The Organic Lentil Pulse Crop

Lentil - Behind the Superfood

Lentils (*Lens culinaris* Medik.) are an old-world crop, domesticated 7000 years ago in the Fertile Crescent and widely spread to the Nile, Central Europe, Greece, and South Asia. Lentils are annual, self-pollinating winter legumes with erect plants 6 to 18 inches tall. The plants have two to four pale blue flowers on the leaf axils and have alternate leaves where upper leaves modify tendrils. The two seeds with doubly convex shapes are produced in 1.5 cm long pods, generally inflated and oblong. Based on the seed size, *macrosperma* and *microsperma* are two cultivated subtypes of lentils. *Macrosperma* has large-sized pods and seeds, cultivated primarily in Europe, North Africa, and America, while *microsperma* is small-seeded, mainly grown in Asia, Egypt, and Ethiopia. The Leguminosae family has 800 genera and 20,000 species; among these species, lentil is self-pollinated diploid cool-season legume species with seven chromosome pairs and a relatively large genome of ~4 Gbp. Lentil, or "*poor man's meat*," is low in fat and high in protein, prebiotic carbohydrates, and a range of vitamins and minerals. A 50-g serving provides 3.7-4.5 mg of iron, 2.2-2.7 mg of zinc, and 22-34 µg of selenium and is very low in phytic acid (2.5-4.4 mg/g) and protein inhibitors. Lentil has a short cooking time (10-12 min) with low processing requirements; dehulling only. Biofortification is an approach to enrich seeds with bioavailable micronutrients using plant breeding tools. Mineral biofortification for iron, zinc, and selenium has successfully been adopted into lentil breeding programs worldwide. Lentils are the fourth predominant pulse crop grown globally. Canada, India, the United States of America (USA), Turkey, Australia, Nepal, and Bangladesh are the major countries leading lentil exports. Global lentil production is approximately 6.45 MT from 5.02 Mha.

Behind the Superfood

Lentil is an excellent source of prebiotic carbohydrates that supports a healthy gut microbiome to reduce obesity-related health issues. These prebiotic carbohydrates are crucial to lentil plant health during heat and drought stress. A cup of lentil provides 13-15 g of prebiotic carbohydrates: this amount doubles after cooling and reheating. Lentil provides >80% of the recommended daily requirements of prebiotic carbohydrates, associated with reduced weight gain via modulating the human gut microbiome. A study indicates rats fed a lentil diet had significantly lower mean body weight (443 g/rat) than those provided control (511 g/rat) or corn starch (502 g/rat) diets. Mean percent body fat and plasma triacylglycerol concentration were lower, and lean body mass was higher in rats fed the lentil than the corn diet. The fecal abundance of healthy bacteria, Actinobacteria and Bacteriodetes, increased in rats fed the lentil diet. In contrast, the number of Firmicutes (a bacterial phylum comprised of multiple pathogenic species) decreased in the lentil diet. Therefore, lentil is promising as a plant-based food to reduce obesity-related non-communicable diseases, a rising health concern in the USA. Further, organic lentils are becoming a popular food among the vegan and vegetarian community; however, organic lentil production is minimal in the USA.

Will the Lentil fit Southern Agriculture?

Lentils are best fit in mid-western regions and Washington due to their agronomic adaptability to cooler summers. Lentils in these regions are conventionally grown, and organic production is minimal. Therefore, organic pulse crops represent a new winter cash crop opportunity for southern areas, including South Carolina and North Carlina. Agriculture has been the main driver of the Carolinas' economies since the 1600s. The major field crops for the region included corn, cotton, soybean, peanut, tobacco, and winter wheat. South Carolina (SC) has 25,000 farms totaling 4.9M acres, while North Carolina (NC) has 46,400 farms and 8.4M acres. Increasing crop production costs and decreasing commodity prices mean regional growers are exploring new specialty crop options. Incorporating cool-season food legumes (lentils: *Lens culinaris* Medik.) into existing cropping systems will increase overall crop productivity. Lentils fit best as a winter crop from January to May in the Southern USA. Lentils have adapted to diverse soil types but grow well in sandy loam soils with slightly acidic to mildly alkaline soils with a pH range of 6-8 with high phosphorus soil conditions. Soil temperature up to 40◦F is favorable for lentil planting with an annual rainfall of 75 cm. Lentils can tolerate droughts and frost with freezing temperatures of 21◦F. The seed rate for different lentil varieties varies from 40 to 70 lbs/acre with 1 to 2-inch seed depth. Inoculating lentil seeds with nitrogen-fixing bacteria *Rhizobium leguminosarum* promotes roots' nodulation, leading to biological nitrogen fixation. Based on the variety and growing conditions, lentils can harvest in 80-100 days.

Seed Availability

Lentil market classes are available either as whole seed or dehulled/split. The two most common lentil markets are red and green. Lentil producers can buy seeds vis seed companies such as Meridian Seeds, Pulse USA, and other certified seed sources. For lentil consumers, lentils can be found at most grocery stores. Some recipes may need a particular color of lentil, such as, brown, green, French green, red or black, but all lentils are nutritious. The color can also change with cooking. Lentils do not require pre-soaking before cooking. Lentils are vital in Indian, Sri Lankan, Middle Eastern, and Southern US cooking.

Pests & Diseases

Field pests- aphids, leaf and bud weevils, lygus bugs, cutworms, thrips, pod borers, leaf miners

Storage pests- lentil seed beetle, cowpea seed beetle, and adzuki bean seed beetle

Fungal diseases- ascochyta blight, fusarium wilt, botrytis grey mold, rust, stemphylium blight, anthracnose

Viral diseases-lentil yellow disease, bean yellow mosaic, pea seed-borne mosaic, cucumber mosaic, alfalfa mosaic, broad bean stain viral disease

Organic Requirements

The organic crop production standards outlined by the USDA require the following for a crop to be considered organic:

(1) Land cannot apply ANY prohibited substances for at least three years before the land and crop are considered organic.

(2) Soil fertility and crop nutrients must be managed through organic practices (cultivation, rotation, cover crops, etc.) and only supplemented with organic fertilizers and allowed synthetic materials.

(3) Crop management is primarily through various management practices (physical, chemical, biological controls). Only approved synthetic herbicides and pesticides can be used as a secondary control option.

(4) Seeds must be organic when available. Seed can **only** be treated with approved organic seed treatments and inoculum.

Table 2: Lentil market classes and varieties

	Market Class	Variety
Red Lentils	**Extra Small Red**	CDC Impala
		CDC Imperial
		CDC Rosie
		CDC Roxy
	Small Red	CDC Maxim
		CDC Impulse
		CDC Nimble
		CDC Proclaim
		CDC Simmie
		CDC Dazil
		CDC Imax
		CDC Redberry
		CDC Redcliff
		CDC Scarlet
		CDC Carmine
		CDC Coral
		Crimson
	Large Red	CDC KR-2
		CDC Sublime
Green Lentils	**Small Green**	CDC Imvincible
		CDC Jimini
		CDC Kermit
	Medium Green	CDC Imigreen
		CDC Impress
		Avondale
	Large Green	CDC Lima
		CDC Greenland
		CDC Greenstar
		CDC Impower
		CDC Improve
	French Green	CDC Marble
		CDC Peridot

DR. DIL'S SRI LANKAN LENTIL RECIPE

A delicious & nutritious meal in minutes!

Ingredients:

1 tablespoon olive oil
1 large onion
1 large tomato
1 teaspoon fresh parsley
4 garlic cloves
2-inch piece of ginger
1 cup red lentil (dry)
3 cups water
1 teaspoon each ground cinnamon, curry powder, and chili pepper (add more as desired)
1 cup coconut milk
2 pounds raw spinach or kale
Salt and pepper (for taste)

Preparation & Cooking:

Chop onion, tomato, fresh parsley.

Mince garlic cloves.

Peel and mince ginger.

Rinse raw spinach or kale.

Rinse red lentils, then place them into a wide saucepan.

Add the prepared olive oil, onion, tomato, parsley, garlic, ginger, water, and spices to saucepan with lentils.

Cook for 5 to 10 minutes; until the lentils are tender.

Add the coconut milk and cook for another 5 to 7 minutes.

Add in the fresh spinach or kale and cook until the greens are tender.

Add salt and pepper for taste.

Enjoy with Rice or Naan bread!

Table 1: Nutritional values per 100 g of raw lentil

Nutrient	Lentil
Proximate analysis	
Water (g)	8.3
Energy (kcal)	352
Protein (g)	25
Total lipid (g)	1.1
Carbohydrate (by difference, g)	63
Fiber (g)	11
Sugars (g)	2.0
Minerals (mg)	
Calcium (Ca)	35
Iron (Fe)	6.5
Magnesium (Mg)	47
Phosphorus (P)	281
Potassium (K)	677
Sodium (Na)	6
Zinc (Zn)	3.3
Vitamins	
Vitamin C (mg)	4.5
Thiamin (mg)	0.87
Riboflavin (mg)	0.21
Niacin (mg)	2.61
Vitamin B-6 (mg)	0.54
Folate, DFE (µg)	479
Vitamin A, RAE (µg)	2
Vitamin E (mg)	0.49
Vitamin K (µg)	5.0

Data obtained from the USDA Nutrient Database for Standard Reference (USDA, 2018)

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Resources

USA Dry Pea & Lentil Council:

The USA DPLC was established in 1965 as a non-profit organization to promote dry peas, lentils, and chickpeas in the United States.

https://www.usapulses.org/membership/usadplc

USA Pulses:

Processing Information and Technical Manual, Pulse Industry, Consumers

https://www.usapulses.org/technical-manual/chapter-3-production/lentils

Washington State Crop Improvement Association:

Seed Certification, Foundation Seed, Variety Descriptions and Resources, Buy Certified Seed

https://washingtoncrop.com/

Pulse USA:

Seed Supplier and Find Growers

https://www.pulseusa.com/

North Dakota State University:

Pulse Crop Production Field Guide

https://www.ag.ndsu.edu/publications/crops/pulse-crop-production-field-guide-for-north-dakota

Saskatchewan Pulse Growers:

Growing Pulses, Market Development, Research, Resources

https://saskpulse.com/growing-pulses/lentils/seeding/

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