



Some natural dyes are rare and difficult to manufacture in mass quantities, making them more expensive to produce. Image Source: Shutterstock user Nik Merkulov

Centuries ago, Tyrian purple, a reddish-purple dye made from the fluid of murex shellfish, was the most expensive fabric and paint dye in the world at over \$19,000 per pound in today's currency. This high cost reflected the extreme difficulty of production; it required hunting the specific shellfish species that produced the dye and carefully extracting the tiny amount of purple liquid inside of every shell. It took thousands of shellfish to make a single pound of Tyrian purple and the color was so rare and expensive that it became a status symbol for royalty and the ultra-wealthy at the time.¹ For hundreds of years, purple was seen as a royal color, a tradition that continues even today, all because of Tyrian purple's almost prohibitively expensive manufacturing process.

Today, purple dye is much more common than it once was. Modern textile and paint manufacturers have relatively inexpensive synthetic sources for purple, such as Mauveine, made artificially from coal tar.² However, although the invention of a wider range of synthetic dyes has made dyed products easier to manufacture than ever before, there are still a number of commercial dyes used today that remain rare or very difficult to make.

When manufacturers choose to use these uncommon, expensive dyes in their products, however, they face a major challenge: they need to test their dyes and products for color consistency, but they also want to avoid wasting product during the testing phase. In order to solve this problem, manufacturers can use spectrophotometers that are capable of testing very small sample sizes. By shrinking the size of their test samples, manufacturers of expensive or rare dyes can thoroughly test their products for color consistency while also keeping their overhead costs as low as possible and preserving scarce materials.



Many natural dyes can be difficult to find or expensive to manufacture. Image Source: Shutterstock user piyaphong

The Challenges of Manufacturing Rare or Expensive Dyes

The color consistency of a product can significantly impact quality perception, which is why every manufacturer that works with dyes needs to implement strict, spectrophotometer-based color quality control protocols throughout the manufacturing process. Industries that work with inexpensive commercial dyes are able to perform these color quality control tasks fairly easily. For instance, many [hair dyes](#) are made with relatively inexpensive raw dye materials, including amino compounds which are plentiful and readily available for commercial use.³ Hair dye companies can test all of their dyes for color consistency using a spectrophotometer with a standard sample size port. These companies don't necessarily have to worry about the size of the instrument's required minimum sample because the dyes they use are plentiful and easy to produce in mass quantities.

However, industries that choose to make products out of rarer or more expensive dyes will likely have to adjust their color quality control testing in order to avoid wasting resources. In general, dyes derived from natural materials are more expensive than those made synthetically. This is because [natural dyes](#) contain less than 2 percent color, on average, compared to synthetic dyes, which contain more than 90 percent color. This means that you need far more natural material to create the same amount of color you can get from synthetic dyes, significantly driving up the cost of the natural dyes. In fact, the most expensive dyes in the world, such as lapis lazuli and brazilwood, are naturally derived.⁴ To test the color of rare or expensive dyes like these without wasting more product than absolutely necessary, it is essential to use a spectrophotometer equipped with accessories designed specifically for smaller-than-average sample sizes.



Because dyes like lapis lazuli are so expensive, it's important to carefully test these dyes using the smallest sample sizes possible. Image Source:Shutterstock user Abel Turnik

How to Test the Color of Rare or Expensive Dyes

In order to test the color of rare or expensive dyes without wasting product, you'll need to work with the [smallest sample sizes possible](#). However, one of the challenges of working with small sample sizes is that not all spectrophotometers are capable of measuring them. A spectrophotometer with a standard cell holder isn't able to accurately measure the color of a micro liquid sample, as the instrument requires a greater amount of liquid in order to fill the holder completely. But you can make the most out of your expensive or rare opaque dye products by using the smallest cell holder available for your color measurement instrument.

If you wish you use less liquid dye in your color quality control tests, then you'll need to use a spectrophotometer that has a specialized [semi-micro cell holder accessory](#), which is designed to accurately test the color of much smaller sample sizes. However, the suitability of semi-micro cell holders will depend on the specific dye you are testing. HunterLab's semi-micro cell holder, for example, is designed to measure translucent and transparent samples rather than fully opaque liquid dyes. This semi-micro cell holder accessory is installed directly onto the spectrophotometer's transmission compartment, safely housing your small liquid samples without spilling or wasting the expensive or scarce raw material. Using this holder, HunterLab's instruments are capable of measuring as small as 10 mm pathlength cell size samples requiring as little as 0.6 mL of material, depending on your needs. This sample size allows you to minimize the dye necessary for accurate analysis, allowing you to preserve rare and expensive dyes and potentially lowering your manufacturing costs.

Additionally, HunterLab's spectrophotometers also support small sample measurement capabilities via specialized port plates and Small Area View (SAV) options, which can be used to measure small

samples of powdered products; while nearly all dyes are measured in liquid form, there are some rare dyes that come in powdered form. HunterLab's instruments are designed to measure samples as small as 0.4 ccs of [pressed powder](#).

Whether you're working with scarce or expensive dyes in liquid or powder form, HunterLab has the small sample accessories and options you'll need to make accurate, reliable measurements. When you use these specialized tools, you can work with even the most expensive materials while keeping overhead costs as low as possible.

HunterLab Innovation

For more than 60 years, HunterLab has worked closely with a broad range of industries to create [state-of-the-art spectrophotometers](#) designed for the highest level of accuracy, versatility, and usability. Today, our instruments include advanced accessories, like small port holders designed for powder, liquid, and solid samples, that streamline the manufacturing process while helping you preserve scarce and expensive product. [Contact us](#) today to find out more about our renowned products and let us help you select the right tools for your needs.

1. "Tyrian Purple", July 21, 2016, https://www.ancient.eu/Tyrian_Purple/
2. "The Color Purple", <https://www.cnn.com/style/article/perkin-mauve-purple/index.html>
3. "Hair Dye", <http://www.madehow.com/Volume-3/Hair-Dye.html>
4. "The 10 Rarest Colors in the World", 2016, <https://www.indy100.com/article/these-are-10-of-the-rarest-colours-in-the-world-ZkxPMefbggb>