Lycored

True colors to reflect the great taste of your meat-free products

Off the vine: How our superstable red and orange shades deliver superior performance in plant protein-based meat and fish alternatives

Meating your future

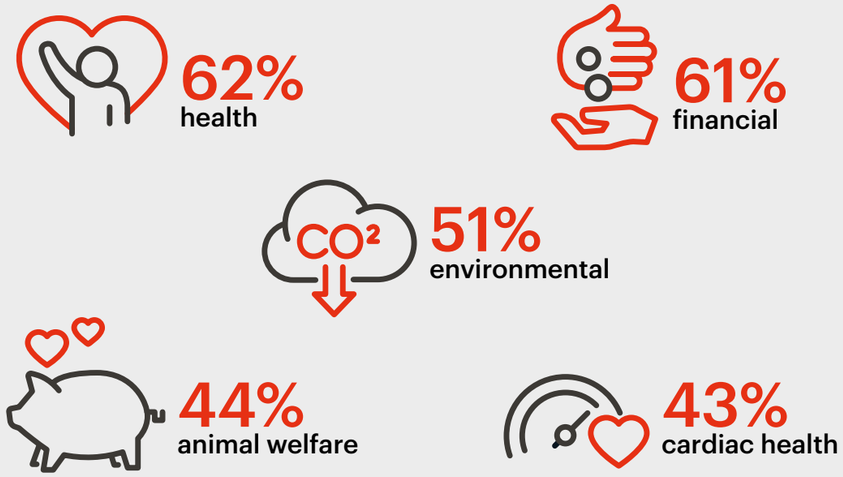
Global consumption of all plant-based foods is growing, including an emerging class of products designed to look and taste like popularly consumed meats. Although proteins that are derived from animals remain a leading food choice, many consumers are actively purchasing meat-free alternatives to limit their intake from animal sources. As part of these new dietary trends, people are increasingly searching for alternatives to traditional diets, such as the growing number of 'flexitarian' consumers and meat reducers.

Results from a sweeping 2019 survey conducted by Ipsos Retail Performance revealed just how popular veganism and interest in plant-based diets has become in the United States over the past 15 years. The data shows surprising growth in US followers of a plant-based diet, from an estimated 290,000 in 2005 to more than 9.7 million today.

Consumer market analysts FMCG Gurus recognized similar trends in their recent global study which revealed 34% of global consumers follow a diet centering on meat avoidance or limitation. Of these consumers, 22% revealed they chose to give up meat in the last 12 months and another 39% were considering doing so over the same period.

Consumers are taking a more proactive approach to their health, driven by the desire to stay fit and healthy until as late in life as possible. With health and financial reasons leading the list, FMCG Gurus found the top five reasons consumers are eliminating or reducing meat.

Top five global reasons for eliminating/reducing meat



Familiar foods, familiar formats

The food industry is working hard to introduce great tasting and looking animal protein-free alternatives in formats that directly appeal to meat eaters including:

Health, wellness and plant proteins

Proteins, plant cellulose fibers and other base building blocks for meat-free substitutes come from a variety of sources, but commercially the industry is currently engineering foods out of proteins derived from a broad but proven variety of all natural, clean-label plant sources:

- Soy protein
- Pea protein
- Mycoprotein
- Chickpea protein
- Seaweed protein
- Cell-based cultures

Consumers are embracing an attitude of ***“good for me and good for the environment”.***

Changing tastes, changing attitudes

Tastes are changing in the U.S. and around the world. FMCG Gurus statistics revealed in 2019 that 46% of Europeans claimed to consume meat alternatives at least once a week. Consumers are embracing an attitude of “good for me and good for the environment” and the movement is resulting in meat-free diets being considered a trendy lifestyle aesthetic.

Kelly Fairchild, an analyst for Ipsos Retail Performance noted that plant-based diets are quickly becoming mainstream in the US, but change hasn’t been linear or steady. However, recent years have seen rapid adoption of vegan diets and more consumer accessible meat-free products making their way onto shelves. “As the dialog around veganism shifts from one of animal welfare, to wider concerns around climate change and personal health, we are seeing more and more people adopt this once minority dietary preference.”

Bringing meat-free foods to the carnivore’s table

Although people are choosing to eat more meat-free foods, not everybody is jumping on the bandwagon. 71% of global consumers responding to the FMCG gurus survey said that presently they do not eat meat substitute products. Consumer attitudes are clearly shifting, however, and the vegetarian food industry is investing a tremendous amount of effort in creating substitutes nearly indistinguishable from real meat in regard to taste, texture after cooking, and presentation.

To meet these consumers at the table and grow the segment, food engineers have been busy perfecting recipes that mimic the qualities of ground beef, chicken, tuna and encased meats in common recipes. Their strategy is to make products that help people engage with the diet choice through accessible and delicious options offering few trade-offs with the real thing.

Several of the more prominent players in this category are actively developing products that are intended to meet meat eaters on their own terms. Industry is intentionally designing foods that overcome criticisms of taste, texture and appearance, that pushes past cultural behaviors preventing the adoption of plant-based meat alternatives.

The burger is king

Plant-based burgers that ‘bleed’ and taste like the real thing is becoming a real thing. Plant-based burgers have recently become a lot more popular. Organizations producing these burgers are targeting both plant-based and meat-based diets by one, increasing options for vegetarians and vegans and then two, enticing meat eaters to consume environmentally friendly meat without compromising on taste. Again appearance is everything. One popular “All American” veggie burger offering even comes with grill marks to add to its overall grilled-beef effect.

Color it tasty

How can brands make plant-based foods more appealing and more successful with consumers? Color. Of the consumers in the FMCG Gurus study answering the question, 61% responded color and appearance are important. Another 65% believe color helps make the product look visually appealing and 58% found it increases flavor expectations.

According to Fergus Clydesdale, PhD, food’s visual appeal and presentation is so important, and color has everything to do with it:

“Color plays a key role in food choice, by influencing taste thresholds, sweetness perception, food preference, pleasantness and acceptability.”

A recent study asked: “Can basic tastes, such as sweet, sour, bitter, salty, and possibly also umami, be conveyed by means of color?” Charles Spence et al reviewed the body of scientific research which concluded that people systematically associate specific colors with particular tastes. Importantly, the study’s conclusion also noted that there is good evidence to suggest that this sensitivity is generally consistent across different cultures and over time (at least over the last three decades), despite the wide cultural differences in the use of colors across cuisines.

Given human’s relationship with the colors associated with raw and cooked meat, this suggests that for products that need to taste like the real thing they have to present like the real thing. Therefore the color of plant-based meat products means everything to the success of these products with consumers.

61%
responded color and appearance are important

65%
believe color helps make the product look appealing

58%
found it increases flavor expectations

Plant-based clean label colors for plant protein-based meat alternatives

The clean-label ingredient lists of plant-based meat alternatives are another factor contributing to their success. The concept of clean-label is prominent among consumers who want all-natural food and drink and plant-based products provide added reassurance about product purity.

The FMCG Gurus study found that consumers around the world believe it is important that food and drink is 100% natural.

It’s evident that to attract both vegetarians and carnivores to try plant-based meat products and appeal to their tastes, ingredient lists need to be clean and that includes the colorants needed to make foods more appetizing on all fronts.

Challenges of coloring plant-based meat alternatives

With MarketsandMarkets projecting the Meat Substitutes Market to be worth $3.5 billion by 2026 and at double-digit compound annual growth, there is plenty of near-term opportunity in the category to create products that appeal to all food consumers.

But industry data on consumer tastes point out that to compete in the category their products must reflect the natural colors and hues of real meats and fish and be clean-label; free from any ingredients made from animal by-products.

Industrial scale manufacturing of these foods requires technical sophistication and experience with high-pressure, high-pH processing techniques. It's at this juncture where viable color ingredient choices – especially in the red and pink hues – becomes challenging relative to stability in processing.

Industry bugged by limited color ingredient choices

From an economic and technical standpoint food engineers have five primary choices to naturally color foods generally:

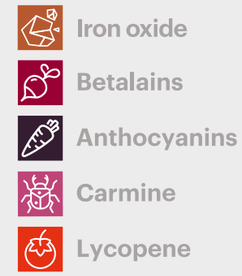
	Natural	Plant-based
Iron oxide	✓	×
Betalains (such as red beet)	✓	✓
Anthocyanins (such as black carrot)	✓	✓
Carmine	✓	×
Lycopene	✓	✓

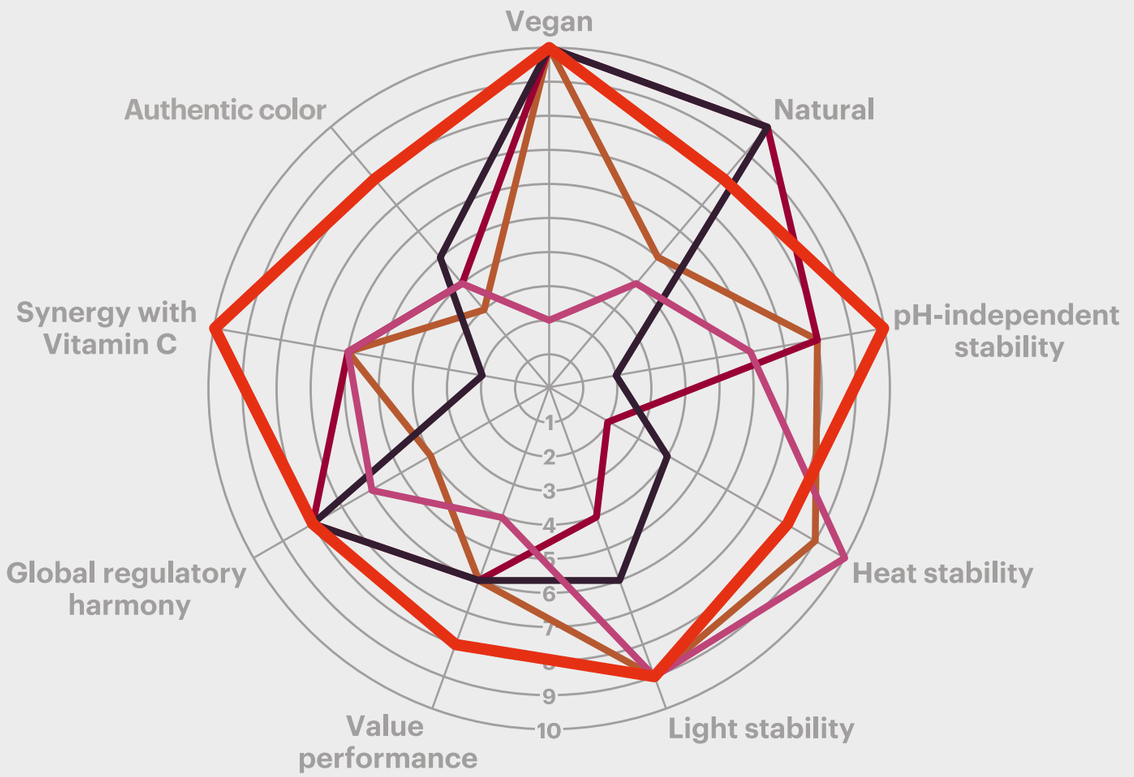
Although considered a relatively all-natural and practical red hue source for many food products, carmine is made from insects and is therefore not an acceptable choice.

Of the four primary natural color sources, Lycored`s palette of lycopene-based colors are proven to provide highly authentic shades, that are superstable, taste-neutral, pH independent, highly consistent through temperature and light conditions, thereby offering the best coverage for most products being manufactured for the market today.

Keeping it real, pink and appealing with lycopene-based color solutions

Lycored compared its family of lycopene-based colors to the four alternatives, evaluating each source across nine performance and specifying criteria relative to plant-based alternatives. The diagram reveals that Lycored's lycopene-based colors offer the broadest utility and value from a general food manufacturing and marketing standpoint.



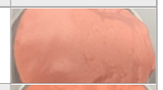
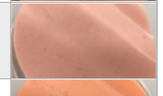


A closer look at achievable shades

Lycored's broad range of hues provide a far-reaching palette that makes it easy to find a color intensity and hue that meets all manufacturing and stability criteria, and that shouts 'this is delicious ham!'

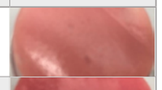
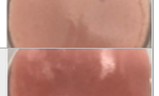
Sausage/Frankfurter

Fat/oil

Colorant	Dosage	Image
ConstantCrimson A	0.15%	
ConstantCrimson A	0.30%	
ResilientRed A	0.15%	
ResilientRed A	0.30%	
ResoluteRuby A	0.15%	
ResoluteRuby A	0.30%	
SteadfastScarlet A	0.15%	
SteadfastScarlet A	0.30%	
OrangeOvation A	0.10%	
OrangeOvation B	0.10%	

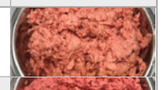
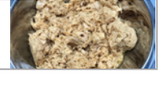
Deli ham style

Protein gel (without oil)

Colorant	Dosage	Image
ConstantCrimson A	0.15%	
ConstantCrimson A	0.30%	
ResilientRed A	0.15%	
ResilientRed A	0.30%	
ResoluteRuby A	0.15%	
ResoluteRuby A	0.30%	
SteadfastScarlet A	0.15%	
SteadfastScarlet A	0.30%	
OrangeOvation A	0.05%	
OrangeOvation B	0.05%	
StellarYellow A	0.02%	

Chicken or Tuna type

Soy chunks, rehydrated

Colorant	Dosage	Image
ConstantCrimson A	0.15%	
ConstantCrimson A	0.30%	
ResilientRed A	0.15%	
ResilientRed A	0.30%	
ResoluteRuby A	0.15%	
ResoluteRuby A	0.30%	
SteadfastScarlet A	0.15%	
SteadfastScarlet A	0.30%	
OrangeOvation A	0.10%	
OrangeOvation B	0.10%	
StellarYellow A	0.02%	

Putting Lycored's natural colors to the test in plant-based deli ham

To put its family of super stable colors to the test, Lycored conducted a comprehensive study to measure the stability levels of lycopene-based colors versus two other typical industry colors (beet, iron oxide) along with samples without color. Deli ham slices were chosen as the focus because the ham's color is its top selling feature and it is subject to the effects of UV due to its transparent packaging and prominent display.

Study parameters

The methodology focused on replicating the product's processing experience, storage conditions, exposure to light, freezing, user experience at home, and extended shelf lifetime (over a month beyond a typical shelf life).

Stability was evaluated across very specific criteria relative to the product:

Color screening
- Evaluate color shades across dosages and target color reference

Replicate full production methodology
- Ingredients, cooking in water bath, freezing, packaging etc.

Replicate shelf life (real time and accelerated)
- Control sample
- Standard retail storage
- Accelerated storage e.g. 6000 LUX (light intensity)
- Chilled storage to replicate consumer user experience upon opening of pack

Testing and evaluation points (target shelf life and accelerated alignment)
- Accelerated days
- Standard (months)
- Dark (months) upon opening of pack

Color analysis
- Color Flex, L*a*b
- Delta E for color change
- Photographic imagery under standardized lighting (Daylight)
- Pantone / RHS references

Lycored screened a number of shades to evaluate different dosages and the intensity of color that may apply depending on the product and relative to different country regulatory restrictions. For example, there is a maximum lycopene usage level in the EU, but no maximum set for the US.

Test conditions

Light intensity 600–800 Lux

Standard conditions 5°C

Real time study span of 3 months

Definitions

Delta E (DE or ΔE) values indicate how much a standard and sample differ from one another in L, a and b (Delta=total color difference)

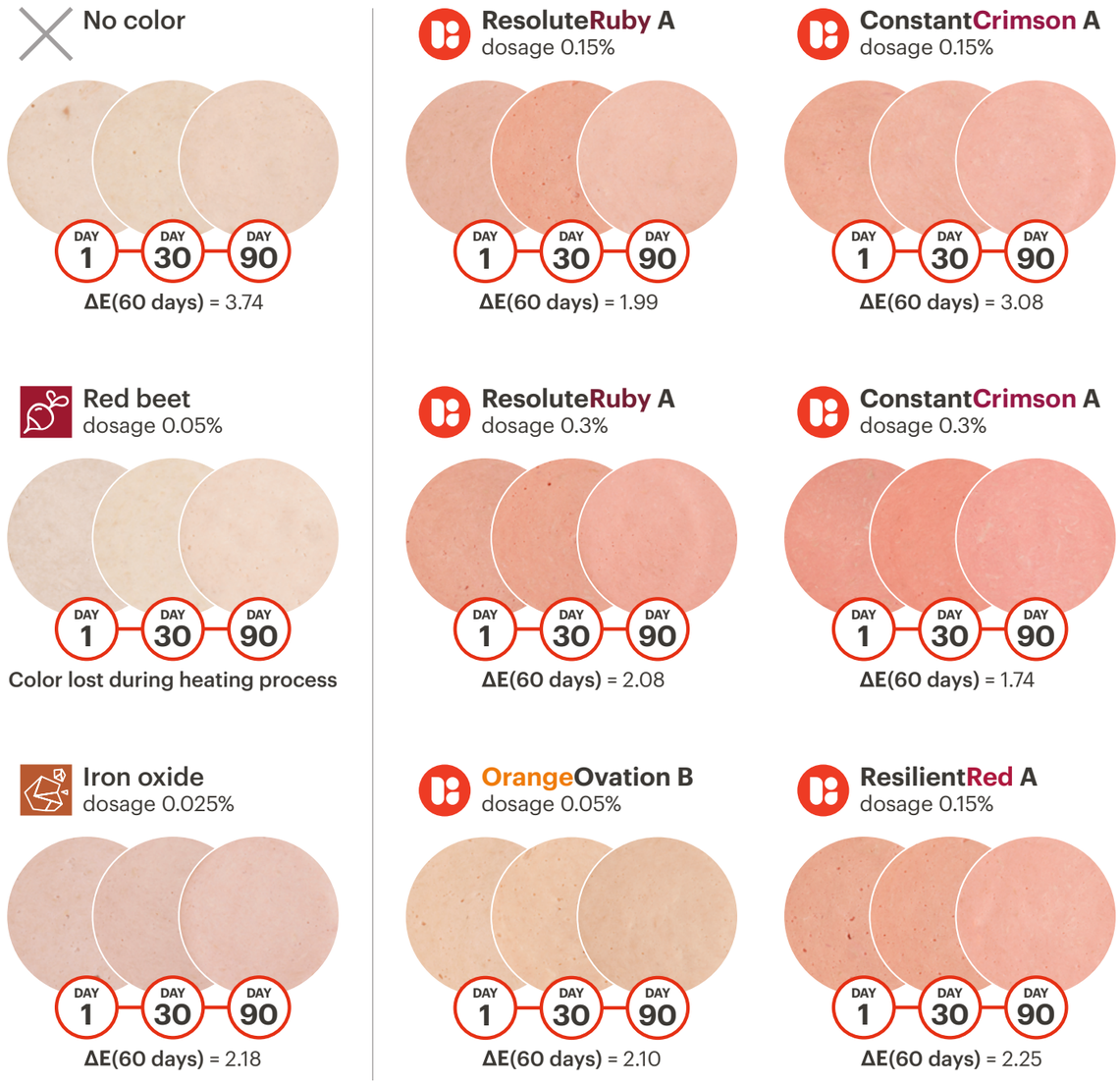
ΔE<2 Difference not perceived with eyes

ΔE2-4 Slight difference

ΔE>4 Visible difference

Lycored offers a number of shade variations of all which perform with a delta E (level of change) of below 4 throughout typical shelf life of 2 months, which means very slightly visible to the naked eye.

Realtime stability test results at day 1, day 30 and day 90



The results

Our stability test data revealed that lycopene-based colors outperformed all competitors relative to stability to process, heat and light and providing an authentic ham like hue.

Lycored offers a number of shade variations of all which perform with a delta E (level of change) of below 4, which means very slightly visible to the naked eye.

To access our complete list of hues best-suited to your product's format and color profile go to:
www.lycored.com/huefinder

Adding sizzle to plant protein-based frankfurter sausage type

We have completed an accelerated stability study comparing a range of colorants compared to Iron oxide. We evaluated the product both smoked and unsmoked and also evaluated post cooking as per a typical consumer experience.

Our results showed some key insights such as:

- ResoluteRuby A is more stable compared to iron oxide and to the control uncolored base
- Before and after heating process in this application, ResoluteRuby A can mask base color change throughout shelf life
- ResoluteRuby A looks authentic and most comparable to meat-based frankfurter sausage
- Smoking the sausages actually enhances color stability in the application
- Our color proved to be stable in semi-permeable casings with exchange of smoke, water and air, during smoking, cooking and shelf life of 3 months
- Our color is stable in high shearing with 1500RPM for 3 minutes, during emulsion preparation in a cutter

Test conditions

Shaded, cold outside (replicating the shade the consumer sees on the shelf in retail or at home in the fridge).

Light intensity 600–800 Lux

Standard conditions 8°C

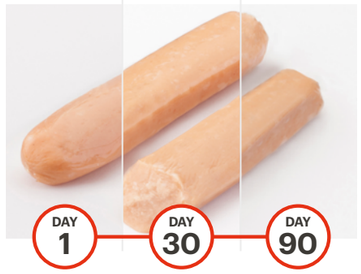
Real time study span of 3 months

Accelerated stability test results at day 1, day 30 and day 90

No color
smoked

ΔE(60 days) = 3.20

ResoluteRuby A
dosage 0.15%, smoked



ΔE(60 days) = 2.01

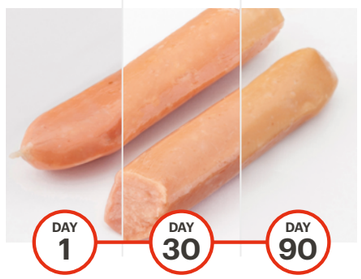
ResoluteRuby A
dosage 0.15%, unsmoked

ΔE(60 days) = 2.66

Iron oxide
dosage 0.025%, smoked

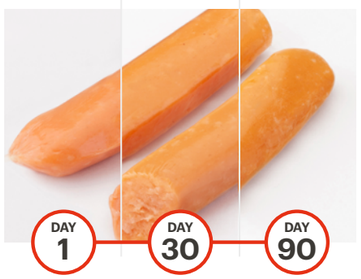
ΔE(60 days) =0.89

ResoluteRuby A
dosage 0.30%, smoked



ΔE(60 days) = 1.63

SteadfastScarlet A
dosage 0.15%, smoked



ΔE(60 days) = 4.23

Case study: Now, that's a tasty-looking burger!

A typical challenge:
Achieving an authentic "bloody" red shade for the raw variant, while also achieving stable and appetizing red brown cooked beef shade.

The solution:
Our lycopene-based ResoluteRuby A, works well in a higher fat matrix and is responsible for the perfect red shade to achieve that "raw" burger look.

An additional challenge was to replicate the bleeding effect: As lycopene does not typically migrate or leech a blend with beet was needed to give the bleed effect.

Last word on the first choice for natural color authenticity

The importance of color authenticity and stability to the market success of plant-based meats cannot be underestimated. Consumers' perceptions insist that meat-free alternatives look and taste like the real thing while also only utilizing all-natural, clean-label ingredients. Vegans and vegetarians' dietary restrictions narrow the choices for natural ingredients even further and to attract these and other potential consumers, plant-based meat alternatives must be clean-label and free from animal by-products.

Limited choices for coloring such a meaty category

Food engineers seeking both clean label and plant-based colors for their recipes have limited choices for red hues, but not all have the intensity, processing integrity and stability required to meet consumers highest expectations.

Of all the plant-based color sources Lycored's palette of lycopene-based colors provide the most authentic and stable shades, ideal for all types of plant-based meat products. Stability test data proves it, revealing that lycopene-based colors outperformed all competitors relative to process stability, exposure to heat and light, and delivering that authentic, appetizing hue consumers crave.

Taste neutral, Lycored's red hues are pH independent and offer highly consistent stability from manufacturing to point of sale. They also offer the best coverage for most plant-based meat substitutes being manufactured today.

Time for the industry to eliminate color barriers

As the demand for plant-based products mount, it is time for the industry to limit the color barrier preventing customers from trying and enjoying these foods. Food manufacturers should proactively advance the authentic visual appeal of foods in this category and better correlate color with the different types of plant-based meatless alternatives.

What else is needed to help consumer's cross over? Firstly, a traceable supply chain with continued focus on cultivation of the crop and soil. Followed by developing a better base of experience and collecting data to educate the market and increase awareness of the best alternatives.

Lycored is committed to helping the industry sustain and grow demand for plant-based meat alternatives. Through lycopene science and collaboration we are helping the industry break down the color barriers preventing people from trying plant-based meats.

References

1. https://www.peta.org/living/food/best-vegan-chicken-products/

2. https://flavourjournal.biomedcentral.com/articles/10.1186/s13411-015-0033-1

Discover your perfect color match for plant-based meat and fish alternatives with Lycored's HueFinder

HueFinder is a unique online color-matching tool which allows manufacturers to find the perfect shade for food and beverage products, access valuable application specific insights and accelerate new product development or natural reformulation projects.

Find your perfect color match with HueFinder,™ our online color finder;

www.lycored.com/huefinder

Lycored

For further information please contact us at:

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or visit www.lycored.com