https://the-ken.com/story/turmeric-yellow-brick-road-india/

THE UNIQUE BLUE CURCUMIN

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Synopsis

Curcumin, the active compound in turmeric, has long been known for its health benefits. However, did you know that there is a unique variant called Blue Curcumin? Due to its extraordinary potential, this compound has begun to attract the attention of researchers and the health industry.

Blue curcumin has extensive health benefits, ranging from antioxidants to anti-inflammatory, antibacterial, and anticancer. In the pharmaceutical industry, blue turmeric can be developed into herbal medicines, cosmetics, essential oils, and health supplements. Identification of blue curcumin species is challenging due to its similarity to other species, color variations, and limitations of conventional identification methods. With a more scientific approach, such as DNA analysis, errors in identification can be reduced.

We just started a study to validate the blue curcumin species using a DNA barcoding approach based on the ITS2, rpoC1, and trnH-psbA genes.

A wide impact of our study ranges from strengthening species identification, utilization in pharmaceuticals, and increasing economic competitiveness, to biodiversity conservation.

We do hope that this study will provide a comprehensive analysis that can help conserve and sustainably utilize this important resource.

https://food.detik.com/info-kuliner/d-5336571/bukan-kuning-kunyit-langka-ini-warnanya-biru-kehit

Introduction

When you hear the name blue curcumin, you might imagine a warm, bright blue drink that's tempting. However, when this root is brewed with hot water, the resulting liquid is actually a cloudy, brownish color.But how is that possible?

Well, the name "blue" curcumin comes from the fact that it's not because the brewed water is blue, but because the root emits a purplish-blue glow when it is fresh and freshly cut, with a distinctive aroma.

Why Is the Root Blue?

The purplish-blue color is due to the presence of essential oil compounds such as camphor, ar-turmerone, and other sesquiterpene compounds. These compounds are volatile and only stable under certain conditions, such as in fresh, unheated roots. However, when brewed with hot water, these compounds are easily destroyed or oxidized, so they no longer exhibit a blue color. This is why when you brew blue curcumin, the water turns cloudy-brown, not the blue you imagine.

Is It Still Beneficial?

Absolutely! Although not blue in color, the brew still contains various active compounds having anticancer, antioxidant, antimicrobial, and anti-inflammatory properties that are useful in helping to relieve pain and inflammation, maintain body immunity and improve blood circulation.

We are all familiar with yellow turmeric as an herbal medicine or kitchen spice. But did you know there's another unique type of turmeric? It's called Blue Curcumin, and it comes from *Curcuma aeruginosa*, a relatively unknown plant.

What makes blue curcumin so appealing is its bluish or purplish-purple tubers when sliced, unlike the bright yellow of regular turmeric. This blue color is due to the presence of special natural compounds within them. Besides its unique appearance, blue curcumin also contains many active substances with health benefits, making it increasingly popular as a potential herbal remedy.

Interestingly, this blue curcumin is not alone. There is also a "close relative" that is no less cool, namely black curcumin (*Curcuma caesia*), whose rhizome is blue-black and has no less health benefits. Both have very similar shapes from the leaves, flowers, even the rhizomes are almost indistinguishable if only seen from the outside. This is where the problem arises: how to distinguish two plants that look almost the same?

Well, this is where technology comes into play. Because the old way of looking at physical form often causes confusion, researchers finally use a more modern method, namely DNA barcoding. It's like checking a plant's ID card, this DNA barcoding directly looks at the genetic code inside to determine its species.

That's why researchers now rely on DNA barcoding technology to determine the type of turmeric they are studying. So, instead of just guessing from its external form, they look directly at its genetic part. In our research, we use three gene parts as "identity markers" called ITS2, rpOC1, and trnH-psbA. Through this approach, we want to ensure that the blue curcumin we study is indeed a different species, not confused with black curcumin. Because, if the identification is wrong, the research results can also be far off.

So, our adventure to trace the blue curcumin trail is not only about the beautiful color, but also about how science can help us understand plants more deeply down to the DNA level. The goal? So that there are no more misidentifications and the study can be more accurate.

Differentiate Similar Plants

What is DNA Barcoding?

Imagine when you shop at the supermarket, each product has a unique barcode that can be scanned to find out its name, price, and other details. Well, the concept of DNA barcoding is almost the same, but what is scanned is a small part of the living creature's DNA. By scanning certain DNA segments, scientists can confirm that a plant is indeed blue curcumin and not another species that is physically similar.

Why Does Blue Curcumin Need to be Identified Through DNA?

Blue curcumin has many properties that make it popular in the world of health, beauty, and traditional medicine. Unfortunately, the external appearance of blue curcumin is very similar to black curcumin. This can cause major problems, for example in the herbal and pharmaceutical industries, where errors in raw materials can make drugs ineffective, or even dangerous. Differences in rhizome color or aroma can be very subtle and are not always clear when only seen or smelled. Therefore, visual methods alone are not enough. DNA-based identification is a much more reliable solution. By using DNA barcoding, we can determine whether a sample really comes from genuine blue curcumin, or is actually from another type.

How Does DNA Barcoding Work?

This technology consists of four main steps that are quite simple but very effective:

1. DNA Extraction
First, we take samples from parts of the plant, either from leaves, stems, or rhizomes (underground parts such as ginger). From there, they isolate DNA - a kind of "secret code" of life that exists in every living thing.

2. DNA Amplification
After the DNA has been successfully extracted, certain parts of the DNA are amplified using a technique called PCR (Polymerase Chain Reaction).

Morphological parts of Blue Curcumin plant grown in the experimental field of SEAMEO BIOTROP, Bogor, Indonesia

This is like making many copies of the part of the DNA you want to study so that it is easier to analyze.
3. Sequencing or DNA Reading
The next step is to read the arrangement of the "letters" in the DNA (called nitrogen bases: A, T, C, and G). From here, the sequence of genetic code that identifies the species will be obtained.

4. Matching with Database
The DNA sequence obtained is then compared with data in databases such as GenBank (NCBI) or BOLD (Barcode of Life Data System). If the DNA results match more than 98% with the *Curcuma aeruginosa* data, it means that the sample is indeed blue curcumin.

Marker Genes Used to Identify Blue Curcumin

For more accurate results, we used three DNA sections that are often used to distinguish plants:
ITS2: This section is very effective in distinguishing similar species, including among fellow turmeric.
RbcL: This gene is often used as a universal barcode because it is quite consistent between plant species.
TrnH-psbA: Additional genetic variation that helps distinguish species within a group or genus.
The combination of the three provides more precise and reliable identification results.

How Does DNA Barcoding Differentiate Blue Curcumin from Other Types?

Seeing Genetic Differences

Each species has small differences in its DNA sequence. Like the differences in human fingerprints, although similar but not the same. These differences can be recognized by barcoding technology, especially with the ITS2 gene which is very sensitive to small differences. DNA barcoding is able to capture these differences and use them to distinguish between blue curcumin, black curcumin, yellow turmeric, and white turmeric.

Matching with Reference Barcodes

If the DNA sequence results from the sample match more than 98% with the *Curcuma aeruginosa* data in the database, then it is certain that it is blue curcumin. If it does not match, it could be another species, or perhaps a new species that has not been documented.

Creating a Tree of Life

From the DNA data, we can create a "family tree" that shows the kinship between species. In this tree, blue curcumin will appear on its own branch, separate from the other turmeric, indicating a clear genetic difference.

Benefits of DNA Barcoding for Blue Curcumin

Species Conservation

Blue curcumin is a rare plant and is at risk of extinction if it continues to be exploited. DNA barcoding helps ensure that conservation efforts are targeted, as well as preventing illegal trade or planting of fake species.

Guaranteeing the Authenticity of Herbal Products

In the world of herbal and traditional medicine, counterfeiting of raw materials often occurs.

Whether intentionally or not, the ingredients used may not be genuine blue curcumin. With DNA barcoding, producers can check the authenticity of the ingredients, and consumers are safer.

https://www.bloomberg.com/news/articles/2021-08-18/blue-turmeric-is-the-latest-super-spice-to-shake-up-pantry-shelves

Supporting the Pharmaceutical Industry and Research

Blue curcumin has active compounds which are believed to have the potential to be used as medicine. However, for drug research, the accuracy of the ingredients is very important. DNA barcoding helps ensure that the ingredients being studied come from the right source.

Development of Superior Varieties

By understanding the genetic relationship between species, scientists can carry out genetic engineering or crossbreeding to produce new blue curcumin varieties that naturally contain higher levels of active compounds.

Conclusion

Blue curcumin is a rare herbal plant that has many unique qualities compared to other types of turmeric. Its distinctive aroma and active compound content make this plant very valuable, both for health and industry.

Unfortunately, because its shape is similar to other turmeric, it is often mistaken in recognizing it. This is where DNA barcoding technology plays an important role. With a DNA-based approach, we can identify blue turmeric accurately and scientifically, similar to scanning a product barcode in a supermarket, but for plants.

This technology not only helps ensure the authenticity of blue curcumin but can also maintain its sustainability in nature. In addition, this method has great potential to be applied to other herbal plants. Starting from preventing counterfeiting of nature-based products, to supporting the preservation of biodiversity.

Although still being developed, DNA barcoding has shown a bright future. With support from researchers, the government, and the community, blue curcumin may become the main star in the DNA-based herbal plant identification revolution in the future.

Great Potential Still Waiting to be Explored

Although not as popular as yellow turmeric, blue curcumin holds extraordinary potential. This herbal plant is still in the early stages of research, but its benefits and development opportunities are very promising. The unique color, distinctive aroma, and strong active compound content make blue curcumin a potential main ingredient in various natural health innovations.

There Are Still More Turmeric to Explore

Did you know? In various regions in Indonesia, there are still many types of blue curcumin that have not been widely studied. This is a great opportunity for the scientific world to dig deeper into the properties and differences of each local variety. For this reason, research development is very important. We need more:

- Clinical research to scientifically prove health benefits,
- Product innovation that combines blue curcumin in the form of capsules, healthy drinks, supplements, or skincare,
- Cooperation between sectors from researchers, and industry players, to the government,
- Exploration in the fields of food and cosmetics so that consumers can feel the benefits of blue curcumin in everyday life.

Our Roles Are All Important

To realize a bright future for blue curcumin, cooperation from many parties is needed:

- Researchers and academics, to continue to deepen knowledge and expand studies.
- Industry and entrepreneurs, to be able to create innovative products based on natural ingredients.
- Government and regulators, to support regulation, protection, and promotion of nature-based products.
- All of us as a society, can start to care more and choose natural products that contain blue curcumin.

We can also play a role by spreading information, supporting local products based on blue curcumin, and becoming part of the growing natural health revolution.

Time to Act: Ready to Be Part of Future Health Innovation?

Blue curcumin is not just an ordinary herbal plant; it is a symbol of how nature can provide healthy solutions, as long as we are willing to protect it and develop it sustainably. So, now is the right time to:

- Start getting to know more about blue curcumin and its benefits;
- Try blue curcumin products that are starting to appear on the market;
- And of course, support the movement toward nature-based health.

Come on, let's open our eyes and hearts, and listen to the latest health innovations from Indonesia's own nature. Ready to explore the extraordinary potential of blue curcumin?
Let's continue to follow the development of science and be part of a healthier and more natural future!

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Short Author's Biography

Dewi Rahmawati is a freelance writer with a background in molecular biology. She has a special interest in genetics, tissue culture, and biotechnology applications in species conservation. She is currently actively writing popular science-based articles for educational platforms, with the aim of making science more understandable and interesting for all groups.