combined amaranth – corn silage milk yield increased from 11.0 to 11.7 kilograms and fat content increased from 3.7% to 3.8%.

Therefore, we came to the following conclusions:

1) *A. lividus* and *A. mantegazzianus* among amaranth are more appropriate for ensilage;
2) *A. cruentus* (L) is not good silage by itself;
3) *A. cruentus* siloing should be done in combination with other forage plants, such as corn and sorghum;
4) The best time to cut amaranth for ensilage is the fruiting period.

Following this guideline will help you to produce a top quality silo. It can help you to improve health condition of cattle and provide better quality and quantity of dairy products.

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Potential of Amaranth Components in Functional and Nutritional Supplements in the Czech Republic

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Foods containing whole amaranth and special nutritional products containing amaranth provide nutritional substrates that are predictable in reducing disease risk. The main field of interest is prevention of cardiovascular diseases and reduction of plasma cholesterol levels, prevention of colorectal cancer and chemoprevention in industrial regions contaminated by industrial and traffic pollutants.

Amaranth seeds oil and cardiovascular diseases

The fat content in amaranth seeds is high (7-8%), being twice as much as the true cereals. One of the most important constituents is squalene, present with 4-6%, more than four-fold the concentration compared with olive oil (Table 1). It is suggested that the lipid constituents of amaranth seeds may decrease plasma cholesterol levels through activation of liver cholesterol 7 alpha-hydroxylase (enzyme responsible for cholesterol elimination) and HMG CoA reductase (the rate limiting enzyme in cholesterol biosynthesis). New findings clearly indicate that other unknown potent cholesterol synthesis inhibitors are present in amaranth seeds apart from described tocotrienols and squalene (Table 1).

New Amaranth Publication

Arris Sigle, a Kansas farmer with many years of experience growing amaranth, has authored a detailed article complete with photos and data on his experiences with amaranth. His "Cheyenne Gap Amaranth" article is being provided free of charge to amaranth farmers and other individuals. If you did not receive a copy with this newlsetter, but would like a free copy, request it from the Jefferson Institute (phone 573-449-3518 or email cmiller@jeffersoninstitute.org).

	Unit	Olive Value per 100 grams	Amaranth Value per 100 grams
Energy	kcal	884	899
Lipids			
Fatty acids, saturated	g	**13.5**	**23.2**
14:0	g		0.2
16:0	g	11.0	20.0
18:0	g	2.0	3.0
Fatty acids, monosaturated	g	73.7	22.5
16:1	g	0.8	
18:1	g	72.5	25.5
20:1	g	0.3	
Fatty acids, polysaturated	g	**8.4**	**49.8**
18:2	g	7.9	49.5
18:3	g	0.6	0.2
Cholesterol	g	0.0	0.0
Squalene	g	**0.8**	**6.5**
Vitamin E	g	12.0	11.0

Effect of fibers

Amaranth seeds and biomass are rich in soluble and insoluble diet fibers important in prevention of coronary heart disease and in prevention of diseases of the colon. The percentage of soluble and insoluble fibers is different in seeds and leaves and ranges from 12-30%. Research interest is presently focused on biological and preventive value of dietary fibers in terms of fermentation and production of short chain fatty acids and methane.

Bioflavonoids in functional food

Another important component of amaranth biomass is a wide spectrum of flavonoids (rutin) with high antioxidant capacity. Application of amaranth bioflavonoids in the prevention of various human diseases is presently under laboratory and clinical investigation.

Amaranth seed and leaf proteins

Amaranth proteins are in comparison with usual plant proteins rich in essential amino acid lysine. This advantage could be used for fortification and increase of the biological value of common vegetable proteins to replace partial animal proteins in humans and in animal nutrition (Table 2).

Essential Amino Acids g/100g	Amaranth	Wheat	Soya
Lysine	5.95	0.23	2.30
Leucine	4.20	0.71	2.80
Isoleucine	2.71	0.36	1.67
Phenylalanine	4.70	0.52	1.80
Methionine	0.64	0.18	0.45
Threonine	3.25	0.28	1.50
Tryptofane	1.82	0.13	0.50
Valine	3.85	0.42	1.70

Amaranth Farming in Missouri
by James Quinn, Jefferson Institute

During the last three summers (1999-2001), amaranth has been grown commercially on up to five farms in Missouri. The summer of 1999 was a trial year with one acre plantings grown for experience. During 2000, four farmers had acreage ranging from 14 acres to 70 acres, with two farmers growing organically. Some of these farmers grew amaranth again the summer of 2001.

The price for amaranth makes it of interest to the farmers, with conventionally grown amaranth selling for $0.35-0.40 per pound and organically grown amaranth ranging from $0.60 to $0.80 per pound. Farmers are planting amaranth mostly in June, but a couple of fields were planted in July. The biggest challenge of growing it has been weed control, with late season broadleaf weeds such as, waterhemp and morning glory causing the most concern. On the positive side are the low planting costs for seed and moderate fertilizer expenses. Yields have varied greatly, ranging from 200-300 pounds to well-over 1,000 pounds, with the lower yields the result of a poor stand, weed pressure, or post-harvest shattering.

Timing of harvest was critical in 2000. A killing frost created an optimum harvest window for several days. Three of the four farmers completed their harvest in this time, which was fortunate since wet and windy weather resulted in significant shattering thereafter. In contrast for 2001, a hard frost did not occur early, resulting in slow dry down on the plants. Clover screens for a combine have provided the best combine separation of the grain.

The Missouri growers have struggled to find local seed cleaners who could efficiently clean the amaranth seed after harvest. One private cleaner screened out a high percentage of good seed with the foreigh material, leading to unacceptable cleaning losses. The 2001 amaranth crop is being cleaned by Missouri Foundation Seeds.

On a technical note, a stalk rot was noted in both 2000 and 2001. It was positively identified as *Pythium* from samples taken in early and mid crop development. *Pythium* has been previously reported on by Mihal and Champaco in the Canadian Journal of Botany (1992, Vol. 71, pages 1219-1223)- 'Diseases of *Amaranthus* spp. caused by *Pythium aphanidermatum* and *Macrophomina phaseolina*'. The economic damage to the amaranth fields was difficult to determine, but did not appear to be severe. Prolonged periods of excessive soil moisture with warm summer conditions are conducive to infection.

Farmers in Missouri will continue to produce amaranth if more substantial markets can be found. The Jefferson Institute is currently working on expanded amaranth marketing, as noted in the lead story of this newsletter.

New Amaranth Institute President Named
David Brenner, of Iowa State University, has been elected as President of the Amaranth Institute for 2002-03. He will chair the next meeting of the Institute, and continues to oversee the amaranth listserve that allows amaranth questions and information to be shared by email to interested participants. Mr. Brenner is the curator of the Amaranthus germplasm, along with other genera, for the North Central Region Plant Introduction Station, part of the USDA National Plant Germplasm System. He can be contacted at dbrenner@iastate.edu.

Upcoming Amaranth Institute Meeting and Newsletter
The next meeting of the Amaranth Institute will be held during August, 2003 in Ames, Iowa. The meeting will be organized by David Brenner of Iowa State Univeristy (dbrenner@iastate.edu). There will not be an Amaranth Institute meeting during 2002, but information will continue to be shared through the amaranth listserve, maintained by David Brenner, and through the annual Legacy newsletter. Contributions to the 2002 Legacy newsletter should be submitted by October 1, 2002, to Legacy, c/o Jefferson Institute, 601 W. Nifong Blvd., Suite 1D, Columbia, MO, 65203 or emailed to cmiller@jeffersoninstitute.org.

Amaranth Conference
August 16-17, 2001

David Brenner, Amaranth Institute President, particpated in the 2001 Amaranth Conference. Here he is shown in an amaranth field near Columbia, MO.

Conference attendees observed the Jefferson Institute demonstration planting at Bradford Farms in Columbia, MO.

Linus Rothermich discusses his experience growing amaranth during a field tour for the 2001 Amaranth Conference.

During the 2001 Amaranth Conference, participants got the opportunity to ask a panel of amaranth growers questions and inquiries.

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