



Grapefruit and Pummelo for Southern Arizona

Glenn C. Wright

*Because at some more flexible period he had advanced from oranges to grapefruit
he considered himself an epicure.*

Sinclair Lewis, 'Main Street' 1920

Introduction

Grapefruit (*Citrus × aurantium* L. var. *racemosa* (Risso) ined.) formerly (*Citrus x paradisi*) (Fig. 1) is a fruit that can cause great disagreements. Many people believe that the fruit is excessively bitter, thick-peeled and/or difficult to eat, while many others enjoy the bracing flavor of the fruit, either fresh or juiced, as an essential part of a winter morning's breakfast. Pummelos (*Citrus maxima* (Burm.) Merr.) are relatively unknown in the United States but are widely available in East Asian countries. Pummelos are slowly increasing in popularity due to returning travelers, East Asian immigrants and adventurous "foodies" who are willing to give them a try.

Because of their shape and size, pummelos are often confused with grapefruit, because grapefruit is a pummelo hybrid and because there are also several cultivars of "grapefruit" that are instead hybrids between pummelo and grapefruit or pummelo and mandarin that still do resemble grapefruit. In this publication, the term "pummelo hybrid" refers to fruits with pummelo and either mandarin or grapefruit parentage, not to the grapefruit itself. Both pummelos and pummelo hybrids have a distinct flavor that is often sweeter than a grapefruit. Whether you prefer grapefruit, pummelos or pummelo hybrids, selecting the proper cultivar (a "cultivar" is a cultivated variety) is essential.

Pummelos are one of the five progenitor citrus species, along with kumquat, *Citrus micrantha* (a small wild citrus from the Philippines), citron and mandarin. These five likely originated from a common ancestor found as a fossil in Yunnan, China.¹ There are many pummelo cultivars, but most are found only in their East Asian countries of origin, only a few are available in the United States.

Grapefruit is relatively genetically unstable, resulting in spontaneous mutations, which have led to the colored grapefruit we enjoy today. Like pummelo, only a few grapefruit cultivars are available at a local retail nursery. Descriptions of the most commonly available grapefruit, pummelo and pummelo hybrid cultivars available from retail nurseries in Arizona (plus a few extra of interest to the author) and their characteristics are found below. These descriptions are specific for the Arizona desert and may be slightly different than those found in other publications. Primary harvest periods for the grapefruit and pummelo cultivars mentioned are found in Table 2.

Grapefruit

Grapefruit is a hybrid of pummelo and sweet orange². It is unknown if grapefruit was purposely hybridized by a farmer or if it arose as a result of natural hybridization. The exact origin of the fruit is also unknown, but it is most likely either Barbados or Jamaica³. The Reverend Griffith Hughes reported a grapefruit-like fruit in Barbados as early as 1750, known as the "forbidden fruit" or a "smaller shaddock"⁴ (See the origin of the term "shaddock" in the pummelo section below). In 1814, the "smaller shaddock" was called "grapefruit" in a reference describing the plant life of Jamaica⁵. Even the

origin of the term "grapefruit" is shrouded in mystery. A reference from 1824 describes the fruit as growing in clusters like grapes⁶. However, grapefruit does not taste anything like a grape, leading some to believe that it was named after the sea grape (*Coccoloba uvifera*), a plant native to the Caribbean⁷.

White Grapefruit

Only two white grapefruit cultivars are commonly grown, the 'Duncan' and the 'Marsh'. Other cultivars of

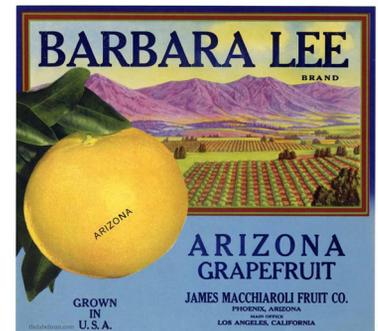


Figure 1. Early 1900's grapefruit crate label from Arizona.

white grapefruit-like fruit, such as the 'Oroblanco' and the 'Melogold' are hybrids of pummelo and grapefruit and are described in the subsequent section.

White grapefruit are actually yellow, due to the accumulation of carotenoids, especially xanthophylls.

Duncan

'Duncan' (Fig. 2) may have appeared as early as 1809, as a seedling introduced by Count Odette Phillipe to Safety Harbor Florida. These seeds came from either Cuba, Jamaica or the Bahamas⁸, and Phillipe gave many to his neighbors. One of the seedling trees ended up in Dunedin, Florida where it was propagated and named by A.L. Duncan in 1892⁹. 'Duncan' trees are large, vigorous and spreading. This cultivar is reportedly more cold-hardy than the 'Marsh'. Fruit is round, light yellow and holds well on the tree. The rind is medium-thick. The flesh is pale yellow, and has high acidity and sugars, giving a balanced, rich flavor; probably better than 'Marsh'. Thirty to 50 seeds can be found in a fruit, which limit its acceptability in the market as a fresh fruit, but it is still used for juice processing. Fruits are ready to eat in late November but will sweeten and are best in February when the acidity is lower^{10,11}.

Marsh

'Marsh' (Fig. 3) originated before 1862 as a root sprout or seedling in Lakeland, Florida. It was distributed and named by C.M. Marsh a nurseryman in the area. This is the white grapefruit historically grown in Arizona. Tree size, shape and vigor are similar to 'Duncan', but 'Marsh' is less frost tolerant. Superior fruit characteristics make 'Marsh' more popular than 'Duncan'. Fruit have 3 to 8 seeds and are slightly smaller than 'Duncan'. 'Marsh' fruit are later ripening and hold longer on the tree than 'Duncan'. Fruit have a light-yellow exterior color with a light-yellow interior. The peel is slightly thicker than that of 'Duncan'. The flesh is tender and juicy; and the flavor is sweet, but with higher acidity than 'Duncan'¹².

Colored Grapefruit

Colored grapefruit are pink- and red-fleshed and originated as mutations from either the 'Duncan' or the 'Marsh'. 'Duncan' gave rise to the 'Foster' grapefruit while 'Marsh' gave rise to the 'Thompson' ('Pink Marsh') grapefruit, both early pink-fleshed cultivars. Colored cultivars exhibit two different pigments. As with white grapefruit, carotenoids are responsible for the yellow color of the peel. But colored grapefruit also contains β -carotene and lycopene, both also carotenoids, which lead to the pink and red interior and exterior color.¹³

Redblush (Ruby Red)

Redblush' (Fig. 4) appeared as a spontaneous bud mutation of 'Thompson', in 1931 in McAllen, Texas. 'Ruby Red' was another mutation from 'Thompson' that appeared in McAllen in 1929¹⁴. Both have darker coloration



Figure 2. Duncan grapefruit.



Figure 3. 'Marsh' grapefruit.



Figure 4. 'Redblush' grapefruit.

compared to 'Thompson' but otherwise are so similar to be indistinguishable. For this publication, they are considered to be the same. Until the recent appearance of 'Flame' and 'Rio Red', 'Redblush' was the most commonly grown colored grapefruit in Arizona and the U.S. In Arizona, 'Redblush' is the more commonly used name for this cultivar.

Trees of 'Redblush' are vigorous, large and productive. Fruit is medium-sized and round, generally pale yellow, with a slight pink tinge. The peel is medium-thickness with a smooth surface. Interior color is pink, especially near to the peel, but the color fades from pink to buff as winter progresses to spring. Flesh is tender and juicy, with a flavor similar to 'Thompson' and 'Marsh'. Fruit has one to three seeds. Fruit holds on the tree well into the spring, as does 'Marsh'.¹⁵

Rio Red

'Rio Red' (Fig. 5) appeared as a bud sport from a red grapefruit that descended from 'Ruby Red' in 1976. It was released from Texas A&I University (now Texas A&M – Kingsville) in 1988¹⁶. Trees of this cultivar are large, vigorous, and productive. Fruit is medium sized, with an attractive pink blush, which can be deeper where the peel is shaded by a leaf or where two fruits grow against each other. Fruit are medium sized and round, but occasionally also slightly pear-shaped when the tree is young (this is known as "sheepnose"), and slightly flattened (oblate) when the tree is mature. The peel is of medium thickness and can be slightly pebbly. The flesh is tender and juicy with an intense red color, especially near the peel and the segment membranes. The flesh color does not fade. Flavor is a good balance of sweetness and acidity. Fruit can hold on the tree without becoming insipid until late May or early June. This is the most commonly planted commercial cultivar in Arizona, California and Texas and is the cultivar most likely to be found in an Arizona supermarket.

Flame

Flame (Fig. 6) originated from seed collected in 1973 from a mutation of 'Ruby Red' found near Houston, Texas. It was released by the USDA in 1987¹⁷. Trees of 'Flame' are large, vigorous, and productive. Fruit is medium-sized, but a bit smaller than 'Rio Red'. Compared with 'Rio Red', the fruit of 'Flame' has a thinner, smoother peel that is more yellow, but still with some pink blush. The flesh is tender and juicy, with a more intense red color than 'Rio Red' that is evenly distributed. Flavor is a good balance of sweetness and acidity. Fruit holds on the tree similar to 'Rio Red' but the flesh will fade slightly as the season progresses.

Star Ruby

Star Ruby (Fig. 7) was developed by irradiating seed of the seedy, but intensely red colored 'Hudson' grapefruit, which itself is a bud mutation of the 'Foster' (See the subsequent publication [Mandarins for Southern Arizona](#) for an explanation of irradiation – a common practice in



Figure 5. 'Rio Red' grapefruit.



Figure 6. 'Flame' grapefruit



Figure 7. 'Star Ruby' Grapefruit.

citrus breeding, especially for mandarins). ‘Star Ruby’ was released by Texas A&I University in 1970¹⁹. In the desert, ‘Star Ruby’ is not the easiest cultivar to grow. Trees are smaller and less vigorous than the other grapefruit cultivars. ‘Star Ruby’ is susceptible to Phytophthora root rot, nutrient deficiencies, and frosts. Nevertheless, the fruit quality characteristics make this cultivar attractive. Fruits are slightly smaller than ‘Rio Red’ or ‘Flame’, with a smooth, yellow peel and a pinkish-red exterior blush. The peel is thin. The flesh is more darkly pigmented than any other red-fleshed grapefruit, and the fruit is juicy and tender with one to three seeds. The author believes that ‘Star Ruby’ is the sweetest of all the grapefruit cultivars mentioned here. Fruit mature at the same time as ‘Rio Red’ and hold on the tree into late spring.

Pummelos and Pummelo Hybrids

As one of the five progenitor species of citrus, the exact origin of the pummelo is unknown, but is probably southern China or northern Southeast Asia. Countries in this region lead the world in the production of pummelo. From Southeast Asia, it is likely that the pummelo spread to Polynesia, as the fruit is commonly cultivated in Fiji, Tahiti and other island nations. From Southeast Asia, the pummelo was also carried westward. Pummelos were reportedly grown in Palestine and Spain before 1200 C.E.²⁰, and they were well-known in Europe in the 1650’s. Pummelo seeds were likely brought to Barbados in the 1600’s²¹ by an English sea captain named Phillip Chaddock²², and for that reason, the fruit is sometimes known as a “Shaddock”.

While pummelos have many characteristics that are similar to grapefruit, there are also many differences as shown in Table 1.²³

Pummelos

Chandler (Red)

While there are many colored pummelos, ‘Chandler’ also marketed as ‘Red’ is the only one commonly available for planting in Arizona (Fig. 8). This cultivar is a product of the cross of two other pummelos made by the citrus breeding program at the University of California, Riverside, and was released in 1961.²⁴ Trees are large and vigorous, but also with drooping branches. Fruits are round and their weight ranges from 1 to 2 ½ pounds each. The peel color is yellow with an occasional pink blush. The rind is smooth and thick and adheres tightly to the flesh. Flesh color is pink to red, due to lycopene, and flavor is sweet with some acidity – less acid than a grapefruit. The flesh is juicy but also slightly coarse. Chandler can be quite seedy if cross-pollinated with other citrus cultivars with viable pollen. If left too long on the tree, or fertilized with too much nitrogen, ‘Chandler’ is prone to granulation.

Sarawak

The origin of ‘Sarawak’ pummelo, (Fig. 9) is unclear, but it is thought that it developed in Tahiti from seeds imported from Sarawak (a region of Malaysia located on the island of Borneo). Budwood of ‘Sarawak’ was received in California in 1955. At this time, there are no citrus nurseries in Arizona that carry this pummelo, but the author hopes that because of this publication, it will soon be made available.

Table 1. Characteristics of Pummelos and Grapefruit

	Pummelo	Grapefruit
Seeds	Monoembryonic – one seedling per seed	Polyembryonic – more than one seedling can emerge from a seed.
Twigs and leaves	Pubescent	Smooth
Petioles	Very broadly winged	Broadly winged
Fruit size	Large to Very Large, borne singly	Medium to Large, borne in clusters
Fruit shape	Round, obovate or pear shaped	Round, oblate or obovate shaped
Rind	Thick to very thick and spongy	Thin to medium thick, not as spongy
Segments	Often more than 12, not uniform width	Seldom more than 12, fairly uniform width
Core	Hollow or solid	Hollow or solid
Flesh	Most often firm	Tender and melting
Flavor	Variable, depending on variety	Generally similar across all varieties



Figure 8. 'Chandler' pummelo.



Figure 9. 'Sarawak' pummelo

Trees of 'Sarawak' are medium-sized but with drooping branches. Fruits are borne in clusters, as with a grapefruit, and are usually smaller than a typical pummelo, but still larger than a grapefruit. 'Sarawak' fruits are round with a slightly flattened bottom and a greenish-yellow rind. The rind is thicker than a grapefruit, but still thinner than a typical pummelo. 'Sarawak' pummelos have at least 20 seeds. The flesh is greenish-yellow and highly juicy. Flavor at maturity is sweet, and slightly tart that reminds the eater of melons or limes. 'Sarawak' pummelos do not seem to be subject to granulation.

Pummelo Hybrids

Oroblanco

'Oroblanco' (Fig. 10) is a hybrid of a normal diploid (2N – two sets of chromosomes) acidless grapefruit with a tetraploid (4N – four sets of chromosomes) seedy grapefruit made in 1958 at the University of California, Riverside and released in 1980. Because of its parents, 'Oroblanco' has three sets of chromosomes and as a result is always completely seedless, even when pollinated by other cultivars.²⁵ Trees are

large, vigorous and spreading. Fruit are borne singly and in clusters and appear similar to a white grapefruit except that they are slightly larger and oblate (flattened), rather than round. Fruit hold well on the tree. The peel color is greenish-yellow at maturity, and the rind is thicker than a grapefruit, but not as thick as a typical pummelo. The flesh is pale yellow. The flavor of 'Oroblanco' is distinctly sweeter than a 'Marsh' grapefruit with a higher sugar content and lower acid levels. In Israel, this cultivar is marketed as a "Sweetie", and in the United States it is often a replacement for a white grapefruit in the supermarket where it is labeled "Oroblanco grapefruit".

Melogold

"Melogold" (Fig. 11) is a product of the same cross as 'Oroblanco'.²⁶ It differs from 'Oroblanco' in that the fruit is much more pummelo-like. The fruit is about 25% larger, with a milder flavor, but with similar color inside and out.

Cocktail

'Cocktail' (Fig. 12) is a hybrid of a 'Siamese Sweet' pummelo and a 'Frua' mandarin. The cross was made at the University of



Figure 10. 'Oroblanco' pummelo hybrid.

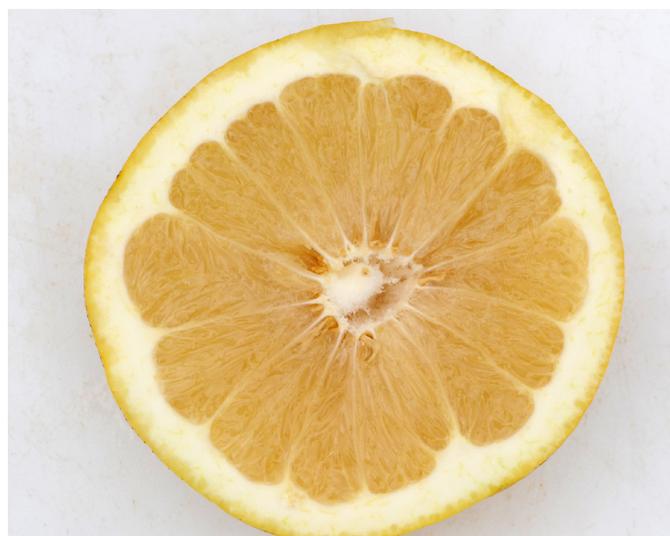


Figure 11. Melogold pummelo hybrid.

California, Riverside sometime in the 1950's, but the cultivar was never officially released. Somehow it "escaped" into the public sector²⁷. Trees are large and vigorous. 'Cocktail' fruit are about the size of a grapefruit with a dark yellow, thin peel. The interior is yellow orange and there are many seeds. Fruit is juicy and sweet with almost no acidity whatsoever. It is this lack of acidity that makes the flavor unique and popular among those who do not like acidic citrus fruit. 'Cocktail' fruit matures early in the winter but does not hold long in the desert.

Valentine

This unique pummelo hybrid (Fig. 13) is a 1950's cross made at the University of California, Riverside of a 'Siamese Sweet' pummelo and an unnamed tangelo that itself is a hybrid of a 'Ruby' blood orange and a 'Dancy' mandarin. The cultivar was released in 1997.²⁸ It was named 'Valentine' because at Riverside, it attains maximum color about February 15th and when cut lengthwise and turned upside down, it resembles a valentine. In Arizona, the author has just a few trees and how it performs in the desert is not well-characterized. Trees appear to be moderately vigorous. Fruit size is small for a pummelo, but larger than the typical grapefruit. Fruits are seedy and quite sweet with a low level of acid. 'Valentine' fruit appear to be edible in December, but coloration occurs beginning in January, as might be expected considering its blood orange parentage. 'Valentine' fruit are subject to granulation, especially when the tree is young.

Special Considerations for Growing Grapefruit and Pummelo in Arizona

Information on how to grow citrus in Arizona, including irrigation, fertilization, propagation, frost protection common citrus problems, diseases and insects can be found using the search engine at <https://extension.arizona.edu/pubs>. However, there are certain horticultural considerations that if noted, will make growing a grapefruit or pummelo tree more successful.

Rootstocks

All grapefruit and pummelo trees are grown on a rootstock. A rootstock is another citrus cultivar that the grapefruit or pummelo tree is budded to in the nursery. Rootstocks generally improves growth, fruit quality or disease resistance of the tree. If you look carefully at the trunk, you will often see an area where the bark changes texture or where the trunk increases in circumference. Below that area is the rootstock and above it is the grapefruit or pummelo tree. Choosing the proper rootstock is vital when growing grapefruit or pummelo in the desert, but it is often difficult to know which one is used. Sometimes the rootstock name is found on a tag tied to the branch or wrapped around the trunk. Occasionally it is found on a sticker on the pot. The best rootstocks for grapefruit and pummelo in Arizona (in no particular order) are as follows: Sour orange, Smooth Flat Seville, Carrizo Citrange and C-35 Citrange. Flying



Figure 12. 'Cocktail' pummelo hybrid.



Figure 13. 'Valentine' pummelo hybrid.

Dragon (a dwarfing rootstock) and Trifoliate orange seem to be more suitable in heavy clay or silt soil, rather than in sandy or gravelly soils unless amended with organic matter. High soil and water pH, common to Arizona, lead to nutrient deficiencies for trees budded to Flying Dragon and trifoliate orange. The author has seen grapefruit trees budded to Volkameriana rootstock which will produce a large tree with heavy yield of acceptable fruit. The author does not recommend purchasing pummelo trees on Volkameriana or Macrophylla rootstocks, as these will produce vigorous trees but with serious problems with granulation.

Granulation

Granulation can be a serious problem in pummelos (Fig. 14). Granulation is a crystallization of the juice sacs before harvest and is seldom found in grapefruit, probably because of the acidity of the flesh. The cause of granulation is not completely understood. Granulation appears to be more of a problem in hotter citrus growing areas than in cooler ones. When it is excessively hot in the fall, granulation is more likely to occur.



Figure 14. Closeup of a granulated pummelo.

Granulation also appears to be worse in citrus grown on sandy and gravelly soils rather than on heavier soils. There are certain things that one can do to lessen the chance of granulation.

- Choose the correct rootstock (see above).
- Fruit that is picked after it is mature is more likely to granulate, so pick fruit early.
- Do not overfertilize with nitrogen fertilizer.
- Do not fertilize too late in the season with nitrogen fertilizer.
- Add organic matter to the soil.

Grapefruit, Pummelo and Drug Interactions

Grapefruit have many health benefits. When consumed, they are low in calories, have a low glycemic index, thus they do not negatively impact one's blood sugar levels, they can reduce blood sugar, reduce the chances of stroke, they are high in fiber, potassium, lycopene, vitamin C, and choline²⁹.

The "culprits" that cause problems when one consumes grapefruit or pummelo while taking certain drugs are known as furanocoumarins³⁰. These are defense compounds that help citrus fight herbivores and plant pathogens. Most furanocoumarins are found in the peel and pulp. Citrus cultivars with the most furanocoumarins include pummelos, grapefruit, 'Mexican' lime, 'Persian' ('Tahiti') lime, and bergamot. The limes and bergamot are of reduced concern because people do not eat them in the

same quantity as grapefruit or pummelos. Fortunately, oranges, mandarins and lemons have little or no furanocoumarins.

The interaction occurs because furanocoumarins block a family of enzymes called cytochrome P₄₅₀. These enzymes convert various substances to inactive forms in our bodies. Drug makers take this conversion into consideration when they determine appropriate dosages of various drugs so that the correct amount of the drug gets into the bloodstream. Grapefruit juice affects how drugs are changed (metabolized) in the body for eventual elimination and can alter the amount of drug in your bloodstream. This can lead to enhanced side effects or lower drug effectiveness.

In 1989, Dr. David Bailey, a Canadian researcher, discovered that grapefruit juice blocked the P₄₅₀ enzymes of a group of research study participants, allowing four times the recommended amount of a blood pressure drug into their bloodstreams⁷. Researchers have discovered dozens of drugs that interact with grapefruit juice. With some drugs, this type of overdose could be fatal, and as little as one whole fruit or one cup of juice can block the enzymes and lead to toxic levels in the blood. For more information, see various websites, including <https://www.drugs.com/article/grapefruit-drug-interactions.html>.

Fortunately, citrus breeders are developing cultivars of grapefruit and pummelo with lower levels of furanocoumarins³¹. One of these is '914', a patented grapefruit pummelo hybrid that is being developed at the University of Florida (Fig. 15). Trees of '914' are being distributed to Florida citrus growers for testing. Expect to see a grapefruit such as these at the supermarket within the next 5 to 10 years

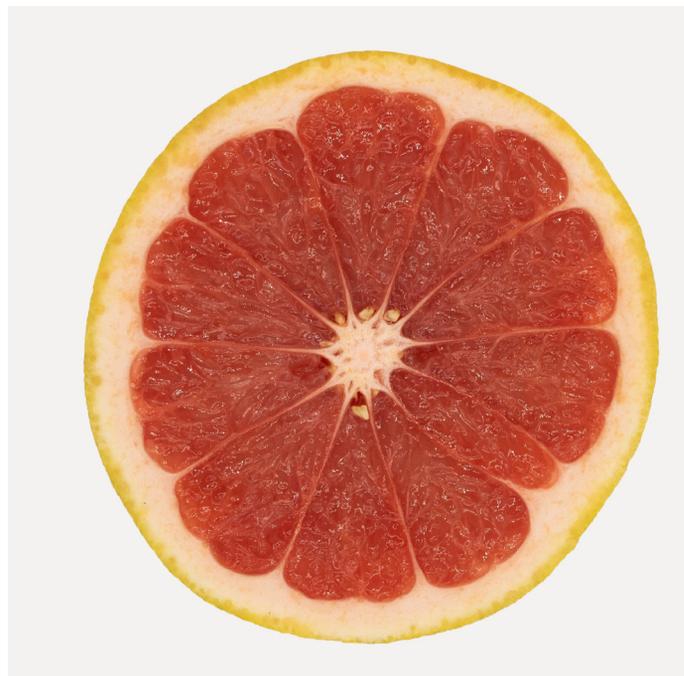


Figure 15. '914' grapefruit pummelo hybrid.

Grapefruit and Pummelo aren't just for eating fresh or for juicing anymore

Many people complain about the bitterness of grapefruits, and it is impossible to avoid all bitterness in the fruit. However, one can reduce the bitterness of a grapefruit by not eating the white part of the rind and the segment walls, where much of the bitterness is found. The best way to do so is to remove the segments with a serrated grapefruit spoon or a grapefruit knife (Fig. 16). Then, sprinkle the segments lightly with salt. Salt will neutralize some of the sour flavor, making the fruit taste sweeter.

In addition to eating the fresh fruit and drinking the juice, grapefruits and pummelos can be used in a number of ways around the house. Here are 16 unexpected ways to use grapefruits and pummelos taken from the internet.



Figure 16. A double-bladed grapefruit knife. Note the parallel blades on the right for separating the segment from the segment wall, and the curved blade on the left for extracting the segment from the grapefruit half.

1. Include pummelo in a Vietnamese shrimp and chicken salad (Fig. 17).
2. Tenderize meat with grapefruit or pummelo juice mixed with soy sauce, honey, garlic, salt and pepper.
3. Use pummelo juice or grapefruit juice in a cocktail, such as a "paloma" or a "greyhound".
4. Dip pummelo segments in salt, sugar and chile, to bring out the flavor.
5. Make pink grapefruit sorbet or gelato.
6. Sprinkle half a grapefruit with brown sugar and place under the broiler until the sugar begins to bubble. It makes a great warm breakfast,
7. Use dried grapefruit or pummelo peels as a fire starter.

8. Repel cats with a mixture of coffee grounds and chopped grapefruit rinds. Be sure to replace the rinds every week or so.
9. Clean a sink or a copper saucepan with a grapefruit half sprinkled with salt.
10. Use a mixture of grapefruit juice and vinegar to clean wood floors.
11. Grapefruit can be used as a homemade exfoliating scrub.
12. Drop a grapefruit peel in a hot bath and jump in! It will add a refreshing scent to the water.
13. Mix a cup of grapefruit juice with ½ cup of water in a saucepan and bring to a simmer. You will soon have grapefruit scent throughout the house.
14. Make candied pummelo or grapefruit rind or wheels and coat them in chocolate.
15. Make grapefruit marmalade.
16. Make a pink grapefruit tart (Fig. 18).

The use of grapefruit and pummelos is only limited by one's imagination!

Table 2. Harvest Period of Grapefruit, Pummelo, and Pummelo Hybrids in Arizona.

Grapefruit or Pummelo Cultivar	Primary Harvest Period																							
	Aug		Sep		Oct		Nov		Dec		Jan		Feb		Mar		Apr		May		Jun		Jul	
	1	15	1	15	1	15	1	15	1	15	1	15	1	15	1	15	1	15	1	15	1	15	1	15
Grapefruit																								
Duncan									█	█	█	█	█	█	█	█	█	█	█	█				
Marsh										█	█	█	█	█	█	█	█	█	█	█	█			
Flame, Redblush (Ruby Red), Rio Red									█	█	█	█	█	█	█	█	█	█	█	█	█			
Texas Star Ruby											█	█	█	█	█	█	█	█	█	█				
Pummelo and Pummelo Hybrids																								
Chandler									█	█	█	█	█	█										
Sarawak									█	█	█	█	█	█										
Melogold									█	█	█	█	█											
Oroblanco									█	█	█	█	█	█										
Cocktail									█	█	█	█	█	█										
Valentine									█	█	█	█	█											



Figure 17. Vietnamese pummelo salad.



Figure 18. Hugo and Victor's pink grapefruit tart.

Photo credits

Figures 1,14 – Glenn C. Wright

Figures 2-13 - Toni Siebert and David Karp, University of California-Riverside Citrus Variety Collection.

Figures 15 – Fred Gmitter, Jr., University of Florida

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Sources

1. Wu, G., J. Terol, V. Ibáñez, et al. 2018. Genomics of the origin and evolution of citrus. *Nature* 554: 311–316. <https://doi.org/10.1038/nature25447>.
2. Wu et al., Genomics of the origin and evolution of citrus, p. 311.
3. Webber HJ. 1943. Cultivated varieties of citrus, p. 570. In: HJ. Webber and LD. Batchelor. (eds.). *The citrus industry volume 1, history, botany and breeding*. University of California Press, Berkeley and Los Angeles, CA. 1036 pp.
4. Hughes, G. 1750. *The natural history of Barbados: In ten books*. Printed for the author, London. 314 pp.
5. Lunan, J. *Hortus Jamaicensis*. 1814. St. Iago de la Vega Gazette, Jamaica. 2 vol.
6. Tussac, FR. de. 1808-27. *Flore des Antilles*. Published by the author and with F. Schoell, Paris. 4 vol.
7. Nosowitz, D. 2020. Grapefruit is one of the weirdest fruits on the planet, *Atlas Obscura*, accessed October 21, 2020. <https://www.atlasobscura.com/articles/grapefruit-history-and-drug-interactions>.
8. Saunt, J. 2000. *Citrus varieties of the world*. Sinclair International Limited, Norwich, UK. p. 89.
9. Webber, *Cultivated varieties*, p. 575.
10. Saunt, *Citrus varieties*, p. 90.
11. Duncan grapefruit, Citrus Variety Collection, accessed October 22, 2020. <https://citrusvariety.ucr.edu/citrus/duncan.html>
12. Saunt, *Citrus varieties*, p. 91.
13. Xu CJ., PD. Fraser, WJ. Wang, and PM. Bramley. 2006. Differences in the carotenoid content of ordinary citrus and lycopene-accumulating mutants. *J. Agric. Food Chem.* 54(15):5474-81. doi: 10.1021/jf060702t. PMID: 16848534.
14. Webber, *Cultivated varieties*, p. 583.
15. Redblush grapefruit, Citrus Variety Collection, accessed October 23, 2020. <https://citrusvariety.ucr.edu/citrus/redblush.html>.
16. Saunt, *Citrus varieties*, p. 93.
17. Saunt, *Citrus varieties*, p. 92.
18. Saunt. *Citrus varieties* p. 94.
19. da Graça, JV., ES. Louzada and JW. Sauls. 2004. The origins of red pigmented grapefruits and the development of new varieties. *Proc. Intl. Soc. Citriculture* 369-374.
20. Tolkowski, S. 1938. *Hesperides: a history of the culture and use of citrus fruits*. John Bale Sons and Curnow. London. 371 pp.

21. Ferrari, GB. 1646. Hesperides: sive de malorum aureorum coltura et usu libri quatuor. Hermanni Scheus, Rome. 480 pp.
22. Kumamoto, J., RW Scora, HW. Lawton and WA. Clerx. 1987. Mystery of the forbidden fruit: Historical epilogue on the origin of the grapefruit *Citrus paradisi* (Rutaceae). *Econ. Bot.* 41:97-107.
<https://doi.org/10.1007/BF02859356>
23. Webber, Cultivated varieties, p. 569.
24. Chandler pummelo, Citrus Variety Collection, accessed October 26, 2020.
<https://citrusvariety.ucr.edu/citrus/chandler.html>
25. Saunt, Citrus varieties, p. 106.
26. Saunt, Citrus varieties, p. 105.
27. Cocktail grapefruit, Citrus Variety Collection, accessed October 26, 2020.
<https://citrusvariety.ucr.edu/citrus/cocktail.html>
28. Valentine pummelo hybrid, Citrus Variety Collection, accessed October 26, 2020.
<https://citrusvariety.ucr.edu/citrus/Valentine.html>
29. Why is grapefruit good for you? Medical News Today, accessed October 27, 2020. <https://www.medicalnewstoday.com/articles/280882>
30. Dugrand-Judek A, A. Olry, A. Hehn, G. Costantino, P. Ollitrault, Y. Froelicher, et al. (2015) The distribution of coumarins and furanocoumarins in Citrus species closely matches Citrus phylogeny and reflects the organization of biosynthetic pathways. *PLoS ONE* 10(11): e0142757. <https://doi.org/10.1371/journal.pone.0142757>.
31. 914. Florida foundation seed producers, accessed October 27, 2020.
<http://www.ffsp.net/varieties/citrus/914-2/>



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