

A good story behind the food we eat ...
Where the rare citrus grows

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Mr. President, Mr. Secretary, and fellow members ... I am honored to “Finally” be making my second presentation this evening. My sincerest apologies for standing you up last November and my appreciations for your understanding due a family matter. Sadly, that family matter eventually led to the passing of my father this past month. This paper is in his honor.

As some may recall, I wrote a food column published in the Kentucky New Era. In organizing files on my computer early last year, I came across a folder with all my columns. Like perusing through old photo albums that generate memories, each column was connected to a story ... a cooking adventure of yester-year involving family or friends. My monthly column titled ... “*Tales of the Weekend Kitchen Warrior ...*” defined my times in the kitchen as being bold, fearless and undeterred in what can be accomplished when heat is applied to food, regardless of the source of heat or ingredients involved ... to take journeys, be adventurous, and always explore something new and different. To be honest, my food is more about stories than the food itself.

My Mother’s Day column published in May 2017, “*Lemons and mom’s make everything brighter and better*” was one of my favorites. It showcased an ingredient often misunderstood ... much like our mothers. It may be a stretch ... and an odd comparison to compare moms with this bright yellow citrus fruit ... But, we know how moms can occasionally give us a sour face, fussing at what we are doing OR when we don’t want to hear what they have to say ... even though we know they are likely right. Moms are there for us making every day a little brighter and better.

Long before I made this contrasting comparison with the citrus fruit, Shakespeare provocatively references oranges in his often troubling comedy *Much Ado About Nothing*. Claudio is misled by Don John into believing that his Hero has been unfaithful. In a fit of anger, he sends her back to her father calling her a rotten orange: “There, Leonato, take her back again. / Give not this rotten orange to your friend” (IV.i.29-30). Earlier

in the play, witty Beatrice likens Claudio himself to an orange in lines that foreshadow Claudio's jealous rage. She calls him "civil as an orange, and something of that jealous complexion" because, like the "Seville" orange referenced in her pun on "civil" he can be sweet or sour, loving or jealous (II.i.287).

Lemons leave a sour note on its own but when used as an ingredient, an added garnishment, it makes a profound tasty statement on our taste buds.

***NOTE:** if you are not using lemons regularly as a culinary ingredient, you are missing out on your dish being elevated to mouth-watering pleasure.]*

Our tongue can play odd tricks in the mind with the lemon. How can something so sour on its own bring a new dimension to a dish or help quench the thirst on a hot day? Squirting lemon juice on steamed vegetables, fish, chicken, stir fry, etc. is like turning up the volume of your favorite song.

Salt ramps up flavors as well, but something about the acidic nature of lemons as well as limes, oranges, and grapefruits, make a dish's essence zing without guilt. Many professional chefs we've spoken to over the years agree citric acid has boldness that heightens the taste receptors.

NOTE: Acidic taste receptors leads to an increase in salivation, literally making food more mouth-watering. The presence of saliva on your tongue is necessary for your taste buds, and your brain, to perceive flavor.

That affinity in the human taste receptors has made citrus production the highest-value fruit crop in terms of international trade. Oranges account for the majority of citrus production but the industry also sees significant quantities of grapefruits, pomeloes, lemons, and limes.

A few days after rereading the column, I came across a New York Times story about a unique destination for top chefs in France ... an orchard featuring over 1100 citrus varieties grown in an area of just 13 hectares ... about 32 acres. Cultivations are from over 50 countries. It comprises the world's most diverse mandarin orange collection with over 300 varieties. Who would have thought of so many Mandarin oranges?

There are ... Corsican citrons, makrut limes, Meyer lemons, Timor pomelos, Okitsu Satsuma mandarins, bergamot oranges, Clanor sweet oranges, clementines, Page mandarins, Samuyao papedas, Clemendor

mandarins, Star Ruby grapefruits, Chinotto sour oranges, variegated lemons, variegated sour oranges, Fukushu kumquats, Buddha's hand citrons, Hong Kong kumquats, Brown River finger limes, caviar limes ... and the list goes on and on.

I was drooling just thinking about the spectrum of flavors of these obscure citrus fruits ... thinking about the taste that could be incorporated into a dish. In specialty groceries in larger markets, I have come across a selection of fruits quite unique compared what you find in regional markets ... but this was a bit mesmerizing.

This citrus grove is located on the eastern coastal hillsides of Corsica in the region of **San Giuliano (JuLeeAnNo)** and is referred as the place "Where the rare citrus grows," the title of this paper.

Corsica is the 4th largest island in the Mediterranean and has been part of France since 1768, though retains a distinct Italian culture. The warmer summers and winters make for an ideal climate to grow citrus. Located 105 miles south off the coast of France and 56 miles west off the coast of Italy, the island makes for unique isolation which plays a significant role in the foundation of this grove. The Mediterranean Island is free of naturally transmitted European and exotic Citrus diseases.

Misc. notes: 114 x 56 miles = 3368 sq. miles / Corsica Bouillabaisse famous dish noted / Napoleon was born on Corsica

What was equally intriguing of learning of this special grove was the fact it is not open to the public nor does it compete with commercial growers. The Grove was founded and funded by the French government with its existence being strictly for purposes of research. There are though a few allowed patrons ... mostly scientist and horticulturalist, but also a select group of premier French chefs who are allowed to visit returning home with a bag of some of the rarest citrus treasures in the world.

Founded in 1958, the **Citrus Biological Resource Center** is run jointly by the French National Research Institute for Agriculture, Food and the Environment (acronym - INRAE) and the French Agricultural Research Center for International Development (acronym - CIRAD). The center is formerly referred to as the INRAE-CIRAD Conservatory. For purposes of the presentation, I will refer to it as simply the conservatory or the Citrus

Biological Resource Center. The initial objective of the conservatory was to gather citrus varieties to promote the development of citriculture in Corsica. The focus was to select the most adapted varieties and rootstocks for the local environment.

Corsica is home to many commercial groves producing a variety of citrus fruits, though is probably most noted for its clementine. In fact, the Corsican clementine is the only clementine grown commercially in France.

And ... for a side note story and a little historical background on the clementine within the citrus family tree ... the clementine comes from a natural cross between the tangerine flower and the pollen of the orange tree. In 1892, it was in Algeria, that botanist Louis Charles Trabut observed the first hybrid plants in the nursery of a monk named ... but who else ... Clément. He christened the fruit in his honor and devoted an article to its discovery in 1902. And with that, the clementine was launched! The first traces of the clementine in Corsica date from 1925 that were planted on the eastern coast.

Through the years the research at the center expanded to include studying greater varieties of citrus, begin selective cross pollination, and to learn more about the origins of citrus.

Between 1959 and 1964, introductions were focused on citrus from Northern Africa, specifically germplasms from Morocco and Algeria.

SIDE NOTE: [Germplasms is part of the germ cell with the hereditary DNA. For those of us here who may not have performed as well in the biology arena at school, Germplasm are the living genetic resources such as seeds or tissues that are maintained for the purpose of breeding, preservation and other research uses.]

Beginning in 1981, introductions of cultivars were performed using the seeds from a number of worldwide citrus producing countries in the Americas, Asia, Africa and Australia. Great care is taken to avoid introducing pests and microorganisms responsible for diseases transmissible by grafting. There is a lengthy quarantine process in specialized greenhouses that takes between seven to ten years before a tree is actually planted in the grove.

What could be the most unusual tree in the orchard is likely several hundred years old but was not introduced to the grove until 1997. It appeared in northern Corsica in the late 1600s. The tree bore both acidic lemons and sweet oranges. The tree, which grew in a secluded hilltop

village, went unnoticed for centuries, alternating between the two fruits like a soft-serve ice cream dispenser. A single branch might yield not only oranges and lemons but also fruits that are part lemon, part orange. It was some 300 years later when an amateur pomologist (a person who studies and cultivates fruit) discovered the tree. He traced its age using records from a local monastery, then alerted the leading rare-citrus authority at the Citrus Biological Resource Center in San Giuliano. The conservatory has been home to that lemon-orange tree since 1997. The staff refers to as a graft chimera (**Ki mer ra**), the botanical equivalent of the mythical lion-headed, serpent-tailed goat.

Since 1999 no citrus cultivars have been introduced from outside the European Union. The research still has enormous impact on a regional, national and global scale. Citrus genetic resources like the center on Corsica are the cornerstone of citrus research, cultivation and breeding programs. Citrus production is one of the major fruit sectors worldwide, with well over 100 million tons produced each year on the five continents. Researchers consider the conservatory “an open-air library” with work ranging from genomics to participatory breeding of new Citrus varieties. Scientists work in the center’s laboratory, studying citrus-specific diseases and the effects of climate change in addition to the genus’s genetic history. Besides breeding hardier and more intriguing new fruit, the researchers also test commercial applications for existing ones, whether in cocktails, pharmaceuticals or perfume. If a variety is found to meet commercial parameters, it is nearly a 20 year span before it is available in the market.

Stakeholders are throughout the Mediterranean and the global tropical supply chains. The aim of this conservatory is to preserve genetic material and distribute it under the right sanitary conditions.

Many countries, including the United States, China, Brazil and Japan, maintain citrus collections and research facilities. France’s is among the largest and most beautiful. The collection represents an abundant resource for researchers in their studies throughout the world.

Most in this room have an affinity toward the history aspects of a topic, so the question is ... When and where did the citrus tree line begin? The answer can’t be made in mere minutes but through a lifetime of study though I will share an overview synopsis.

Just within the last decade research undertaken at the conservatory in collaboration with Spanish and American teams has provided a better understanding of the genetic origins of citrus fruit.

In 2018, there was an entirely new look at the evolution of Citrus. An international study involving the Citrus Biological Resource Center in San Giuliano (**JuLeeAnNo**), was published in the journal *Nature*. The findings revolutionized the botanical classifications of citrus fruits. The work revealed ten true Citrus species, four of which are behind modern cultivated varieties of today such as oranges, mandarins, grapefruits, pummelos, citrons, lemons and limes. The information began to pave the way for new varietal breeding strategies which are amongst the most widely grown worldwide.

Those ten species are the result of some eight million years of evolution, during which scientists now recognize two major phases of evolutionary diversification. The first occurred in Asia at the end of the Miocene period, between six and eight million years ago, and the second in Australia at the start of the Pliocene period, around four million years ago. The theory suggests the first phase may be linked to a dramatic reduction in monsoons in Asia at the time, and led to a separation into eight branches, including four ancestral species from which cultivated Citrus varieties originated. The second phase resulted in three Australian lime species.

The main modern Citrus groups trace their origins to four ancestral species of the ten true species corresponding to mandarins, pummelos, citrons and a papaya known as biasong in the southern Philippines, where it originated.

NOTE: Latin names are *C. reticulata*, *C. maxima*, *C. medica* and *C. micrantha*

Through natural hybridization, these four ancestral species resulted in most cultivated varieties of today including oranges, grapefruits, lemons and limes.

Certain groups, such as sour oranges, rough lemons and Mexican limes are the result of direct hybridization between these four ancestral species. Others, such as lemons, sweet oranges and grapefruits, resulted from more complex evolutions. Lemon, for instance, is a hybrid between a sour orange and a citron; grapefruit is a hybrid between a pummelo and a sweet

orange. Sweet oranges research shows a more complex structure resulting from a mixture of two ancestral species, mandarins and pummelos.

NOTE: Their exact origin not yet clear from the study.

The various species of Citrus are all believed to be native to the subtropical and tropical regions of Asia and spread from there to other sections of the world.

Note: Citrus has been cultivated through the ages, and in some pretty remote places including Malay Archipelago (**ar·kuh·peh·luh·gow**), Citrus has been cultivated through the ages, and in some pretty remote places.

The history of the spread of citrus reads like a romance novel. There is a rich background from the natural world that began 6 to 8 million years ago. Though the heritage branches did not really begin to expand exponentially until just a few thousand years ago when trade routes began to occur. In the early days of commercial exchange, man came into contact with these citrus varieties which then began to cross-pollinate.

The appearance of both the beautiful tree and fruit attracted the attention of travelers and received mention in their written narratives.

Around 310 B.C. the first member of the citrus family was introduced to Europe ... likely a citron and lemon. For several hundred years this was the only citrus fruit known. A mosaic tile floor found in a Roman villa near Tusculum indicates lemons and limes were becoming known in Italy. Until the first century AD, the only citrus produce available to the ancient Romans were the extremely rare and inordinately expensive citrons and lemons.

Though there are no direct references to citrus in the Bible given there is no word for "citrus" in ancient Greek or Hebrew dialect, scholars note written instructions for religious ceremonies in which the fruit mentioned appears to fit the category we know as citrus.

Described in the Bible as early as 200 B.C., **etrog** is commonly referred to as **peri eitz hadar**, literally translated to a 'fruit of the beautiful tree.' Historians believe the 'fruit of a beautiful tree' would be this citrus fruit as mentioned in Leviticus (**luh·vi·tuh·kuhs**) 23:40 ... "And you shall take on the 1st day the fruit of beautiful trees, branches of palm trees and boughs of leafy trees and willows of the brook, and you shall rejoice before the Lord your God 7 days!"

Etrog is generally grouped under the larger classification of citron which is a varied part of the citrus family tree line.

NOTE: citron is unlike the more common citrus species we are familiar with today. The main content of a citron fruit is the thick white rind which cannot be separated from the segments easily. The citron's pulp is dry, containing a small quantity of juice, if any.

Citron was used for fragrance or zest of its rind incorporated into ceremonial activities or for medicinal purposes.

Another mosaic found in Rome dated about 330 A.D. for Constantine the Great, indicates in Italy, oranges and lemons were being grown.

Citrons and lemons were the first citrus fruits to arrive in the Mediterranean and were status symbols for the elite. All other citrus fruits most probably spread more than a millennium later for economic reasons.

Citrus only gained in popularity throughout Europe as the Medieval ages waned. Nobility looked upon fresh fruits and vegetables as too dirty to touch, only to be eaten by the lower classes and the poor. Amazing how perceptual status of the citrus fruit has oscillated ... from not being lavished by the nobles during medieval times to a sign of wealth in the early 20th Century.

We won't call out any names, but there may be members of this group who remember during their youth that getting your hands on a freshly picked ripened orange was both a rarity and a treat unless you lived in Florida or California. If someone splurged and placed an orange inside your Christmas stocking, you considered such a gift ... quite a luxury.

Not until around 1400 is there increased evidence of goods traffic along Central European and long-distance trade routes involving these exotic fruits. From the 16th century on, citrus were transported across the Alps to the North in increasing numbers. In central Europe, the valuable plants developed into important mobile elements of decoration in the French formal gardens in summer. In Germany it was only in the 17th century that citrus fruits increasingly contributed to the table decoration. By the end of the 18th century centerpieces known as plat de ménage appear, providing vinegar, oil and spices for the meal. The crowning center of each centerpiece was a basket filled with what else? ... Fresh citrus fruit.

In the US, the citrus industry began rapidly developing in 1821 when the Spanish gave up their territories and its many orange groves to the United States. It was nearly sixty years later in the 1880's before major shipments of oranges, grapefruit, limes, and lemons were sent to Philadelphia and New York by railway and ships.

The estimates of today's global citrus production are estimated to be 100 million metric tons. Oranges account for half of the production followed by tangerines/mandarins, lemons/limes, and grapefruit. China is the largest producer followed by Brazil and the European Union. The United States is the fifth largest producer.

Though as large as the citrus global market is, its shrinking ... and not entirely due to demand. Production is less than one-third of what it was 20 years ago. Citrus area is down by nearly 40 percent.

A disease first described in 1929 and then first reported in China in 1943 became known today as Citrus Greening (**Note:** Latin name is *Candidatus Liberibacter asiaticus*). Or as the Chinese call it ... yellow dragon disease [Huanglongbing (HLB)] It is one of the most serious citrus plant diseases in the world. Once a tree is infected, there is no cure. While the disease poses no threat to humans or animals, it has devastated millions of acres of citrus crops throughout the world. The Florida orange production alone dropped by half in the decade since citrus greening was first detected in the state in 2005, and it has cost the industry billions of dollars and thousands of jobs.

It is spread by an Asian citrus plant louse (psyllid - **si-lid** - *Diaphorina citri* Kuwayama or ACP) that jumps from tree to tree to suck the sap. Bacteria is introduced blocking the sap channels choking off the flow of nutrients. The leaves turn yellow, the fruit is deformed, the juice is bitter, and eventually the tree dies within a few years. For reasons not quite clear, in the mid-2000s, the disease began spreading at a phenomenal speed putting the future of citrus at risk all over the world.

A question we shudder to ponder is ... Could we soon be forced to do without a glass of orange juice or a slice of grapefruit at breakfast? Given the devastation of citrus over the last couple of decades, the answer is unfortunately a maybe if not a yes.

Countries around the world are trying different methods to combat the spread of citrus greening disease. Studying the bacteria directly has proven to be difficult because it cannot be cultivated in the laboratory. Pesticides are being used where allowed with results but obvious negative side-effects. Uprooting sick trees and replanting is an expensive proposition. A type of small wasp that attacks the lice has also been released.

The only citrus producing region as yet unaffected by citrus greening disease is the Mediterranean area but it can't remain untouched forever. After decimating orange groves in United States and trees in Brazil, citrus greening disease now threatens the key producing region of the Mediterranean, according to researchers. One species of the insect which spreads the disease has already been found on the Arabian Peninsula. Should lice carrying the virulent strain of citrus greening disease arrive in the Mediterranean region, experts expect it to spread rapidly, as it will be difficult to use pesticides extensively.

Just over one fifth of the oranges, clementines and lemons consumed in the world come from the Mediterranean region, according to the trade magazine FruitTrop.

While there is 'No miracle solution', there could be hope. In February 2021 geneticists at University California Riverside announced they had discovered a possible solution. There is a peptide found in the Australian finger lime — a fruit resistant to citrus greening. Finger limes are an oddball in the citrus world; related to but not in the same immediate family as the various hybrids creating the common citrus fruits of the day.

When the peptide is injected into sick trees, research indicates some promising results. The study shows the peptide treatment kills the bacteria causing citrus greening by triggering a citrus tree's immune response to fight the infection better.

Testing indicated trees treated with this peptide had dramatically reduced amounts of the bacteria with one tree showing no detectable bacteria. Untreated trees, in contrast, grew sicker and eventually died.

So, the answer to the question, "Could we soon be forced to do without a glass of orange juice or a slice of grapefruit at breakfast," let's hope not.

Through the work of citrus researchers around the world in conjunction with the abundant resources provided by the Citrus Biological Resource Center, our joy of citrus fruits will hopefully continue to fancy our taste buds and senses for generations. In its unique isolated environment free (for the most part) of naturally transmitted exotic Citrus quarantine diseases, the conservatory's scientists engineer new varieties and preserve early iterations of forgotten and near-extinct fruits. It is because of the conservatory's work that many citrus trees at pedigreed French farms, as well as around the world can be traced back to buds and seeds from the San Giuliano's orchard. It has also become a pilgrimage site for French chefs which was the story that generated the interest this Athenaeum paper.

I am not sure culinary dishes are built around stories or vice versa or if they're so intertwined ... it doesn't matter. Regardless ... there is generally a good story behind the food we eat. No doubt my future use of citric fruits in my cooking will link back to what I have learned in preparing for this presentation. Professional chefs across the world want to know the stories behind their dishes. Building a good story around a dish showcases the inspiration behind its creation which entices the mind before tantalizing the senses. Because of the Citrus Biological Center in San Giuliano (JuLeeAnNo), Corsica, citrus fruit has a storied history from its humble beginnings millions of years ago. From being cherished for its medicinal and religious values to being detested by the noble during medieval times, to being a luxury gift at a holiday ... the citrus fruit has traveled the status symbol spectrum. Its cross cultivations between four of the ten original citrus tree lines have become quite the romantic drama that continues to play out as noted by French chef Pierre Sang Boyer, who runs three popular namesake restaurants in Paris.

"You might think you know a fruit, but at San Giuliano you learn it has a history — and you learn how nature works. The citrus conservatory serves as a corrective of sorts, a place where chefs can be inspired by the wildness of an entire genus, where a familiar yellow lemon grows beside its ancestors, the sour orange and the citron, but also its baroque cousins, like the blood lemon, marked by vivid red streaks on its rind, and the Beldi lemon, an aromatic Moroccan variety with hints of bergamot — all of which are descendants of a few distinct Southeast Asian citrus trees."

Where the Rare Citrus Grows in San Giuliano, Corsica one citrus tree met another ... and the Zest is history. 😊

Post comment: Given my father was an avid story teller who played a huge role with my love of food, cooking, taking journeys, be adventurous, and always explore something new and different, this paper was presented in his honor.

END

SOURCES

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