HS1489
https://doi.org/10.32473/edis-HS1489-2024

Escarole and Endive: Nutritious Leafy Vegetables with High Potential for Floridians[1]

Germán Sandoya, Makou Lin, Jeongim Kim, and Steven Sargent[2]

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.

1. This document is HS1489, one of a series of the Department of Horticultural Sciences, UF/IFAS Extension. Original publication date October 2024. Visit the EDIS website at https://edis.ifas.ufl.edu for the currently supported version of this publication.

2. Germán Sandoya, associate professor, Department of Horticultural Sciences, UF/IFAS Everglades Research and Education Center; Makou Lin; graduate assistant; Jeongim Kim, associate professor; and Steven Sargent, professor, Department of Horticultural Sciences; UF/IFAS Extension, Gainesville, FL 32611.

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. e*ndivia* 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.
Credits: Gustavo Kreutz UF/IFAS

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.

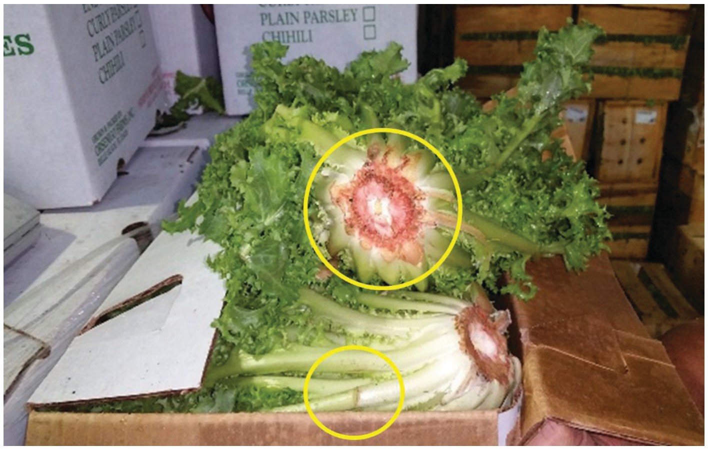

Figure 4. Pink rib disorder in packed escarole is evident on the cut-ends and at cracks in the stems (circled).
Credits: Steven Sargent, UF/IFAS

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 (Shoaib 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'Innoocenti 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'Innoocenti 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.

References

Aisa, H. A., X. Xin, and D. Tang. 2020. “Chemical Constituents and Their Pharmacological Activities of Plants from *Cichorium* Genus.” *Chinese Herbal Medicines* 12 (3): 224–236. https://doi.org/10.1016/j.chmed.2020.05.001

Al-Snafi, D. A. E. 2016. “Medical Importance of *Cichorium intybus* — A Review.” *IOSR – Journal of Pharmacy* 6 (3): 41–56. https://www.iosrphr.org/papers/v6i3/E0634156.pdf

Azay-Milhau, J., K. Ferrare, J. Leroy, J. Aubaterre, M. Tournier, A. -D. Lajoix, and D. Tousch. 2013. “Antihyperglycemic Effect of a Natural Chicoric Acid Extract of Chicory (*Cichorium intybus* L.): A Comparative In Vitro Study with the Effects of Caffeic and Ferulic Acids.” *Journal of Ethnopharmacology* 150 (2): 755–760. https://doi.org/10.1016/j.jep.2013.09.046

Brecht, J. K., S. A. Sargent, P. E. Brecht, J. Saenz, and L. Rodowick. 2019. “Protecting Perishable Foods during Transport by Truck and Rail: HS1328, 4/2019.” *EDIS* 2019 (2). https://doi.org/10.32473/edis-hs1328-2019

Dalar, A., and I. Konczak. 2014. “*Cichorium intybus* from Eastern Anatolia: Phenolic Composition, Antioxidant and Enzyme Inhibitory Activities.” *Industrial Crops and Products* 60: 79–85. https://doi.org/10.1016/j.indcrop.2014.05.043

Degl’Innoocenti, E., A. Pardossi, M. Tattini, and L. Guidi. 2008. “Phenolic Compounds and Antioxidant Power in Minimally Processed Salad.” *Journal of Food Biochemistry* 32: 642–653. https://doi.org/10.1111/j.1745-4514.2008.00188.x

Jurgonski, A., J. Milala, J. Juskiewicz, Z. Zdunczyk, and B. Król. 2011. “Composition of Chicory Root, Peel, Seed and Leaf Ethanol Extracts and Biological Properties of Their Non-Inulin Fractions.” *Food Technology and Biotechnology* 49 (1): 40–47. Retrieved from https://login.lp.hscl.ufl.edu/login?url=https://www.proquest.com/scholarly-journals/composition-chicory-root-peel-seed-leaf-ethanol/docview/928761536/se-2

Kamel, Z. H., I. Daw, and M. Marzouk. 2011. “Effect of *Cichorium endivia* Leaves on Some Biochemical Parameters in Streptozotocin-Induced Diabetic Rats.” *Australian Journal of Basic and Applied Sciences* 5: 387–396.

Lee, J., and C. F. Scagel. 2013. “Chicoric Acid: Chemistry, Distribution, and Production.” *Frontiers in Chemistry* 1. https://doi.org/10.3389/fchem.2013.00040

Li, K., L. Zhang, J. Xue, X. Yang, X. Dong, L. Sha, H. Lei, et al. 2019. “Dietary inulin alleviates diverse stages of type 2 diabetes mellitus via anti-inflammation and modulating gut microbiota in db/db mice.” *Food & Function* 10: 1915–1927. https://doi.org/10.1039/C8FO02265H

Llorach, R., A. Martínez-Sánchez, F. A. Tomás-Barberán, M. I. Gil, and F. Ferreres. 2008. “Characterisation of Polyphenols and Antioxidant Properties of Five Lettuce Varieties and Escarole.” *Food Chemistry* 108 (3): 1028–1038. https://doi.org/10.1016/j.foodchem.2007.11.032

Lucchin, M., S. Varotto, and G. Barcaccia. 2008. “Chicory and Endive.” In *Vegetables I: Asteraceae, Brassicaccea, Chenopodiaceae, and Cucurbitaceae*, edited by J. Prohens-Tomas, and F. Nuez. Springer.

Marlett, J. A., and T. F. Cheung. 1997. “Database and Quick Methods of Assessing Typical Dietary Fiber Intakes using Data for 228 Commonly Consumed Foods.” *Journal of the American Dietetic Association* 97 (10): 1139–1151. https://doi.org/10.1016/S0002-8223(97)00275-7

Mascherpa, D., C. Carazzone, G. Marrubini, G. Gazzani, and A. Papetti. 2012. “Identification of Phenolic Constituents in *Cichorium endivia* var. *Crispum* and var. *Latifolium* Salads by High-Performance Liquid Chromatography with Diode Array Detection and Electrospray Ioniziation Tandem Mass Spectrometry.” *Journal of Agricultural and Food Chemistry* 60 (49): 12142–12150. https://doi.org/10.1021/jf3034754

Mentel, I., E. Cieślik, and A. Sadowska-Rociek. 2015. “Healthy Properties of Endive (*Cichorium endivia* l.) Depending on the Variety and Vegetative of Season.” *Journal of Microbiology, Biotechnology and Food Sciences* 4 (3): 118–121. https://doi.org/10.15414/jmbfs.2015.4.special3.118-121

Muthusamy, V. S., S. Anand, K. N. Sangeetha, S. Sujatha, B. Arun, and B. S. Lakshmi. 2008. “Tannins present in *Cichorium intybus* enhance glucose uptake and inhibit adipogenesis in 3T3-L1 adipocytes through PTP1B inhibition.” *Chemico-Biological Interactions* 174 (1): 69–78. https://doi.org/10.1016/j.cbi.2008.04.016

Perović, J., V. Tumbas Šaponjac, J. Kojić, J. Krulj, D. A. Moreno, C. García-Viguera, M. Bodroža-Solarov, and N. Ilić, N. 2021. “Chicory (*Cichorium intybus* L.) as a Food Ingredient — Nutritional Composition, Bioactivity, Safety, and Health Claims: A Review.” *Food Chemistry* 336: 127676. https://doi.org/10.1016/j.foodchem.2020.127676

Pushparaj, P. N., H. K. Low, J. Manikandan, B. K. H. Tan, and C. H. Tan. 2007. “Anti-Diabetic Effects of *Cichorium intybus* in Streptozotocin-Induced Diabetic Rats.” *Journal of Ethnopharmacology* 111 (2): 430–434. https://doi.org/10.1016/j.jep.2006.11.028

Saltveit, M. 2016. “Endive and Escarole.” In *The Commercial Storage of Fruits, Vegetables, and Florist & Nursery Stocks*, edited by K. Gross, C. Y. Wang, and M. Saltveit. Agriculture Handbook 66. USDA-ARS. https://www.ars.usda.gov/is/np/CommercialStorage/CommercialStorage.pdf

Shoaib, M., A. Shehzad, M. Omar, A. Rakha, H. Raza, H. R. Sharif, A. Shakeel, A. Ansari, and S. Niazi. 2016. “Inulin: Properties, Health Benefits and Food Applications.” *Carbohydrate Polymers* 147: 444–454. https://doi.org/10.1016/j.carbpol.2016.04.020

Testone, G., A. P. Sobolev, G. Mele, C. Nicolodi, M. Gonnella, G. Arnesi, T. Biancari, and D. Giannino. 2021. “Leaf nutrient content and transcriptomic analyses of endive (*Cichorium endivia*) stressed by downpour-induced waterlog reveal a gene network regulating kestose and inulin contents.” *Horticulture Research* 8: 92. https://doi.org/10.1038/s41438-021-00513-2

US Department of Agriculture National Agricultural Statistics Service (USDA-NASS). 2017. *Census of Agriculture, United States Summary and State Data.*https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_1_US/usv1.pdf

US Department of Agriculture (USDA) FoodData Central. n.d. “Standard Reference Legacy Data and Branded Foods Data.” Accessed July 16, 2023. https://fdc.nal.usda.gov/index.html

US Department of Agriculture-Agricultural Marketing Service (USDA-AMS). 2016. “Chicory, Endive and Escarole Grades and Standards.” https://www.ams.usda.gov/sites/default/files/media/EndiveEscaroleChicoryStandard.pdf

US Food and Drug Administration (FDA). 2022. “Daily Value on the New Nutrition and Supplement Facts Labels.” Accessed July 16, 2023. https://www.fda.gov/food/new-nutrition-facts-label/daily-value-new-nutrition-and-supplement-facts-labels

Zou, J., L. Reddivari, Z. Shi, S. Li, Y. Wang, A. Bretin, V. L. Ngo, M. Flythe, M. Pellizzon, B. Chassaing, and A. T. Gewirtz. 2021. “Inulin fermentable fiber ameliorates Type I diabetes via IL22 and short-chain fatty acids in experimental models.” *Cellular and Molecular Gastroenterology and Hepatology* 12 (3): 983–1000. https://doi.org/10.1016/j.jcmgh.2021.04.014

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
Alternaria spp.	Alternaria leaf spot	Fungus
Sclerotinia rolfsii	Sclerotium stem blight	Fungus
Rhizoctonia solani	Bottom rot	Fungus
Erysiphe chicocerum	Powdery mildew	Fungus
Fusarium oxysporum f. sp. *cichorii*	Fusarium wilt	Fungus
Botritis cynerea	Gray mold	Fungus
Sclerotinia spp.	White mold	Fungus
Bremia lactucae	Lettuce downy mildew	Oomycete
Pseudomonas cichorii	Bacterial leaf spot	Bacteria
Pectobacterium caratovrum	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)						