

Escarole and Endive: Nutritious Leafy Vegetables with High Potential for Floridians¹

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Introduction

Escarole and endive are leafy vegetables consumed fresh and rich in nutrients, including vitamins and minerals, thus offering an option for healthy diets. In the United States, these two leafy vegetables are mostly planted in California, Florida, and New Jersey, with a small percentage distributed across many US states (USDA-NASS 2017) (Table 1). Escarole and endive are highly consumed in European countries, including Spain, Italy, France, Greece, The Netherlands, and Belgium (Lucchin et al. 2008). They are consumed fresh, supplementary to other leafy vegetables, in salads and other dishes.

In Florida, these leafy vegetables are planted in the Everglades Agricultural Area in southern Florida from October to March and harvested throughout that time. Escarole and endive grow as rosettes similar to leaf lettuce (Figures 1 and 2). Both leafy vegetables are available to consumers in the winter months. This publication aims to create awareness of endive and escarole production in Florida; it is designed for consumers, growers, Extension faculty, and students.



Figure 1. Escarole field in the Everglades Agricultural Area in southern Florida cultivated in rich, organic “muck” soils.

Credits: UF/IFAS Lettuce Breeding Program

The Crop

Escarole and endive belong to the most abundant family in the plant kingdom, *Asteraceae* (*Compositae*), in which many cultivated crops are members, including lettuce, artichoke, and sunflower. Escarole and endive are related and belong to the genus, *Cichorium*. While escarole is classified as *C. endivia* var. *latifolium*, endive is classified as *C. endivia* var. *crispum*. Both are confounded with lettuce; although, lettuce (*Lactuca sativa* L.) belongs to the *Lactuca* genus.

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Figure 2. Endive field in the Everglades Agricultural Area in southern Florida cultivated in rich, organic “muck” soils.
Credits: Gustavo Kreutz, UF/IFAS

Types

The industry classifies different cultivar groups based on their final use as fresh or processed products (Lucchin et al. 2008). The majority of these subclassifications are unknown in the US market:

- *C. endivia* subsp. *endivia* var. *latifolium*, also known as escarole, Batavian endive, and broad-leaved endive
- *C. endivia* subsp. *endivia* var. *crispum*, also known as curled endive
- *C. intybus* subsp. *intybus* var. *foliosum* and var. *sativum*, also known as witloof or Belgian endive.

Main Problems in Production of Escarole and Endive

Diseases

Not many pests and diseases commonly attack escarole and endive compared to lettuce. However, fungal, bacterial, and viral diseases have been a concern for the industry. One example is bacterial leaf spot, caused by *Pseudomonas* spp. bacteria (Figure 3). Table 2 lists the most common diseases in these crops (Raid and Sandoya, unpublished material).

There are several control options for these diseases, including disease-resistant cultivars, although less efforts had been spent on improving resistance through breeding. Most diseases listed in Table 2 can be controlled with fungicides from different Mode of Action groups, recommended by the Fungicide Resistance Action Committee (<https://www.frac.info/>). For more chemical control options, consult the most up-to-date Leafy Vegetable Production chapter in

the Vegetable Production Handbook of Florida, published yearly at <https://edis.ifas.ufl.edu/publication/CV293>.



Figure 3. Escarole showing bacterial leaf spot, presumably caused by *Pseudomonas* spp.
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Further information on integrated-pest management and fertilization can be found at <https://edis.ifas.ufl.edu/publication/CV293> and <https://edis.ifas.ufl.edu/publication/CV008>.

Factors Affecting Postharvest Quality

The United States Standards for Grades of Endive, Escarole, or Chicory specifies minimal physical characteristics and tolerances for defects required to label these as “U.S. No. 1” (USDA-AMS 2016). As with other leafy vegetables, escarole and endive are susceptible to several physiological disorders caused by pre- and postharvest stresses (Saltveit 2016). In severe cases of pre-harvest stress, pink rib (pinking) can develop along the midrib, while pink rib and browning can be induced after harvest at the cut-end surface (Figure 4). Hence, care must be taken during harvest and packing to avoid mechanical injuries (cracked leaves and midribs) to minimize development of these disorders (Brecht et al. 2019). Due to their large leaf areas, escarole and endive are very susceptible to moisture loss, which leads to wilting. Leaf yellowing can also cause them to be out-of-grade. Therefore, cooling to 32°F (0°C) within one to two hours of harvest and storing at 95% to 100% relative humidity will provide two to three weeks of shelf life. Vacuum cooling and hydrocooling are the most common commercial methods. Detailed information on cooling methods and procedures is available in Brecht et al. (2019). USDA Grade Standards are available at <https://www.ams.usda.gov/grades-standards/chicory-endive-and-escarole-grades-and-standards>.



Figure 4. Pink rib disorder in packed escarole is evident on the cut-ends and at cracks in the stems (circled).

Credits: Steven Sargent, UF/IFAS

Cultivars Adapted to Florida Conditions

There are several escarole and endive adapted to Florida environmental conditions. These cultivars are listed here:

- Endive: Markant, Salad King, and Full Heart NR 65.
- Escarole: Forbes, Olmos, Sienna, and Twinkle.

Nutritional Value of Escarole and Endive

Escarole and endive are rich sources of dietary fiber and contain, though in lesser amounts, vitamins as well as macro- and micro-minerals. Due to this nutrient abundance, escarole and endive are popular among consumers. Both leafy vegetables have shown to possess anti-diabetic, antioxidant, and anti-inflammatory properties (Al-Snafi 2016).

An abundant dietary fiber in escarole and endive is the prebiotic fiber, inulin (Shoab et al. 2016). In one serving (1 ounce; 25 g) of endive leaves, inulin can provide up to 0.6 g of fiber, or 2% of one's daily value for fiber as recommended by the U.S. Food and Drug Administration (FDA) (Marlett and Cheung 1997; Testone et al. 2021; FDA 2022). Meanwhile, escarole leaves provide up to 0.4 g of inulin per serving (Marlett and Cheung 1997; Jurgonski et al. 2011) (Table 3). Studies have shown that feeding diabetic mice with escarole extract reduces blood glucose levels (Pushparaj et al. 2007; Muthusamy et al. 2008; Azay-Milhau et al. 2013). Similarly, in another study, feeding endive leaves to diabetic mice helped mitigate liver-related symptoms that are characteristic of diabetes (Kamel et al. 2011). Inulin has been shown to promote the growth of beneficial gut microorganisms, or probiotics, and to have anti-diabetic

activity (Li et al. 2019; Zou et al. 2021); high levels of inulin in escarole and endive may contribute to their anti-diabetic properties.

Escarole and endive accumulate several vitamins that have health-benefit activities including antioxidant properties. Endive leaves can provide over 3 mg of vitamin C per serving, or over 3% of the FDA-recommended daily value for vitamin C (Aisa et al. 2020; FDA 2022), while escarole leaves provide over 1 mg of vitamin C per serving. Both leafy vegetables can also serve as sources of vitamin A and several B vitamins: B1, B2, B3, and B9 (Aisa et al. 2020) (Table 3).

Escarole and endive retain a variety of macro- and micro-minerals. In their leaves, potassium and calcium are the most abundant minerals, while sodium is one of the least (Mentel et al. 2015; Perović et al. 2021). One serving of either escarole or endive leaves can provide over 1% of the FDA-recommended daily value for potassium and calcium while providing less than 1% of the FDA-recommended daily value for sodium (Mentel et al. 2015; Perović et al. 2021; FDA 2022) (Table 4). Due to their marginal sodium content, escarole and endive are suitable foods for low-sodium diets. They are also good sources of phosphorous and magnesium and retain a moderate amount of iron. Both leafy vegetables can provide over 1% of the daily value for iron per serving (Mentel et al. 2015; Perović et al. 2021; FDA 2022) (Table 4).

In addition to dietary fiber, vitamins, and macro- and micro-minerals, escarole and endive accumulate phenolic compounds such as chicoric acid, caftaric acid, chlorogenic acid derivatives, and kaempferol and quercetin derivatives (Degl'Innocenti et al. 2008; Lee and Scagel 2013; Mascherpa et al. 2012). These phenolic compounds are known to have health-beneficial properties, including antioxidant activity (Llorach et al. 2008; Degl'Innocenti et al. 2008; Dalar and Konczak 2014).

Concluding Remarks

- Escarole and endive are found in grocery stores throughout the United States at any time of the year.
- Both leafy vegetables may be mistaken for lettuce.
- There are various recipes to consume these leafy vegetables raw or cooked.
- Their use is not limited to direct consumption. The roots of these leafy vegetables can be used as a substitute for coffee.

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Table 1. Acres of escarole and endive cultivated in the United States.

States	Acres	Percentage
California	1,569	65
Florida	358	15
New Jersey	284	12
Rest of States	221	8
United States	2,432	100

Source: USDA-NASS (2017)

Table 2. Some of the diseases reported to be problematic in the cultivation of escarole and endive.

Organism	Common name	Type
<i>Alternaria</i> spp.	Alternaria leaf spot	Fungus
<i>Sclerotinia rolfsii</i>	Sclerotium stem blight	Fungus
<i>Rhizoctonia solani</i>	Bottom rot	Fungus
<i>Erysiphe chicocerum</i>	Powdery mildew	Fungus
<i>Fusarium oxysporum</i> f. sp. <i>cichorii</i>	Fusarium wilt	Fungus
<i>Botritis cynerea</i>	Gray mold	Fungus
<i>Sclerotinia</i> spp.	White mold	Fungus
<i>Bremia lactucae</i>	Lettuce downy mildew	Oomycete
<i>Pseudomonas cichorii</i>	Bacterial leaf spot	Bacteria
<i>Pectobacterium caratovrum</i>	Bacterial soft rot	Bacteria
Lettuce mosaic virus	Lettuce mosaic	Virus
Impatiens necrotic spot virus	Impatiens necrotic spot	Virus
Tomato spotted wilt virus	Tomato spotted wilt	Virus

Table 3. Escarole and endive contents of inulin (grams/serving); vitamins C, B1, B2, and B3 (milligrams/serving); vitamin A (IU/serving); and vitamin B9 (micrograms/serving). One serving size is equivalent to 25 grams (0.9 ounces) of escarole or endive or 57 grams (2 ounces) of iceberg lettuce. Percentage represents the contribution of one serving of inulin and vitamins to the FDA-recommended daily value for fiber and the respective vitamins.

Crop	Inulin g (%)	Vitamin C mg (%)	Vitamin A IU (%)	Vitamin B1 mg (%)	Vitamin B2 mg (%)	Vitamin B3 mg (%)	Vitamin B9 µg (%)
Escarole	0.4 (1.4)	1.6 (1.8)	542 (18)	0.02 (1.7)	0.02 (1.5)	0.1 (0.6)	35.5 (8.9)
Endive	0.6 (2.1)	3.3 (3.7)	542 (18)	0.02 (1.7)	0.02 (1.5)	0.1 (0.6)	35.5 (8.9)
Lettuce (Iceberg)	NA	1.6 (1.8)	286 (9.5)	0.02 (1.7)	0.01 (0.8)	0.07 (0.4)	16.5 (4.1)

Source: Standard Reference Legacy data in FoodData Central from USDA (n.d.) and Aisa et al. (2020)

Table 4. Contribution of escarole and endive to several macro- and micro-minerals to the FDA daily recommended value (DRV). One serving size is equivalent to 25 grams (0.9 ounces) and to 57 grams (2 ounces) of iceberg lettuce. Minerals are reported as milligrams per serving, and percentage represents the contribution for the respective minerals to the DRV.

Crop	Potassium mg (%)	Calcium mg (%)	Sodium mg (%)	Phosphorous mg (%)	Magnesium mg (%)	Iron mg (%)
Escarole	80 (1.7)	13 (1)	6 (0.26)	7 (0.6)	3.8 (0.9)	0.21 (1.2)
Endive	79 (1.68)	13 (1)	5.5 (0.24)	7 (0.6)	3.8 (0.9)	0.21 (1.2)
Lettuce (Iceberg)	80 (1.7)	10 (0.8)	5.7 (0.25)	11 (0.9)	4 (0.95)	0.23 (1.3)

Source: Standard Reference Legacy data and Branded Foods data in FoodData Central from USDA (n.d.) and Aisa et al. (2020)