


# THE RED REPORT

THE SCIENCE BEHIND TART CHERRIES



Cherries



The Red Report is a summary of the literature on the health benefits of tart cherries. The report was commissioned by the Cherry Marketing Institute (CMI), an organization funded by North American tart cherry processors and growers. The intent of the report is to provide an overview of the scientific evidence and the information is not intended to substitute for the advice of a physician or other healthcare professional.

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# THE RED REPORT:

## The Science Behind Tart Cherries

After years in the shadow of other fruit, **tart cherries are emerging as a major Super Fruit**. A substantial and growing body of scientific research has linked tart cherries to **anti-inflammatory benefits, reduced pain from gout and arthritis** and an extensive list of **heart health benefits**. Recent studies even suggest tart cherries can help **reduce post-exercise muscle and joint pain**.

Available dried, frozen and in juice and concentrate, tart cherries contain a **unique package of antioxidants** and beneficial phytonutrients, including anthocyanins — the pigments that give cherries their bright red color. There are now more than **50 studies** specifically on tart cherries and scientists continue to uncover new and important benefits of this fruit.

**THE RED REPORT** takes a new, scientific look at the power of tart cherries — a **red hot Super Fruit**. To learn more, visit [www.choosecherries.com](http://www.choosecherries.com).



# Tart Cherries: America's Naturally Functional Super Fruit



Homegrown and long a part of America's history, cherries are truly an American favorite.

Technically known as *Prunus cerasus*, tart cherries' nutrition,

unique flavor and naturally functional properties are right on target with today's new food and beverage trends.



The dark, sweet cherries you know from the summer produce aisle are a completely different variety of cherries. You'll recognize tart cherries by their bright red hue in dried, frozen or juice forms.

Now more than ever, Americans are aware of health and nutrition and look to their diets as a means to deliver nutrients and health benefits. Naturally functional foods — or foods with inherent benefits — are now preferred to traditional fortification or dietary supplements as a source of nutrients.<sup>1</sup> Tart cherries' nutritional profile contributes a number of powerful antioxidants, and their sweet-tart taste adds a unique flavor boost.

## Tart Cherry Fast Facts

- Tart cherries are available year-round as dried, frozen and juice or juice concentrates.
- The two main types of tart cherries are Montmorency and Balaton. Montmorency is the most commonly grown tart cherry in the U.S.
- Approximately 94% of cherries consumed in the U.S. are grown here. States with commercial crops include Michigan, Utah, New York, Wisconsin, Washington, Oregon and Pennsylvania.
- Today, there are more than 50 studies specifically on tart cherries. A growing body of research suggests that the powerful antioxidants in tart cherries are linked to a broad range of benefits — anti-inflammation, heart health, pain relief, exercise recovery and more.

# AN ANTIOXIDANT POWERHOUSE

Tart cherries are packed with powerful antioxidants. In fact, they have among the highest levels of antioxidants of other super foods.<sup>2-5</sup> Tart cherries ranked 14 in the top 50 foods for highest antioxidant content per serving size — surpassing well-known leaders such as red wine, prunes, dark chocolate and orange juice, according to one recent study.<sup>6</sup>

Antioxidant Capacity of Tart Cherries<sup>4</sup>

FORM	ORAC (Per serving)	ORAC (Per 100 grams)
Frozen Cherries	2,724 (1 cup)	2,000
Dried Cherries	6,120 (½ cup)	6,800
Cherry Juice	3,622 (8 ounces)	1,600
Cherry Juice Concentrate	3,622 (1 ounce)	12,800

# UNDERSTANDING ORAC

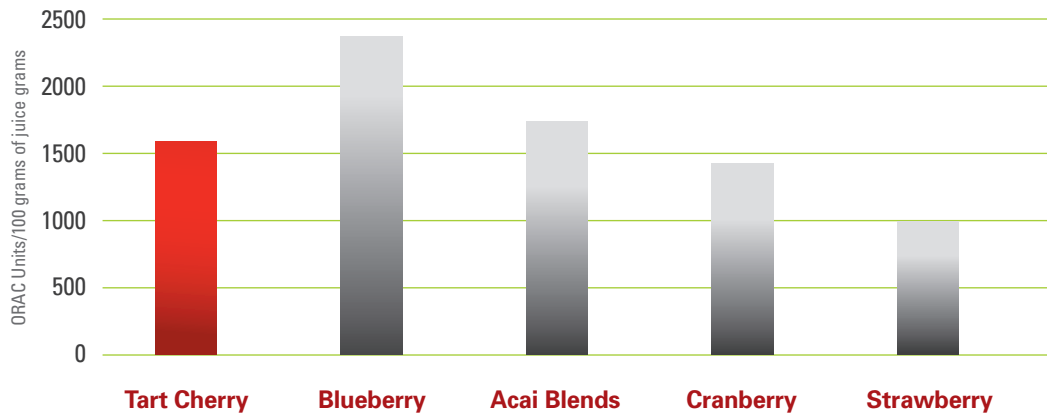
Oxygen Radical Absorbance Capacity (ORAC) is a measure of antioxidant strength. ORAC measures how many oxygen radicals a specific food can absorb and deactivate. The more oxygen radicals a food can absorb, the higher its ORAC score.



# HOW TART CHERRIES STACK UP

Tart cherries have as much, if not more, antioxidants than many other fruits.<sup>4,7</sup>

Antioxidant Levels of Tart Cherries and Other Common Fruits<sup>7,14</sup>



More than 9 out of 10 Americans want to know where their food comes from, and nearly 80 percent say they are purchasing “locally produced” products — or those made in America.<sup>8,9</sup>

Natural or unprocessed foods, super foods and foods containing antioxidants have been some of the most important product attributes Americans seek out to maintain good health.<sup>10</sup>

# Antioxidants are in Demand

- More than 90 percent of adults are aware of antioxidants. One-third is making a strong effort to consume more antioxidants.<sup>11,12</sup>
- Antioxidants were the #1 most sought after ingredient in functional beverages in 2010 by over half of Americans.<sup>13</sup>

Tart cherries are naturally fat-free, low in sodium, and provide a number of key vitamins and minerals, along with powerful phytonutrients.



Even more important than antioxidant levels alone, the natural compounds in tart cherries may work synergistically to deliver powerful health benefits, according to research from the University of Michigan.<sup>14,15</sup> The researchers isolated individual cherry phytonutrients

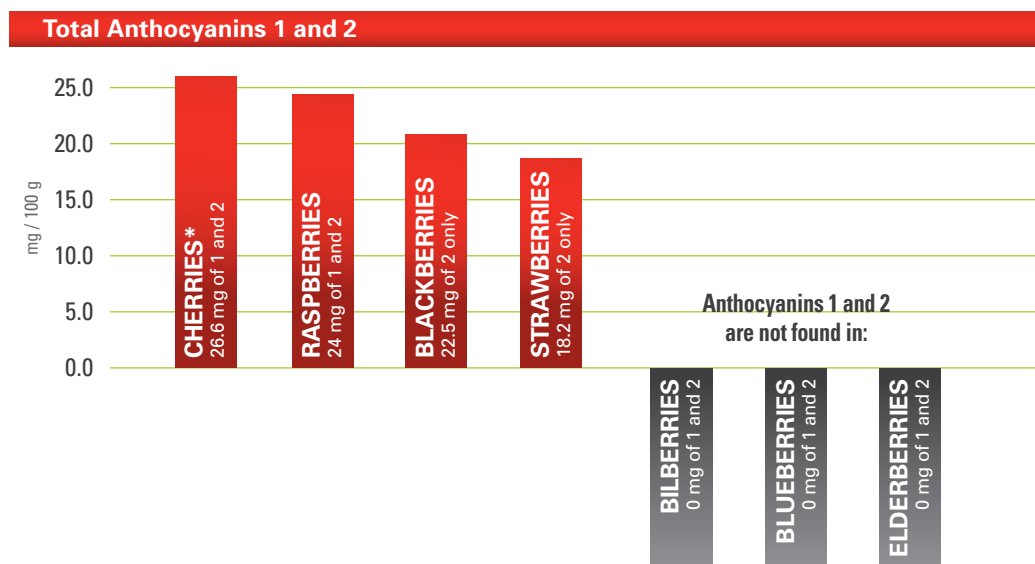
and tested the antioxidant power alone, or paired together. They found that the “whole” was greater than the sum of its parts — specific compounds worked together to boost antioxidant power more than would be expected for any compound on its own.

Anthocyanins are the key antioxidant compounds in cherries. Along with providing the bright red pigment to tart cherries, these phytonutrients have been specifically linked to high antioxidant capacity and reduced inflammation, at levels comparable to some well-known pain medications.<sup>16,17</sup>

Tart cherries are also sources of other phenolic compounds, such as gallic acid, p-coumaric acid, kaempferol, and quercetin, all of which are potent antioxidants.<sup>4,18</sup>

## ANTHOCYANINS

Tart cherries contain the highest concentrations of anthocyanins 1 and 2 which help block enzymes associated with inflammation. Tart cherries contain significantly more anthocyanins than other fruits, including sweet cherries.<sup>16,18</sup>



# PHYTONUTRIENT MATCH-UP<sup>3,5,16,19-37</sup>

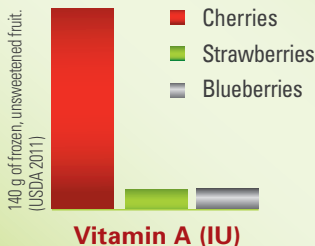
See how other fruits match up to cherries' powerful phytonutrient profile.

Natural Compound	Cherries	Blueberries	Strawberries	Grapes (black/red)	Apples	Pomegranates
Anthocyanins/Anthocyanidins						
Cyanidin	●	●	●	●	●	●
Cyanidin 3-glucosylrutinose (anthocyanin 1)	●					
Cyanidin 3-rutinoside (anthocyanin 2)	●		●			
Cyanidin sophoroside	●					
Peonidin	●	●		●		
Peonidin 3-glucoside	●			●		
Flavanols						
Epicatechin	●	●		●	●	●
Catechin	●		●	●	●	●
Procyanidins (B1, B2 OR B3)	●	●	●	●	●	
Flavanols						
Quercetin	●	●	●	●	●	●
Kaempferol	●		●			
Isorhamnetin	●	●		●	●	
Other Polyphenols and other Natural Compounds						
Chlorogenic acid	●	●	●	●	●	●
Neochlorogenic acid	●			●	●	
3-coumaroylquinic acid	●				●	
Melatonin	●		●	●		●
Perillyl alcohol	●					
p-coumaric acid	●	●	●	●	●	●
Gallic acid	●	●	●	●	●	●
D-glucaric acid	●			●	●	
Ellagic acid	●	●	●	●		●
Antioxidant Level						
ORAC Value	2033	2200	1540	1260	3082	2341

Data were collected from the USDA Database for the Flavonoid Content of Selected Foods - 2003, and published peer-reviewed scientific research. Compounds shown represent the main compounds in tart cherries and were not intended to show exhaustive list of all phytonutrients.

## Nutrient Comparison: Vitamin A

Tart cherries contain 19 times more vitamin A than blueberries or strawberries. One serving of frozen tart cherries provides 25% of the Daily Value of vitamin A.



## CHERRY NUTRITION FACTS

Available dried, frozen or in juice and juice concentrates, cherries deliver a unique nutrient package.<sup>38,39</sup>

Frozen Cherries	Dried Cherries	Cherry Juice	Cherry Juice Concentrate
<b>Nutrition Facts</b> Serving Size: 1 cup (140g)	<b>Nutrition Facts</b> Serving Size: ½ cup (60g)	<b>Nutrition Facts</b> Serving Size: 8 ounces (227g)	<b>Nutrition Facts</b> Serving Size: 2 tablespoons (40g)
<b>Amount Per Serving</b> Calories 60 Calories from Fat 5	<b>Amount Per Serving</b> Calories 200 Calories from Fat 0	<b>Amount Per Serving</b> Calories 140 Calories from Fat 0	<b>Amount Per Serving</b> Calories 100 Calories from Fat 0
<b>% Daily Value*</b>	<b>% Daily Value*</b>	<b>% Daily Value*</b>	<b>% Daily Value*</b>
<b>Total Fat</b> 0.5g Saturated Fat 0g <b>Cholesterol</b> 0mg <b>Sodium</b> 0mg <b>Total Carbohydrate</b> 15g Dietary Fiber 2g Sugars 13g <b>Protein</b> 1g	<b>Total Fat</b> 0g Saturated Fat 0g <b>Cholesterol</b> 0mg <b>Sodium</b> 0mg <b>Total Carbohydrate</b> 49g Dietary Fiber 2g Sugars 41g <b>Protein</b> 2g	<b>Total Fat</b> 0g Saturated Fat 0g <b>Cholesterol</b> 0mg <b>Sodium</b> 30mg <b>Total Carbohydrate</b> 33g Dietary Fiber 0g Sugars 25g <b>Protein</b> 1g	<b>Total Fat</b> 0g Saturated Fat 0g <b>Cholesterol</b> 0mg <b>Sodium</b> 45mg <b>Total Carbohydrate</b> 23g Dietary Fiber 0g Sugars 22g <b>Protein</b> 1g
Vitamin A 25%	Vitamin A 45%	Vitamin A 4%	Vitamin A 0%
Vitamin C 4%	Vitamin C 0%	Vitamin C 0%	Vitamin C 0%
Calcium 2%	Calcium 2%	Calcium 2%	Calcium 0%
Iron 4%	Iron 4%	Iron 8%	Iron 4%
<small>*Percent Daily Values are based on a 2,000 calorie diet. Your Daily Values may be higher or lower depending on your calorie needs.</small>	<small>*Percent Daily Values are based on a 2,000 calorie diet. Your Daily Values may be higher or lower depending on your calorie needs.</small>	<small>*Percent Daily Values are based on a 2,000 calorie diet. Your Daily Values may be higher or lower depending on your calorie needs.</small>	<small>*Percent Daily Values are based on a 2,000 calorie diet. Your Daily Values may be higher or lower depending on your calorie needs.</small>



# The Power of Red: Health Benefits of Tart Cherries



An extensive and growing body of research suggests that the powerful antioxidants in tart cherries that give the super fruit its bright red color are also responsible for their anti-inflammatory properties and health benefits.



**Gout sufferers have long turned to tart cherry juice for natural pain relief.**

A number of studies have specifically linked tart cherry consumption and cherry anthocyanins to decreased inflammation and inflammatory-related conditions.<sup>40-42</sup> One study from University of Michigan researchers revealed a cherry-enriched diet reduced inflammation markers in animals by up to 50 percent<sup>43</sup> and another found drinking eight ounces of tart cherry juice daily for four weeks significantly reduced important markers of inflammation in overweight and obese adults.<sup>44</sup>

This inflammatory benefit is behind cherries' ability to reduce risk for arthritis and gout, promote cardiovascular health and most recently to aid muscle recovery and reduce oxidative stress in athletes.<sup>45</sup>

## GOUT AND ARTHRITIS

For decades arthritis and gout sufferers have regularly consumed tart cherry juice for relief of symptoms. As early as the 1950's, the science began to support this long-held tradition, linking cherry consumption to less pain associated with gout attacks.<sup>46</sup>

More recent studies have supported this finding. One study found that when healthy women ate two servings (280 grams) of cherries after an overnight fast, they showed a 15 percent reduction in uric acid levels, as well as lowered



nitric oxide and C-reactive protein levels – all of which is associated with inflammatory diseases like gout.<sup>47</sup> Another study supported a lower uric acid level after cherry consumption, finding that after drinking eight ounces of tart cherry juice daily for four weeks, many adults had lower levels of uric acid.<sup>44</sup>

The inflammatory benefits have potential to extend to arthritis sufferers too. In a 12-week pilot study conducted by researchers at Baylor Research Institute, a daily dose of tart cherries (as cherry extract) helped reduce osteoarthritis pain by more than 20 percent for the majority of men and women.<sup>48</sup>

## CARDIOVASCULAR AND HEART HEALTH

Tart cherry consumption has been linked to a number of cardiovascular benefits — from overall anti-inflammation to reductions in cholesterol levels, to decreased risk for atherosclerosis and metabolic syndrome — all important heart disease risk factors.

Research from the University of Michigan has found that cherry-enriched diets in animals lowered multiple risk factors for heart disease, from lowering total blood cholesterol levels to

reducing total body weight and fat, in particular the “belly fat” that is most often associated with heart disease risk.<sup>49-51</sup> A recent study found that a cherry diet (at 1 percent of diet as tart cherry powder) reduced C-reactive protein and other markers of inflammation by up to 36 percent and lowered levels of total cholesterol by 26 percent in a five-month mouse study. The mice fed a cherry diet had a 65 percent reduction in early death, likely due to improved cardiovascular health.<sup>52</sup>

The University of Michigan researchers also found the cherry-enriched diets reduced not only overall body inflammation, but inflammation at key sites (belly fat, heart) known to affect heart disease risk in obese, at-risk rats.<sup>40</sup>

The anthocyanins in tart cherries may also lower blood lipid levels. In an animal study, rats who were fed tart cherry-enriched diets for 90 days demonstrated significantly lower plasma triglyceride and total cholesterol, fasting glucose and insulin, and a plasma marker of oxidative damage. They also had slightly higher high-density lipoproteins (HDL – the “good” cholesterol) and significantly elevated blood antioxidant capacity.<sup>53</sup>

## EXERCISE RECOVERY AND PAIN RELIEF

The same RED compounds linked to cherries’ arthritis and cardiovascular benefits have now shown promise for athletes and sports recovery to help relieve muscle and joint soreness. Tart cherries could help athletes reduce muscle damage to recover faster from a tough workout, according to a growing body of research.<sup>54-56</sup>

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**Researchers have linked tart cherries to a number of cardiovascular benefits — from lower cholesterol, to reduced belly fat.<sup>50</sup>**



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**Tart cherries may also reduce risk factors associated with type 2 diabetes.<sup>43</sup>**





Diet can play a key role in managing post-exercise pain. Experts urge athletes to help manage inflammation with natural anti-inflammatory foods, like cherries.

A study conducted at the University of Vermont gave 12 ounces of cherry juice or a placebo twice a day for eight days to 14 college men. On the fourth day, the men were asked to perform strenuous weight lifting of two sets of 20 repetitions each. Strength loss after exercise was only 4 percent with the juice compared to 22 percent with the other beverage, and pain significantly decreased after cherry juice consumption. The researchers concluded that “consumption of tart cherry juice before and after eccentric exercise significantly reduced symptoms of muscle damage.”<sup>54</sup>

Other research supports the pain relief benefits of incorporating tart cherries in a training routine. In one study, runners who drank cherry juice twice a day for seven days prior to and on the day of a long-distance relay had significantly less muscle pain following the race.<sup>55</sup> A similar study in marathoners found that runners who drank cherry juice 5 days before, the day of and 2 days after running a marathon experienced a faster recovery of strength, increased total antioxidant capacity and reduced inflammation and lipid peroxidation compared to a non-cherry beverage.<sup>56</sup>

Red Recovery

Increasingly, sports nutritionists are using tart cherries as part of a recovery program to support athletic performance and recovery. Here’s a sample “red recovery” routine designed to minimize inflammation, boost hydration and fuel the body.

Steps		Pre-Workout	During Exercise	Post-Exercise
	<b>step 1</b> <b>Reduce Inflammation</b> Manage inflammation with natural anti-inflammatory foods	Drink a 10 oz. glass of tart cherry juice, or a cherry juice blend	If exercising in excess of an hour, replace your electrolytes with carbohydrate-based liquids and foods, like sports drinks, gels, honey and sugar cubes	Reduce pain and inflammation with antioxidant-rich cherries. Try a cherry fruit smoothie
	<b>step 2</b> <b>Stay Hydrated</b> Calculate your sweat rate to gauge your fluid needs	Start your workout hydrated with at least 20 oz. of water  Salty sweaters – add a ¼ tsp of salt to your pre-exercise beverage	Stay hydrated by drinking at least 14 oz. each hour you’re active	Replace the fluids you lost by drinking 24 oz. for every pound lost
	<b>step 3</b> <b>Fuel With Proper Foods</b> Nourish your body	Choose small carbohydrate-based meals, like oatmeal topped with dried cherries or a dried fruit power bar	If exercising in excess of an hour, replace your electrolytes with carbohydrate-based foods or beverages	Restore and refuel with a good mix of protein and carbohydrates such as a trail mix of almonds, walnuts and dried cherries



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Researchers continue to study the benefits of tart cherries — there are a number of key research studies currently in progress.

## EMERGING BENEFITS

Researchers continue to uncover new and novel benefits of tart cherries. Some preliminary research has linked tart cherry juice to improvements in sleep and sleep patterns.

In one pilot study, a team of University of Pennsylvania, University of Rochester and VA Center of Canandaigua researchers found that drinking tart cherry juice daily helped reduce the severity of insomnia and time spent awake after going to sleep. The 15 older adults saved about 17 minutes of

wake time after going to sleep, on average, when drinking cherry juice daily, compared to when they were drinking the juice drink.<sup>57</sup> A second study found that healthy adults experienced improved sleep time and a 5-6 percent increase in overall sleep efficiency after drinking two servings of tart cherry juice for a week, compared to drinking a fruit cocktail. The volunteers also reported less daytime napping time while drinking the tart cherry juice.<sup>58</sup>

# Go Red Instead



**The American Heart Association recommends getting antioxidants from foods, not supplements. “Food sources of antioxidant nutrients, principally from a variety of plant-derived foods such as fruits, vegetables, whole grains, and vegetable oils are recommended.”<sup>60</sup>**

The 2010 Dietary Guidelines for Americans and USDA’s MyPlate encourage Americans to “make half their plate fruits and vegetables.” Colorful fruits provide a number of benefits — from contributing important vitamins and minerals, to reducing risk factors for many diseases.

Only one in five Americans is currently getting the recommended fruit each day, which could put their health at risk.<sup>59</sup> For adults, that means incorporating 2 cups daily. To help boost fruit intake, the Dietary Guidelines remind us to think about variety and taste. Now more than ever, there are good reasons to choose cherries.

Since tart cherries are available year-round as dried, frozen or juice, it’s easy to add this



RED super fruit to your diet. In addition to their unique sweet-tart taste, they’re versatile enough to include in any dish.

To learn more about the health benefits of cherries and to find recipes and tips, visit [www.choosecherries.com](http://www.choosecherries.com).



## FIVE WAYS TO ADD TART CHERRIES TO YOUR ROUTINE

1

Brighten up  
Breakfast

Swap your typical berries for dried cherries and add them to your cereal, oatmeal, yogurt or pancakes.

2

Juice on  
the Run

Grab some 100% cherry juice or fill a water bottle with diluted cherry juice concentrate each morning before you hit the gym to help aid in muscle recovery.

3

Switch from  
Blue to Red

Make a change from your standard blueberry muffin recipe and use dried or frozen cherries instead.

4

A Perfect  
Parfait

Keep a bag of frozen cherries in the freezer and layer with lowfat vanilla yogurt and granola.

5

Fruit Fizz

Make a refreshing cherry spritzer by adding cherry juice concentrate to ice cold seltzer water for a refreshing treat.



### MyPlate Servings

A serving of cherries, according to MyPlate (more information at [www.ChooseMyPlate.gov](http://www.ChooseMyPlate.gov)):

- ½ cup dried
- 1 cup frozen
- 1 cup juice

For more tips visit [www.choosecherries.com](http://www.choosecherries.com)

## HOW MANY CHERRIES DOES IT TAKE?

- It takes six to eight pounds of tart cherries to make one pound of dried cherries.
- There are about 100 cherries in an 8-ounce glass of cherry juice.
- An estimated 1-2 servings of cherries daily can help provide some of the health benefits identified in the research, experts suggest.



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