



จุฬาลงกรณ์
มหาวิทยาลัย
CHULALONGKORN UNIVERSITY



Hybrid Flavors: Crafting the Future of Flavor in Next-Gen Beverages

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Self Introduction

- **Assoc. Prof. Inthawoot Suppavorasatit, Ph.D.**
 - Deputy Dean, Faculty of Science, Chulalongkorn University
 - Academic staff
 - Department of Food Technology, Faculty of Science, Chulalongkorn University
 - Speaker
 - Flavor Academy, Food Innopolis, NSTDA
 - National Food Institute
 - Food Additives
 - Plant-based meat
 - Academic Institutes
 - Others



Education and Expertise

- Education
 - B.Sc. and M.Sc. in Food Technology, Chulalongkorn University
 - Ph.D. in Food Science and Human Nutrition, University of Illinois, USA
- Expertise
 - Flavor Chemistry and Analysis
 - Flavor Interactions and Releases
 - Alternative Food Proteins
 - Meat and Meat Products
 - Cocoa and Coffee

What is “Flavor”?



What are hybrid flavors?



Definition

- **Hybrid (from Oxford Languages)**
 - A thing made by combining two different elements
 - A mixture
- **Hybrid beverages**
 - Beverages that combine elements from two or more different types or categories of beverages
 - **Caused hybrid flavors in the beverages!**

Example:

- **Woodbridge Wine Sodas**

- White wine
- classic soft drink flavors



Various combinations

- Fusion of traditional + novel
 - Coffee + fruit
- Cross-category
 - Floral + citrus
- Functional + indulgent
 - Local + global

Various combinations

- Fruit + coconut milk/energy drink
- coffee + juice (joffee)



Trends driving hybrid flavors

- Health and wellness meets indulgence
 - Better-for-you options
 - Low sugar
 - High nutritional value
 - Health or functional benefits



Trends driving hybrid flavors

- Experience-seeking Gen Z and Millennials
 - Unique or unexpected flavor combinations
 - Storytelling (culture, sustainability, craftsmanship)
 - Interactive or sensorial elements (layer drinks, color-changing teas, edible flowers)
 - Social media



<https://lmld.org/fourth-of-july-layered-drinks/>

https://en.wikipedia.org/wiki/Bacon_soft_drink?utm_source=chatgpt.com

Trends driving hybrid flavors

- Sustainability and ingredient innovation
 - Flavor creativity with eco-conscious or novel ingredients
 - Upcycled ingredients (spent fruit pulp, cocoa shells)
 - Low-impact plant bases
 - Fermentation and functionalism (kombucha with tropical fruits/flowers)



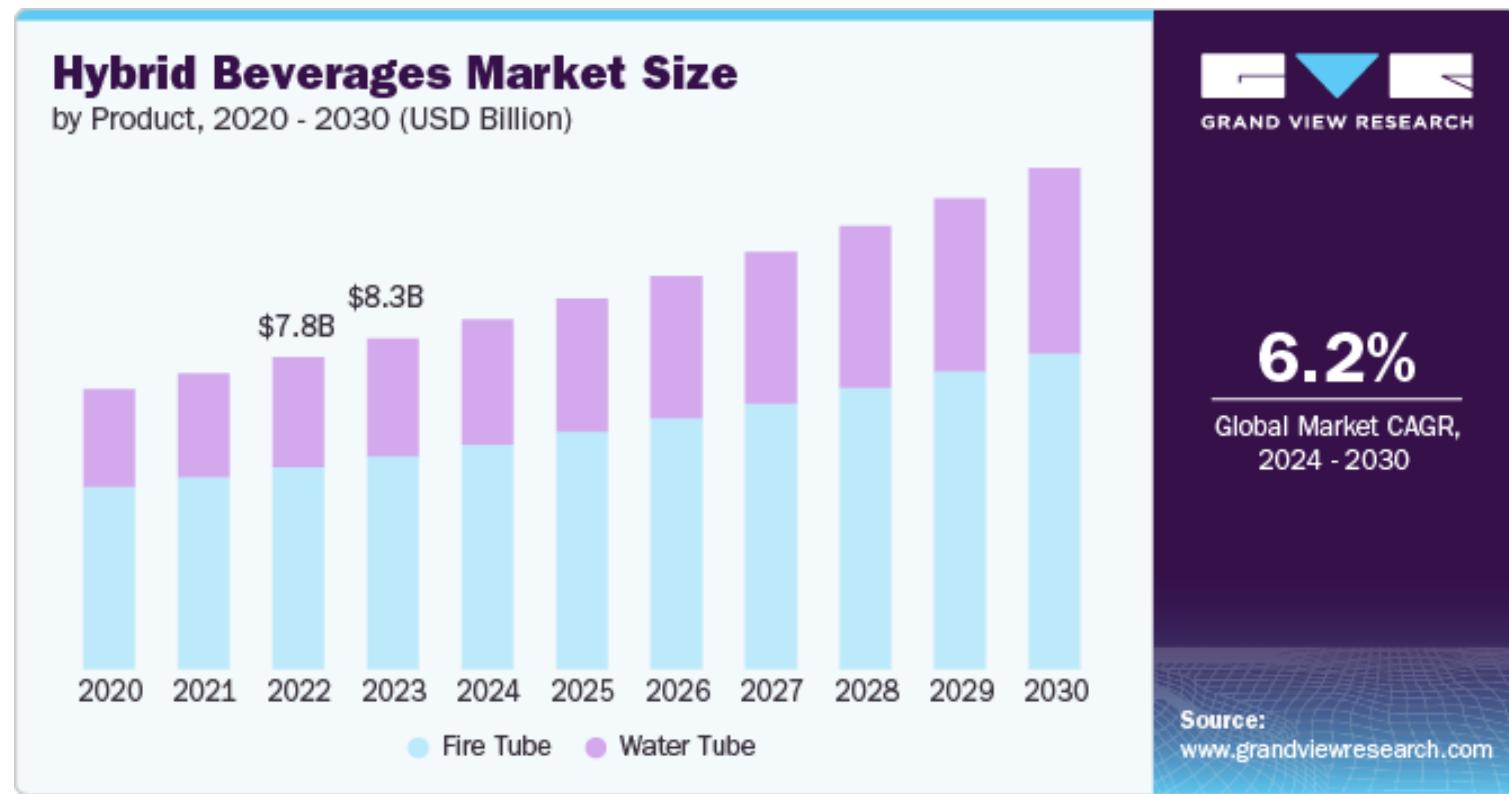
Trends driving hybrid flavors

- Premiumization and storytelling
 - Creating perceived value
 - Rare or exotic ingredients, craftsmanship, packaging, limited editions
 - Narratives to culture or place, heritage or personal stories



Market Growth Potential

- Global hybrid beverage market
 - \$8.26B (2023), CAGR ~6.2%

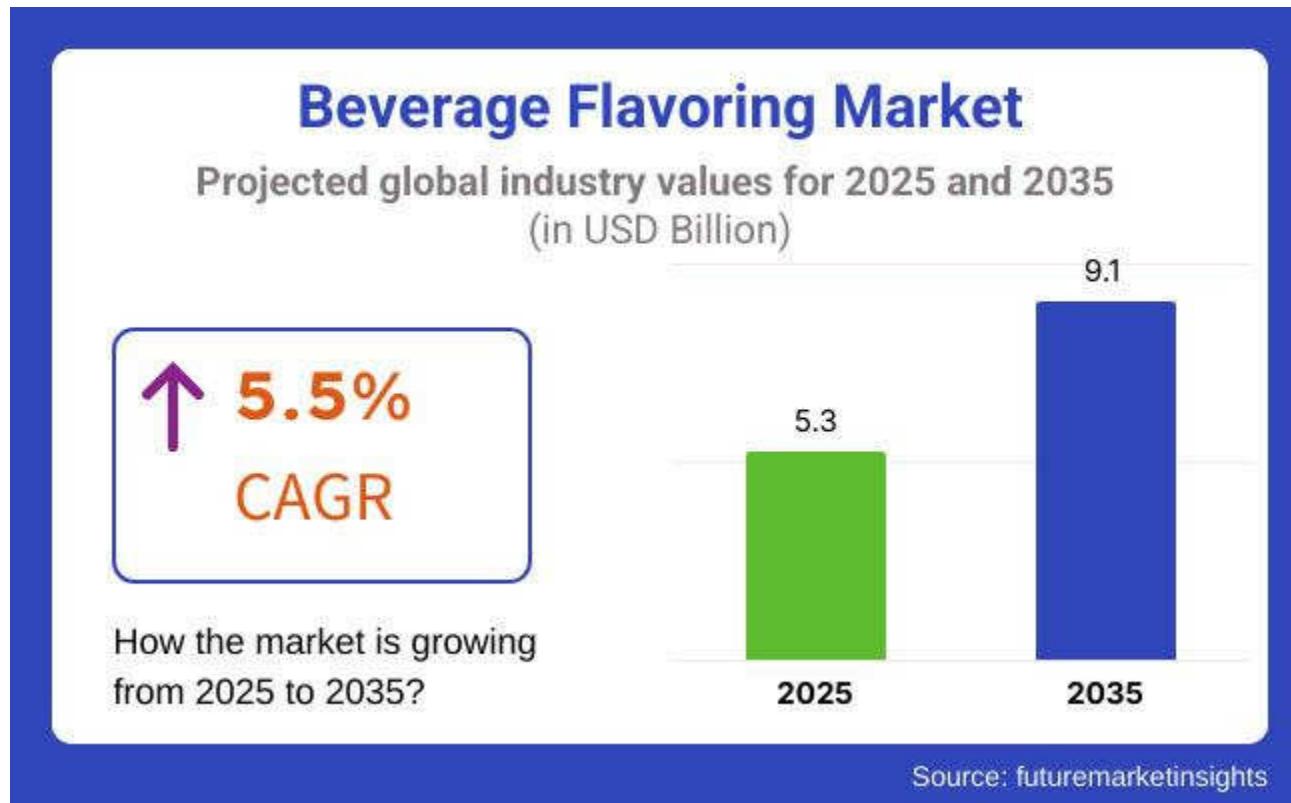


Market Growth Potential

- Global hybrid beverage market
 - Innovation in flavor overlaps
 - coffee + juice and tea-infused cocktails
 - Rising demand for functional drinks
 - kombucha with probiotics, vitamin-enriched teas
 - Consumer focus on health, wellness, and unique products
 - Regional growth:
 - Asia Pacific around 6.8% CAGR
 - North America faster at 8+% percent CAGR

Market Growth Potential

- Global average flavoring market



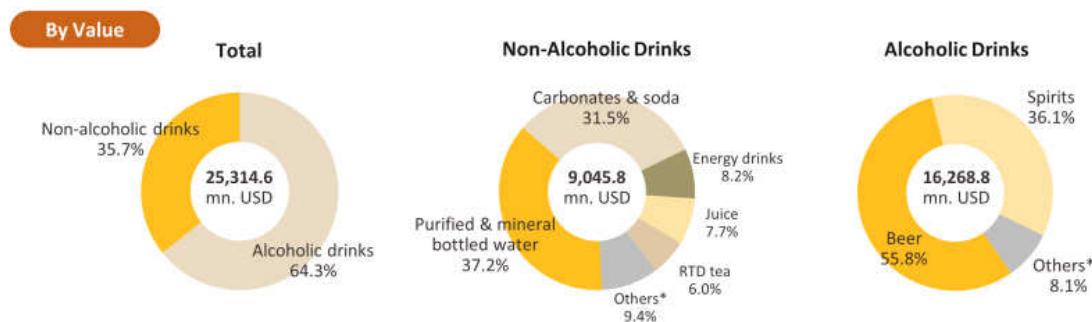
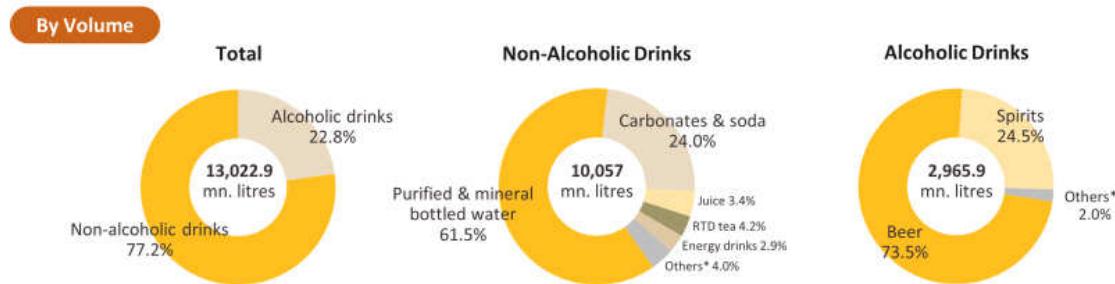
Market Growth Potential

- Global beverage flavoring market
 - Growth drivers
 - Rising demand for customized and hybrid flavor experiences
 - Growth in functional beverages (immunity, energy, relaxation)
 - Popularity of botanical, floral, and cultural-inspired flavors
 - Increased use of natural flavorings and clean label trends

Market Growth Potential

- Thai beverage industry growth: 3.5-4.5% annually through 2027

Figure 1: Thailand Domestic Beverage Consumption (2023)



Source: Euromonitor

Market Growth Potential

- Key Insight on Thai beverage industry growth
 - Health and functional beverages are driving growth
 - Botanical and local ingredient fusion on the rise
 - Premium and lifestyle positioning appeal to urban consumers
 - Plant-based and dairy alternatives enable new hybrid formulations
 - Innovation is key to competing with imports

Thai-Ready innovation concept

- Nom Yen + butterfly pea tea
- Coffee + lychee + jasmine floral note
- Roasted coconut caramel latte with nata de coco (coconut jelly)
- Functional fruit teas with herbal infusions



The Science behind hybrid flavor

- Flavor layering techniques
- Flavor-flavor interactions and flavor-matrix compatibility
- Volatile aroma balance
- Texture and mouthfeel
- Perceptual synergy

Challenges of using flavor in
protein-based beverages:

Example in plant-based beverages

Problems of using flavorings

- Since plant proteins are used
 - Mostly soy proteins and pea proteins
 - Cause beany/green/grassy flavor



To make flavored plant-based beverages

- ▶ Flavoring agents from flavor houses!



Problems of using flavorings

Mix proteins
and
ingredients



Flavorings

Mixing,
homogenizing
and heat
treatments



Plant-
based
beverages

Flavor of plant-based beverages is different
from chosen flavorings

Flavor-food interaction and flavor perception

- Flavor compounds = chemicals
 - Containing functional groups
 - Aldehydes, ketones, esters, ethers, alcohols, etc.
- Each functional group can interact (bind) with macromolecules
 - Proteins, lipids, carbohydrates
- Flavor compounds that are permanently bound are no longer available for perception
 - Weaker or change food flavor profile

Influence of food matrix

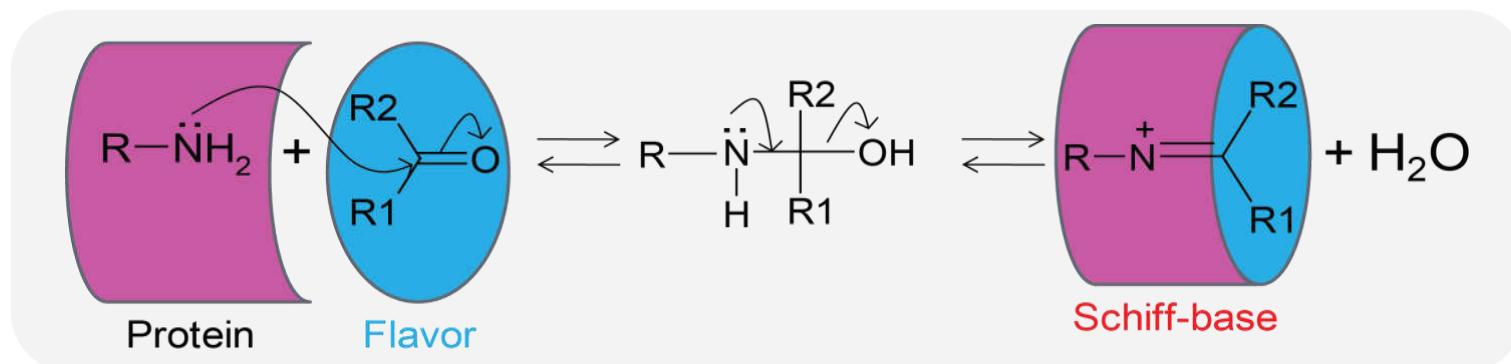
- Protein-flavor interactions
 - Protein itself does not have much flavor
 - But it can alter flavor perception by binding with flavor compounds
 - Off-flavors
 - Desirable flavors
 - Therefore, flavor profile of the food changes!
 - It's difficult for food manufacturers to choose and control proper level of flavoring necessary to achieve the desired flavor intensity in the food

Influence of food matrix

- Protein-flavor interactions (cont.)
 - Chemical interactions
 - Reversible interactions
 - Hydrophobic interactions
 - Ionic bonds
 - Hydrogen bonds

Influence of food matrix

- Protein-flavor interactions (cont.)
 - Chemical interactions
 - Irreversible interactions
 - Covalent bonds (NH_2 and SH group of protein)

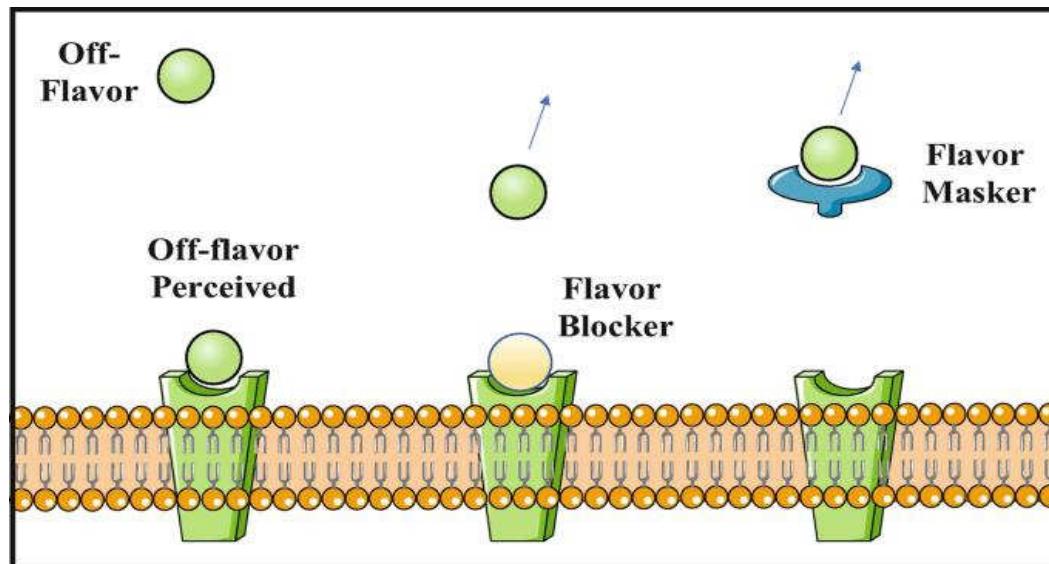


Influence of food matrix

- Protein-flavor interactions (cont.)
 - Resistance to mass transfer
 - Some functions of protein serve in foods
 - Impart viscosity
 - Cause gelation

To solve the flavor problems

- Off-flavor of the proteins
 - Beany/green/grassy flavor
- To solve this problem in the plant-based products
 - Masking agents or flavor blocking agents are needed



McClements and Grossmann, 2022

Problems of using flavorings

Mix proteins
and
ingredients



Flavorings

Mixing,
homogenizing
and heat
treatments



Plant-
based
beverages

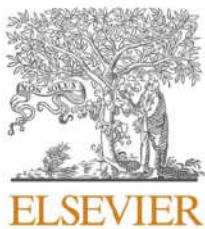
Flavor of plant-based beverages is different
from chosen flavorings

Therefore,

- Need a lot of study!
 - Aroma impact compounds required for adding to the plant-based beverages
 - Aroma compounds-protein and/or ingredients interactions study
 - Flavorings + plant proteins in plant-based beverages

Example: flavor binding in pea protein

LWT - Food Science and Technology 198 (2024) 115964



Contents lists available at [ScienceDirect](#)

LWT

journal homepage: www.elsevier.com/locate/lwt

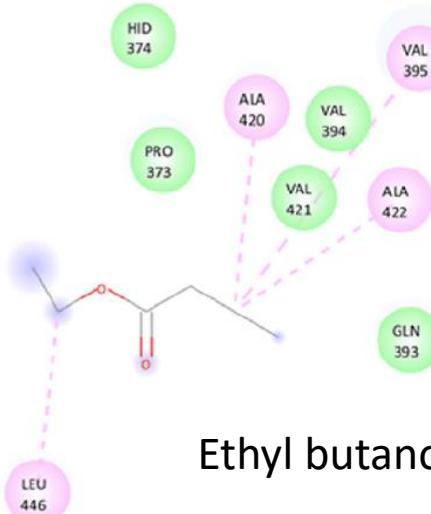
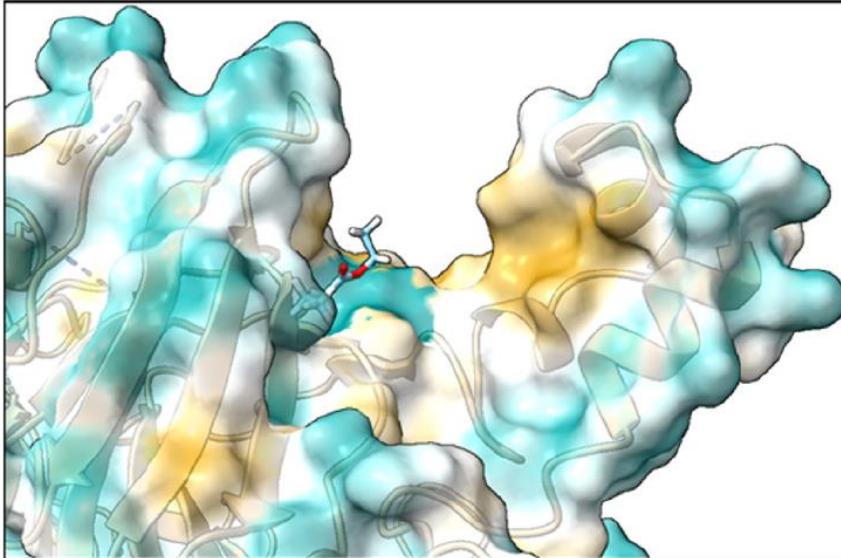


Molecular interactions by thermodynamic and computational molecular docking simulations of selected strawberry esters and pea protein isolate in an aqueous model system

Thanakorn Wongprasert ^a, Pakavit Mathatheeranan ^a, Xing Chen ^b, Tirayut Vilaivan ^c,
Utid Suriya ^{d,e}, Thanyada Rungrotmongkol ^{f,g}, Inthawoot Suppavorasatit ^{a,*}

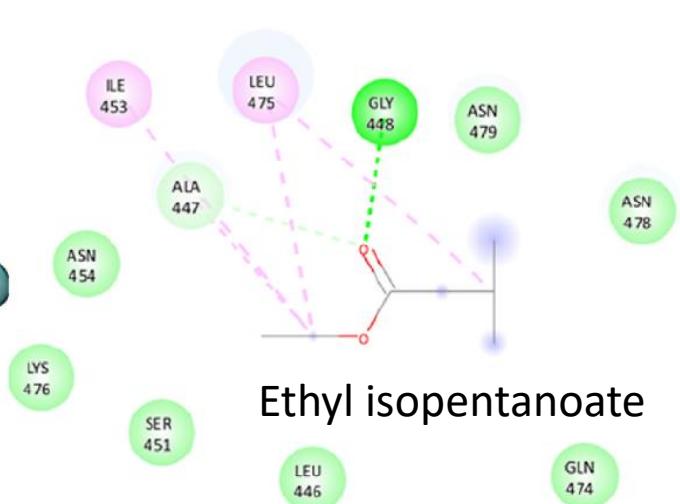
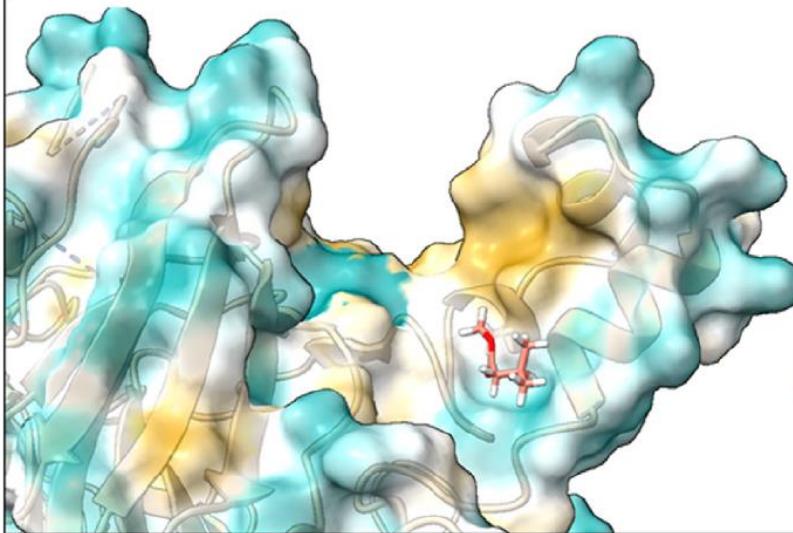
Example: flavor binding in pea protein

(a)



Ethyl butanoate

(b)



Ethyl isopentanoate

Example: flavor binding in pea protein

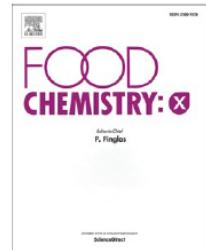
Food Chemistry: X 23 (2024) 101702



Contents lists available at [ScienceDirect](#)

Food Chemistry: X

journal homepage: www.sciencedirect.com/journal/food-chemistry-x



Effect of functional groups in strawberry flavoring on pea protein-flavor interactions: Potential applicable in flavor formulation for plant-based protein aqueous foods

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Tirayut Vilaivan ^b, Utid Suriya ^c, Thanyada Rungrotmongkol ^{d,e}, Keith Cadwallader ^f,
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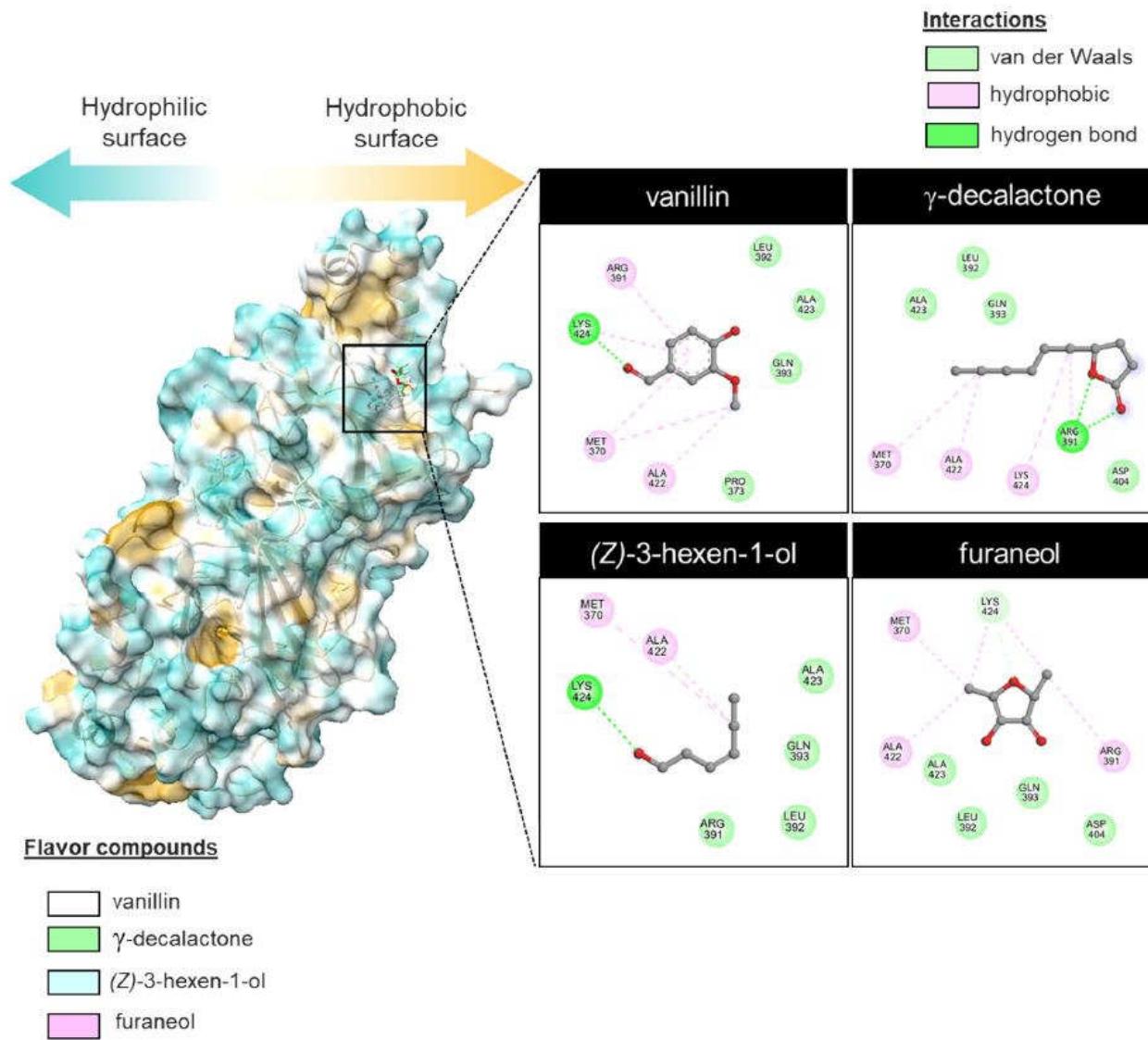
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Example: flavor binding in pea protein



Example: flavor binding in pea protein

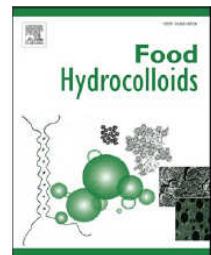
Food Hydrocolloids 162 (2025) 110956



Contents lists available at [ScienceDirect](#)

Food Hydrocolloids

journal homepage: www.elsevier.com/locate/foodhyd



Competitive binding between key aroma components of a strawberry flavoring and pea protein isolate within an aqueous model system



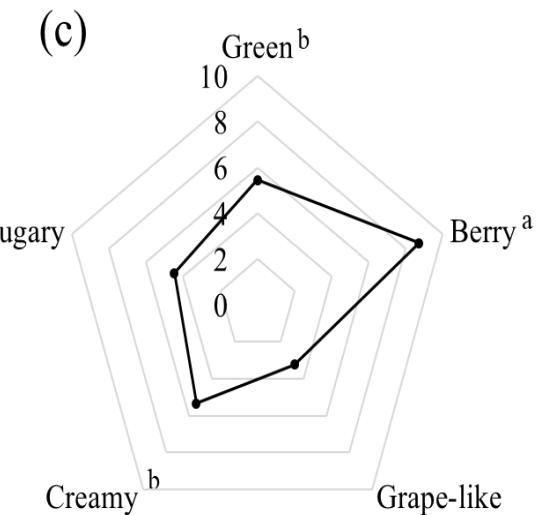
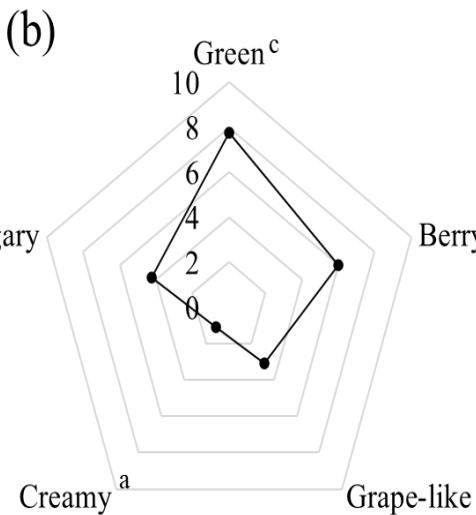
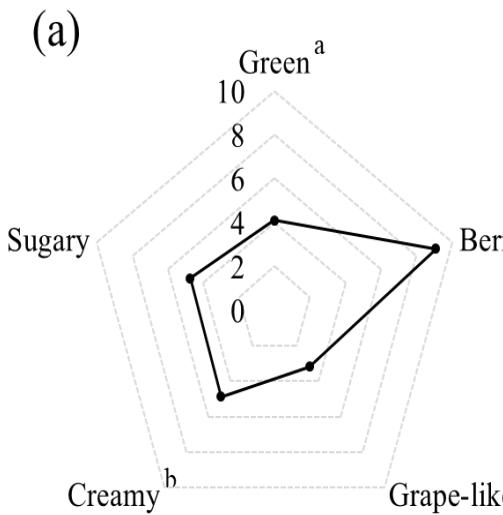
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Example: flavor binding in pea protein



Take home messages

- Hybrid flavors offer health-forward indulgence, functional, storytelling, cost efficiency
- Blend familiar + novel for Thai market success
- Innovate with art, science, and culture
- Flavor is important in term of consumers' consumption choice
- Interaction of flavor to food components causes the change of flavor profile...
- **Still need more studies!**

Thank you for your kind
attention

Q & A

contact: inthawoot.s@chula.ac.th