單選題 (共 50 題，每題 2 分，答錯倒扣 0.5 分，請作答於答案卡中) 注意:請用 2B 鉛筆作答於答案卡

Article 1

(Source: Comprehensive Reviews in Food Science and Food Safety 25(1): e70359)

Natural Phytosterols as the Nutraceuticals or Functional Agents: Insights Into Structure-Activity Relationship
(Compr Rev Food Sci Food Saf 2026 25(1):e70359.)

Phytosterols are naturally occurring ingredients widely present in dietary sources, with over 250 types identified. Mounting studies have shown they possess various health-promoting benefits, such as lowering-cholesterol, anti-inflammatory, and anti-oxidation effects. With these advantages, they are regarded as important bioactive components that are allowed to be incorporated into foods. However, their characteristics of low absorption, rapid metabolism, and excretion significantly limit their practical efficacy. In addition, many delivery vehicles have been fabricated to solve these problems. Crucially, the structural diversity of phytosterols directly influences their physicochemical properties and bioactivities. More interestingly, their unique structures endow them with intrinsic capabilities, including self-assembly, emulsification, gelation, and liposome stabilization, enabling their use not only as nutraceuticals but also as functional agents. These properties also pave the way for the development of carrier-free delivery systems for phytosterols, potentially addressing their application issues. Despite this potential, these functional attributes remain underemphasized. Herein, we comprehensively introduced the structures, dietary and biosynthetic sources, absorption, metabolism, distribution, and bioactivities of phytosterols, with a particular focus on the structure–activity relationship. Furthermore, we highlighted their emerging roles as wall materials, emulsifiers, gelators, and liposome stabilizers, noting that they can position as both nutraceuticals and functional agents to expand their applications.

Phytosterols are natural compounds abundant in dietary sources like vegetable oil, nuts, and cereals. Although low contents were found in vegetables and fruits, they are also the main sources due to the high daily consumption. To date, over 250 types of phytosterol have been identified from nature, sharing a characteristic rigid perhydrocyclopentanophenanthrene skeleton. They are usually characterized by a side chain at the C—17 position and substituent groups at the C—3 position, most commonly occupied by a hydroxyl group. Their structural similarity to cholesterol underpins their clinically demonstrated ability to reduce cholesterol levels. Besides, they show desirable anti-inflammatory and anti-oxidation activities, which are further conducive to reduce the risk of cardiovascular diseases.

With the growing awareness and demand for all-natural and healthy labels, phytosterols have gained much attention as important nutraceuticals due to their biological functions and naturally occurring attributes. They are known for well-established safety status (generally recognized as safe). Up to now, phytosterols have been legally approved as novel food ingredients for food fortification in many countries, including the United States, European Union (EU), China, Australia, New Zealand, and other 20 countries. They have been introduced into various foods, such as margarines, cheese, yogurt, mayonnaise, salad sauces, and others, which are widely available in the market. In spite of these, their practical efficacy is severely limited by low absorption, rapid metabolism, and excretion. Consequently, the recommended daily intake (1.5–3.0 g/day) of phytosterols far exceeds typical dietary consumption (often below 0.4 g/day). To overcome these drawbacks, various carriers, including nanoparticles, micelles, nanostructured lipid carriers (NLCs), solid lipid nanoparticles (SLNs), microcapsules, liposomes, and emulsions, have been developed. These vehicles had high loading efficiency, improved water dispersibility, enhanced stability, especially enhanced bioaccessibility, and even higher bioactivities. Despite these advantages, it cannot be ignored the potential toxicity induced by the used carrier materials.

It is worth mentioning that phytosterol diversity, particularly the substituent groups at position C—3, the saturation of the core skeleton, and the length of the side chain at the C—17 position, directly dictates their physicochemical properties and bioactivities. For instance, a hydroxyl group at the C—3 position results in very low oil solubility (<1.0%), whereas esterification dramatically increases the oil solubility, absorption rate, or even higher cholesterol-lowering efficacy. These findings highlight the critical importance of structure–activity relationship analysis for developing precise nutritional strategies. Intriguingly, their unique molecular structures enable self-assembly behavior with hydrogen bonds, π–π stacking, and hydrophobic interactions as the main driving forces. In addition, the rigid skeleton, hydrophobic side chain, and substituent groups are the decisive structures. Raw phytosterols or their self-assembled structures could further limit the migration of organic solvents to form organogels or absorb on the water-oil interface to stabilize the emulsions, showing excellent gelling and emulsifying activities. Furthermore, they are alternative stabilizers of cholesterol to liposomes. These capabilities position phytosterols not limited to merely functional factors but also novel functional agents as wall materials, emulsifiers, gelators, and liposome stabilizers. Their ability to self-assemble and their multifunctionality represent a new paradigm; that is, phytosterols are not only nutraceuticals with physiological benefits

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but also functional agents that possess inherent material properties, making them suitable for constructing delivery systems. Notably, the inherent bioactivity of phytosterols is conducive to constructing bioactive carriers, which is one of the advantages over other carrier materials. Inspired by our published work, these properties enable to develop carrier-free vehicles for phytosterols to address their application limitations, potentially overcoming their application limitations and carrier-related toxicity concerns. Of particular interest, the difference in structures also leads to different functional performances. However, the fundamental correlations between their structures, self-assembly behaviors, and further properties remain underexplored.

This review comprehensively summarized and discussed recent advances in phytosterol research over the past decade, including their structures, dietary and biosynthetic sources, absorption, metabolism, distribution, and bioactivities. In contrast to the existing reviews, this article emphasized the critical role of intrinsic structure in determining key characteristics of phytosterols, such as hydrophobicity, low bioavailability, bioactivities, and self-assembly properties. A key focus of this review was on the corresponding structure–activity relationship of phytosterols and characteristics/functional performances Additionally, we proposed a novel perspective of phytosterols as not limited to nutraceuticals but emerging roles as functional agents, including wall materials, emulsifiers, gelators, and liposome stabilizers. Our purpose was to provide critical insights into the structure–activity relationship of phytosterols as nutraceuticals and functional agents and propose future development in this field. These findings were conducive to developing precise nutritional strategies for phytosterol-based foods.

Please answer the following question:

1. According to the text, which of the following best describes the "dual role" of phytosterols?

(A) They act as both flavor enhancers and preservatives in processed foods. (B) They serve as both nutraceuticals with health benefits and functional agents like emulsifiers or gelators.

(C) They function as both water-soluble vitamins and fat-soluble minerals.

(D) They are used as both synthetic additives and natural colorants.

2. What is the primary structural skeleton shared by the over 250 types of identified phytosterols?

(A) A flexible fatty acid chain structure.

(B) A characteristic rigid perhydrocyclopentanophenanthrene skeleton.

(C) A complex polysaccharide structure.

(D) A simple polypeptide backbone.

3. Which of the following factors is mentioned as a limitation to the practical efficacy of phytosterols?

(A) High toxicity at low doses.

(B) Excessive water solubility leading to instability.

(C) Low absorption, rapid metabolism, and excretion.

(D) Lack of approval for use in food products by the EU or USA.

4. According to the text, what is the approximate discrepancy between the recommended daily intake and the typical dietary consumption of phytosterols?

(A) Typical consumption matches the recommended 1.5–3.0 g/day.

(B) Typical consumption is twice the recommended dosage.

(C) There is no recommended daily intake established for phytosterols.

(D) Typical consumption (<0.4 g/day) is significantly lower than the recommended 1.5–3.0 g/day.

5. How does the modification of the C–3 position, specifically through esterification, affect phytosterols?

(A) It dramatically increases oil solubility, absorption rate, or cholesterol-lowering efficacy.

(B) It decreases their stability and makes them toxic to humans.

(C) It turns them into water-soluble compounds instantly.

(D) It removes their ability to lower cholesterol levels entirely.

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6. Which mechanisms are identified as the main driving forces for the self-assembly behavior of phytosterols?
(A) Ionic bonding and covalent cross-linking.
(B) Magnetic attraction and electrostatic repulsion.
(C) Hydrogen bonds, π–π stacking, and hydrophobic interactions.
(D) Enzymatic degradation and oxidation processes.

7. While delivery vehicles like nanoparticles and liposomes enhance bioaccessibility, what potential drawback is noted regarding their use? (A) They significantly reduce the shelf-life of the food product.
(B) They neutralize the cholesterol-lowering effects of phytosterols.
(C) The potential toxicity induced by the used carrier materials cannot be ignored.
(D) They make the production process too expensive to be feasible.

8. Which structural feature of phytosterols underpins their clinically demonstrated ability to reduce cholesterol levels?
(A) The presence of a long protein chain.
(B) Their structural similarity to cholesterol.
(C) Their ability to dissolve completely in water.
(D) Their high content of minerals like calcium.

9. In the context of "carrier-free delivery systems," what advantage do phytosterols possess over other carrier materials?
(A) They are completely synthetic and easier to manufacture.
(B) Their inherent bioactivity is conducive to constructing bioactive carriers. (C) They have no structural impact on the food matrix.
(D) They are derived exclusively from animal sources.

10. Which of the following food categories are mentioned as common vehicles for phytosterol fortification in the market?
(A) Raw meats and fresh seafood.
(B) Carbonated beverages and energy drinks.
(C) Frozen vegetables and canned fruits.
(D) Margarines, cheese, yogurt, and salad sauces.

Article 2
(Source: Reading Explorer 4 page 45-47)

HOW SAFE IS OUR FOOD?

A
The everyday activity of eating involves more risk than you might think. It is estimated that each year in the United States, 48 million people suffer from foodborne diseases; 128,000 of them are hospitalized, and 3,000 die. In the developing world, contaminated food and water kill over half a million children a year. In most cases, virulent types of bacteria are to blame.

B

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Bacteria are an integral part of a healthy life. There are 200 times as many bacteria in the intestines of a single human as there are human beings who have ever lived. Most of these bacteria help with digestion, making vitamins, shaping the immune system, and keeping us healthy. Nearly all raw food has bacteria in it as well. But the bacteria that produce foodborne illnesses are of a different, more dangerous kind.

Bad Bacteria

C

Many of the bacteria that produce foodborne illnesses are present in the intestines of the animals we raise for food. When a food animal containing dangerous bacteria is cut open during processing, bacteria inside can contaminate the meat. Fruits and vegetables can pick up dangerous bacteria if washed or watered with contaminated water. A single bacterium, given the right conditions, divides rapidly enough to produce billions over the course of a day. This means that even only slightly contaminated food can be dangerous. Bacteria can also hide and multiply on dishtowels, cutting boards, sinks, knives, and kitchen counters, where they're easily transferred to food or hands.

D

Changes in the way in which farm animals are raised also affect the rate at which dangerous bacteria can spread. In the name of efficiency and economy, fish, cattle, and chickens are raised in giant "factory" farms, which confine large numbers of animals in tight spaces. Cattle, for example, are crowded together under such conditions that if only one animal is contaminated with the virulent bacteria *E. coli* O157:H7, it will likely spread to others.

Tracking the Source

E

Disease investigators, like Patricia Griffin, are working to find the sources of these outbreaks[3] and prevent them in the future. Griffin, of the Centers for Disease Control and Prevention (CDC) in the United States, has worked in the foodborne-disease business for 15 years. Periodic *E. coli* outbreaks turned her attention to the public food safety threat that exists in restaurants and in the food production system. Food safety is no longer just a question of handling food properly in the domestic kitchen. "Now," Griffin says, "we are more aware that the responsibility does not rest solely with the cook. We know that contamination often occurs early in the production process—at steps on the way from farm or field or fishing ground to market."

F

Griffin's job is to look for trends in food-related illnesses through the analysis of outbreaks. Her team tries to identify both the food source of an outbreak and the contaminating bacteria. To link cases together, the scientists use a powerful tool called PulseNet, a national computer network of health laboratories that matches types of bacteria using DNA analysis. PulseNet allows scientists to associate an illness in California, say, with one in Texas, tying together what might otherwise appear as unrelated cases. Then it's the job of the investigators to determine what went wrong in the food's journey to the table. This helps them decide whether to recall a particular food or to change the process by which it's produced.

G

In January 2000, public health officials in the state of Virginia noted an unusual group of patients sick with food poisoning from salmonella. Using PulseNet, the CDC identified 79 patients in 13 states who were infected with the same type of salmonella bacteria. Fifteen had been hospitalized; two had died. What was the common factor? All had eaten mangoes during the previous November and December. The investigation led to a single large mango farm in Brazil, where it was discovered that mangoes were being washed in contaminated water containing a type of salmonella bacteria. Salmonella contamination is a widespread problem; salmonella cases involving contaminated chicken, melons, coconut, and cereals were reported in 2018.

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H

The mango outbreak had a larger lesson: We no longer eat only food that is in season or that is grown locally. Instead, we demand our strawberries, peaches, mangoes, and lettuce year-round. As a result, we are depending more and more on imports. Eating food grown elsewhere in the world means depending on the soil, water, and sanitary conditions in those places, and on the way in which their workers farm, harvest, process, and transport the food.

Reducing the Risk

I

There are a number of success stories that provide hope and show us how international food production need not mean increased risk of contamination. Costa Rica has made sanitation of fruits and vegetables a nationwide priority. Fresh fruits and vegetables are packed carefully in sanitary conditions; frequent hand washing is compulsory; and proper toilets are provided for workers in the fields. Such changes have made Carmela Velazquez, a food scientist from the University of Costa Rica, optimistic about the future. "The farmers we've trained," she says, "will become models for all our growers."

J

In Sweden, too, progress has been made in reducing the number of foodborne disease at an early stage. Swedish chicken farmers have eliminated salmonella from their farms by thoroughly cleaning the area where their chickens are kept, and by using chicken feed that has been heated to rid it of dangerous bacteria. Consequently, the chickens that Swedes buy are now salmonella-free. These successes suggest that it is indeed feasible for companies and farms to produce safe and sanitary food, while still making a profit.

Please answer the following questions:

11. What is the main idea of this reading?

(A) How bacteria can be completely eliminated from food
(B) Why imported food tastes better than local food
(C) How foodborne bacteria spread and how they can be controlled
(D) Why people should avoid eating fruits and vegetables

12. According to paragraph C, why can even slightly contaminated food be dangerous?

(A) Bacteria are invisible to the human eye
(B) Bacteria can multiply extremely quickly
(C) Food often stays warm for a long time
(D) Raw food always contains bacteria

13. What does PulseNet help scientists do?

(A) Clean contaminated food
(B) Transport food safely
(C) Match related illness cases across different places
(D) Test whether food is cooked properly

14. Why has food contamination become a more global problem, according to paragraph H?

(A) People eat more meat than before
(B) Food is produced more cheaply

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(C) People eat food grown in many different countries
(D) Farmers no longer wash their crops

15. What does Carmela Velazquez mean when she says the trained farmers will "become models for all our growers"?

(A) They will appear in television advertisements
(B) Other farmers will copy their safe practices
(C) They will sell more food than others
(D) They will work for the government

Article 3

(Source: Food Engineering Reviews 17, no. 1 , 2025, 27-54)

Food processing has undergone notable and ongoing transformations owing to Industry 4.0, the prevailing industrial revolution that has fundamentally reshaped the dynamics of the sector. Introducing smart technologies like robotics, AI, IoT, and machine learning has led to a new era of automation, enabling more efficient operations, products, and services . Amidst this rapid evolution, it is recommended that small and medium-sized businesses (SMEs) explore the potential of Industry 4.0 technologies. Areas of interest include investment, maintenance, and practical applications. Furthermore, apprehensions arise regarding the technical preparedness concerning data management, infrastructure, data extraction, privacy, security, and handling potential disruptions. AI is significantly transforming the food and beverage industries, offering numerous opportunities to enhance efficiency, quality, and sustainability. It enables machines to engage in activities like cognition, perception, learning, problem-solving, and making decisions. As computing power and data capabilities advance, smart systems can execute multiple tasks simultaneously with precision, within designated timeframes. The widespread adoption of AI stems from its expanded capabilities. To apply AI-powered technologies within sustainable and ethical boundaries in the context of sustainable food systems, frameworks and models are necessary. Creating balanced social, technical, and environmental scenarios and future visions requires a multidisciplinary approach. Visioning methodologies involving diverse stakeholders can be employed by researchers to outline potential outcomes of AI-powered solutions. AI is utilized in the food sector for tasks like modelling, quality prediction and control, process management, drying, sensory evaluation, and addressing complex food processing challenges. Furthermore, AI can enhance business strategies by predicting sales and increasing yield. The ease, precision, and costsaving advantages of AI have made it a valuable asset in the food industry. The incorporation of AI algorithms alongside sensors such as E-nose and E-tongue serves to enhance its advantages even more. The transformative potential of technology, particularly Artificial Intelligence (AI), in the food industry is still in its early stages, as noted by Roy. This early stage presents ample opportunities for food technologists to explore the possibilities and harness the full potential of AI in their field. The integration of AI-assisted sensing systems, commonly referred to as intelligent systems, is being increasingly adopted in the food industry. This advanced technology has the potential to significantly transform the sector by enhancing the efficiency of food manufacturing, optimizing food processing, and ensuring high standards in food production and preservation. According to Thapa et al., these intelligent systems not only streamline operations but also contribute to better quality control and sustainability in the food industry. The fusion of AI with traditional food processing techniques marks a new era where automation and precision lead to safer, more nutritious, and longer-lasting food products.While there have been some research efforts on AI applications in the food sector, the coverage remains somewhat limited. Consequently, there is a clear need for a comprehensive analysis that highlights recent AI applications in the food industry and explores their synergies with relevant instruments. For enhanced accuracy, the document will explore different manifestations of AI and their present implementations within the food sector. This will encompass expert systems, fuzzy logic, artificial neural networks, and machine learning. Moreover, the convergence of AI with advanced technologies like near-infrared hyperspectral imaging, computer vision, and electronic nose will be a topic of discourse. Conducting a thorough search of

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previous research on the topic, it becomes evident that AI has been developed for addressing a diverse range of problems connected to the subject matter of this study. The selection and rejection processes were carried out meticulously ensuring the readers are presented with a comprehensive and insightful examination of how artificial intelligence is being utilized for engineering interventions in the food industry. The ultimate aim was to captivate the readers with a thoughtful and comprehensive narrative. The paper serves as a comprehensive review of the work conducted by researchers worldwide on the application of AI in the food industry. Beyond that, it sheds light on various AI technologies, tools, and unexplored areas within food processing that hold immense potential for the effective implementation of these tools."

16. What is the main idea of this passage?

(A) How food processing has become more expensive
(B) How Industry 4.0 and AI are transforming the food industry
(C) Why food safety is declining worldwide
(D) How consumers choose food products

17. Which of the following is mentioned as a challenge for small and medium-sized businesses (SMEs) when adopting Industry 4.0 technologies?

(A) Lack of skilled chefs
(B) Problems with marketing strategies
(C)Issues related to data management, infrastructure, and security
(D) Decreasing consumer demand

18. According to the passage, which of the following is NOT listed as a current application of AI in the food industry?

(A) Sensory evaluation
(B) Quality prediction and control
(C) Food drying processes
(D) Consumer taste preference surveys

19. Why does the paper include a review of previous research on AI in the food industry?

(A) To show that AI has already solved all food processing problems
(B) To compare different countries' food industries
(C)To provide a comprehensive and insightful understanding of how AI is used
(D) To criticize earlier scientific studies

20. What does Roy mean by saying that the use of AI in the food industry is still in its early stages?

(A) AI will soon replace all human workers
(B) AI has already reached its maximum potential
(C)There are many future opportunities to develop and apply AI
(D)AI is not suitable for food processing

Article 4
(Source: Molecules 2025, 30, 3869)

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Roses (*Rosa* spp.) are the most romantic and widely used ornamental plant worldwide. They have long been valued for their broad applications in landscaping, ecological conservation, perfumery, cosmetics, food processing, as well as medical and health care.

In recent years, there has been growing scientific and commercial interest in roses due to their rich profile of bioactive compounds, including essential oils, polyphenols, flavonoids, polysaccharides, and vitamins, which are associated with a wide range of health benefits such as antioxidant, anti-inflammatory, antimicrobial, and antidiabetic activities, as well as protective effects on different tissues.

Rosa spp., a genus within the family Rosaceae, comprise approximately 317 species and thousands of cultivated varieties. Many of these were previously world-famous ornamental plants without biological applications. They are rich in natural antioxidants and functionally active compounds, which contribute to significant nutritional and bioactivities. This review focuses on five species that are most widely used in industrial applications: *Rosa damascena* Mill., *Rosa rugosa* Thunb., *Rosa canina* L., *Rosa roxburghii* Tratt., and *R. laevigata* Michx. We elaborate on the major bioactive compounds derived mainly from their petals and fruits. Moreover, the potential for the industrial exploitation of roses, particularly in functional foods and pharmaceuticals, remains underexplored, and large quantities of rose by-products generated during essential oil and floral water extraction are often discarded, leading to resource waste and environmental concerns. Therefore, this review presents new findings on the bioactive compounds and health benefits of roses and their by-products.

Herein, we reviewed high-quality literature from the Web of Science, PubMed, and Scopus published in recent years. This review summarizes the advances in the principal bioactive compounds and key biological functions of Rosa species, with a particular focus on rose bioactive ingredients and their practical, economically viable applications in industry. Ultimately, this study seeks to provide a roadmap for the integrated and sustainable utilization of rose resources, supporting the transition from laboratory evidence to industrial applications.

Rose species are rich in a diverse array of bioactive compounds, which contribute significantly to their nutritional, medicinal, and functional properties. The major classes of bioactive constituents include phenolic compounds, polysaccharides, vitamins, carotenoids, and essential oils. These phytochemicals are primarily concentrated in the petals and fruits, which represent the most studied and commercially utilized parts, driving applications in functional foods, nutraceuticals, cosmetics, and pharmaceuticals. Rose essential oil is a valuable aromatic oil extracted from roses; its composition, however, varies considerably across different rose species. Geraniol (42.08%), heneicosane (22.07%), n-heptadecane (16.70%), and linalool (11.55%) are the main constituents of the essential oil from *R.* canina flowers. The total monoterpenoid content of *R.* rugosa essential oil is 70.31%, of which the linalool content is 33.73%. In addition, the relative contents of geraniol and citral are relatively high in the four types of rose essential oils. GC-MS analysis identified citronellol and geraniol as the predominant constituents within the essential oil composition, although their relative abundances exhibited significant quantitative fluctuations in response to variations in temperature and precipitation levels.

In the past decade, there has been a new research focus in the rose industry on the recovery and utilization of by-products after the extraction of rose essential oils. Rose waste has potential applications in food production owing to its rich in bioactive substances, including flavonoids, anthocyanins, polysaccharides, and dietary fiber. It not only extends the industrial chain and enhances industrial value, but also facilitates the recycling of waste materials and reduces environmental impact.

In *R.* damascena residue water, the main compound is phenylethyl alcohol, which is also rich in polyphenols, including epicatechin and hesperidin. This indicates that the composition of polyphenols in *R.* damascena wastewater is similar to that of rose essential oils, with quercetin and kaempferol glycosides being the major polyphenol compounds. After freeze-drying, *R.* rugosa residue also contains high levels of polyphenols and anthocyanins. Additionally, polysaccharides are essential components of rose residues, especially water-soluble pectic extracts of *R.* damascena residues. Two pectic polysaccharide components, WSRP-2A and WSRP-2B, have been identified in *R.* setate × *R.* rugosa waste. However, the soluble dietary fiber content of rose residue is relatively low, and most dietary fiber is insoluble. Thus, improving the utilization of this dietary fiber remains a problem to be addressed.

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Please answer the following questions:

21. Roses (*Rosa* spp.) have recently attracted scientific interest primarily because they are rich in which of the following components? (A) Synthetic antioxidants (B) Bioactive compounds with health-promoting properties (C) High levels of saturated fatty acids (D) Essential amino acids only

22. Which class of bioactive compounds in roses is most closely associated with antioxidant and anti-inflammatory activities? (A) Steroids (B) Sulfur-containing peptides (C) Purine alkaloids (D) Phenolic compounds

23. The genus Rosa belongs to which botanical family? (A) Lamiaceae (B) Asteraceae (C) Rosaceae (D) Fabaceae

24. Which of the following new findings in this article is NOT the authors would like to present? (A) Beauty of roses (B) Health benefits of roses (C) By-product of roses (D) Bioactive compounds of roses

25. Geraniol, citronellol, and linalool identified in rose essential oils mainly belong to which group of phytochemicals? (A) Alkaloids (B) Terpenoids (C) Phenolic acids (D) Polysaccharides

26. GC–MS analysis has shown that the composition of rose essential oils can be significantly influenced by which environmental factors? (A) Soil nitrogen content only (B) Light wavelength (C) Temperature and precipitation (D) Soil pH exclusively

27. Rose by-products generated after essential oil extraction are considered valuable mainly because they are rich in which substances? (A) Flavonoids, polysaccharides, and dietary fiber (B) Proteins and lipids (C) Heavy metals and minerals (D) Synthetic preservatives

28. Which compound is identified as the major constituent in *Rosa* damascena residue water? (A) Citral (B) Ascorbic acid (C) β-Carotene (D) Phenylethyl alcohol

29. Polysaccharides identified from rose residues, such as WSRP-2A and WSRP-2B, are mainly classified as which type? (A) Cellulosic polysaccharides (B) Pectic polysaccharides (C) Starch-derived polysaccharides (D) Chitin-based polysaccharides

30. The integrated utilization of rose resources is most closely aligned with which sustainable development goal? (A) Maximization of ornamental value only (B) Reduction of genetic diversity (C) Waste reduction and circular bioeconomy (D) Increased reliance on synthetic additives

Article 5

(Source: Food Technology Magazine IFT, May 6, 2025)

The World Health Organization, the Centers for Disease Control and Prevention, and several other organizations recommend limiting intake of added sugars to less than 10% of our total daily calories (WHO 2015, CDC 2024). Artificial sweeteners have thus emerged as a promising alternative to sugar in both manufactured and homemade foods and beverages. Yet, claims that artificial sweeteners are linked to weight gain, adverse cardiometabolic outcomes, and cancer have gained widespread attention in the media, causing many consumers to shy away from their use. However, one must always interpret such claims with caution in light of the existing evidence—evidence that this article will sort through with a goal of bringing some clarity to the questions surrounding artificial sweeteners.

Artificial sweeteners—sometimes referred to as low-calorie or non-nutritive sweeteners—are chemically synthesized compounds intended to replace or reduce added sugar in foods and beverages. Of note, this definition excludes those non-sugar, high-intensity sweeteners derived from plants, such as stevia and monk fruit, as well as sugar alcohols and low-calorie sugar isomers, such as allulose. There are six artificial sweeteners approved for use in the United States by the U.S. Food and Drug Administration (FDA): aspartame, saccharin, acesulfame-K, sucralose, neotame, and advantame (FDA 2024). The European Food Safety Authority (EFSA) has approved cyclamate in addition to these same six sweeteners, albeit with slightly different acceptable daily intakes.

The cardiometabolic impact of artificial sweeteners is primarily attributed to their alleged effects on body weight and risk of type 2 diabetes. Addressing the question of body weight, a 12-week randomized control trial from 2019 demonstrated that while consumption of beverages sweetened with sucrose or saccharin appeared to increase body weight, beverages sweetened with sucralose, aspartame, or stevia did not result in a significant change in body weight. It is worth mentioning, however, that participants in this study each drank over 1 L of their assigned beverage per day, likely exceeding the average intake of most consumers. On the other hand, a 2022 systematic review and meta-analysis found that substituting beverages sweetened with low- or no-calorie sweeteners for sugar-sweetened beverages resulted in small reductions in body weight, averaging about 2.3 lb, among overweight and obese adults. Aspartame was the primary sweetener used in the studies analyzed, although acesulfame-K, sucralose, and saccharin were each used in at least one study.

Artificial sweeteners also appear to have no impact on the development of type 2 diabetes. Many studies linking the consumption of artificial sweeteners to the risk of type 2 diabetes were subject to publication bias, with authors omitting studies that did not demonstrate a correlation between the two variables. Illustrating this discrepancy, authors of a 2017 meta-analysis concluded that consumption of artificially sweetened beverages increased the risk of type 2 diabetes. This supposed correlation was only seen with analysis of observational studies, which in the field of nutrition are almost always confounded by such factors as body weight and other dietary habits. Moreover, when the findings were adjusted to account for the omitted data, no such correlation was seen. The analyzed randomized control trials found no association between artificial sweetener intake and indicators of diabetes, and the aforementioned 2022 meta-analysis found that substituting low- or no-calorie sweetened beverages for sugar-sweetened beverages was associated with a reduction in cardiometabolic risk factors.

Lastly, with respect to the possible carcinogenic properties of artificial sweeteners, here too studies have failed to demonstrate a correlation. As in the case of diabetes, many of the studies cited as proving the link between artificial sweeteners and cancer had major flaws and limitations. For instance, an oft-cited 1979 study concluded that saccharin intake was associated with increased rates of bladder cancer. However, this study was done in lab rats exposed to supranormal levels of the sweetener, 40 to 80 times the maximum daily intake defined by the FDA. More recently, both a 2019 systematic review and meta-analysis and a 2023 prospective cohort study found no association between cancer risk and non-sugar sweeteners, including artificial sweeteners.

Despite data supporting their safety, claims that artificial sweeteners are deleterious to one's health remain. How should manufacturers respond to this skepticism? Given the preponderance of evidence, there is little reason to remove artificial sweeteners from product formulations across the board. If companies want to avoid the controversy altogether, then they may consider utilizing stevia, monk fruit, sugar alcohols, allulose, or any of the other approved, non-artificial sweeteners. But perhaps a longer-lasting solution would be to invest in improving consumer education and scientific literacy to counteract the misinformation related to artificial sweeteners. It seems likely that artificial sweeteners are here to stay. As is so often the case, moderation is key.

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31. What is the main purpose of this article? (A) To relegate artificial sweeteners (B) To justify the approval of artificial sweeteners (C) To clarify the misunderstanding of artificial sweeteners (D) To promote artificial sweeteners.
32. According to the definition in this article, which substance is NOT an artificial sweetener? (A) Advantame (B) Allulose (C) Neotame (D) Sucralose.
33. Which statement is NOT true about cyclamate? (A) It is an approved artificial sweetener by the FDA. (B) It is an approved artificial sweetener by the EFSA. (C) It is a chemically synthesized compound. (D) It is a non-nutritive sweetener.
34. According to this article, which is the primary attribute of artificial sweeteners? (A) Body weight gain (B) Lowering risk of cancers (C) Lowering risk of type 2 diabetes (D) Providing sweetness with fewer calories.
35. According to this article, the assertion that artificial sweeteners are deleterious to health is (A) accurate (B) evidence-based (C) substantiated (D) unfounded.

Article 6.
(Source: Food Technology Magazine IFT, January 12, 2026)

When cocoa prices reached a high of $12,000 a tonne in 2024, chocolate companies were hit hard. More than 70% of cocoa is sourced from West and Central Africa, which has felt the impact of unpredictable weather and a new virus affecting cacao trees. While the price per tonne dropped in 2025, the chocolate industry remains focused on controlling raw material costs.

"There is a big challenge when it comes to crop failure," says Tilo Hühn, professor at the ZHAW School of Life Sciences and Facility Management in Switzerland. Switzerland, home to some of the world's leading chocolate brands, including Lindt, Barry Callebaut, and Teuscher, is also home to significant research and development seeking to find cocoa replacements. Barry Callebaut, for example, has partnered with Hühn and his colleagues at ZHAW to investigate cell-based cocoa.

Hühn has research experience with breeding cell cultures to make wine grape plants, and he was part of a team that made the first wine using a bioreactor. He sees similarities between wine and cocoa; terroir influences the sensory attributes of both, and both the wine and chocolate categories offer a variety of premium products. When Hühn and his colleagues were looking for another application of cell cultures, cocoa fit the bill.

"We started with cocoa because we thought to produce premium chocolate; there is a market to apply this very special technique," he says. They made their first chocolate from plant cell–cultured cocoa in 2015, and Hühn says they were pleased with the results; it tasted just like conventional chocolate. "If you don't know that it is produced in a bioreactor, you can't differentiate it," he says. He explains that this isn't surprising because the product the researchers made is nearly identical at the cellular level to cocoa. "We have seen that the composition produced by a cell culture is really similar to the production of a plant outside in the environment," says Hühn. At the time, however, it was a very niche product, expensive to make, and without a market. But that is now changing. There are several cell-based cocoa startups, including California Cultured and Food Brewer in Switzerland.

The cocoa industry's goal isn't to replace cocoa produced using conventional agricultural methods, but it acknowledges the mounting pressures of climate change, Hühn observes. He shares that perspective. His group sees opportunities to create a plant cell–based product that is akin to conventional cocoa and amps up its health benefits. Depending on the culture media used, they can create a cell culture with almost no fat, no acetic acid, and a high amount of various polyphenols, which can then be used to make a chocolate-like product that's just as enjoyable, he says, noting that he sees potential for value-added confectionery offerings.

Barry Callebaut's support for cocoa cell culture technology "is about broadening the spectrum of cocoa-based ingredients available to our customers in a way that complements existing agricultural practices as well as customer demand, innovation, and taste," a company representative said in an email. "We are preparing for a future where we can offer consumers additional choices beyond cocoa from farms and ensure long-term supply security."

But there are hurdles to commercializing cell-based cocoa, including the cost of the bioreactors needed for large-scale production. At the moment, most bioreactors are created for the pharmaceutical industry and are very expensive. "The next big step is to develop a bioreactor design that is affordable," Hühn says.

He also cautions that bigger is not necessarily better because larger bioreactor tanks require more culture media, and culture media is also expensive. His team has filed patents for a plant-based clean-label culture media that they hope can be produced inexpensively. Even so, says Hühn, "I think we are far away from an affordable solution."

36. What does 'Reengineered' mean in the title of this article? (A) To produce chocolate from cell-based materials (B) To produce chocolate from genetically modified cocoa (C) To adopt a novel engineering facility (D) To synthesize cocoa from chemical media.
37. Based on the article, when was the first chocolate made from plant cell–cultured cocoa? (A) 2015 (B) 2023 (C) 2024 (D) 2025.
38. The article suggests that the industry's goal regarding reengineered cocoa is to: (A) Replace conventional cocoa immediately (B) Complement existing agricultural practices and provide long-term supply security (C) Halt all research due to costs (D) Standardize all chocolate formulations.
39. Which challenge is identified as a barrier to commercializing reengineered cocoa? (A) Lack of consumer interest (B) Inadequate regulatory approvals worldwide (C) High cost of bioreactors and culture media (D) Insufficient flavor diversification.
40. Based on the article, which statement best reflects Barry Callebaut's stance on reengineered cocoa? (A) They oppose any use of cell-based ingredients. (B) They want to broaden the spectrum of cocoa-based ingredients and secure long-term supply. (C) They want to discontinue conventional cocoa farming. (D) They are uninterested in the health benefits of cocoa.

Article 7
(Source: Food Engineering Reviews, 2023, 15:577-608)

In recent decades, the demand for high quality food has steadily increased, as has interest in the issue of food quality, both in response to market pressures (e.g., requests from increasingly demanding and knowledgeable consumers) and in response to other factors, such as health and environmental concerns, climate changes, and legislation advances such as the U.S. Food Safety Modernization Act [4], EU Regulation 2019/1381 on the transparency and sustainability of the EU risk assessment in the food chain, and Codex Alimentarius General principles of food hygiene. The concept of food quality gradually evolved in response to these changes in consumer perceptions as well as technological advances. The food quality 1.0 stage was based on inspection-based quality control, which focused on detecting and removing defective food products after production. The food quality 2.0 era introduced prevention-based quality assurance, which focused on preventing defects by applying statistical process control tools and standards during production. Food quality 3.0 was the next step toward customer-oriented quality improvement, which focused on meeting and exceeding customer expectations through the application of total quality management (TQM) principles and continuous improvement methods. This included the use of advanced technologies and practices, such as precision agriculture and organic farming. Consumer awareness and demand for clean label products, as well as regulatory and industry efforts to ensure food safety and quality, were also central to this stage. The upcoming concept of food quality 4.0 could be characterized by even more advanced technologies, such as the IoT, Big Data analytics, artificial intelligence, and blockchain to improve traceability, food safety, and quality assurance.

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Overall, traditional aspects of food quality focus on ensuring that food is safe, nutritious, and enjoyable to consume. While these aspects are still important, the shift toward food quality 4.0 is expanding the scope of food quality to include additional factors such as sustainability, transparency, and digitalization. Food quality 4.0 is a recent development that builds on previous stages of quality management in the food industry and it aims to integrate digital technologies and data analytics into the existing quality management systems to enable real-time monitoring, traceability, transparency, and optimization of food quality throughout the value chain. The main difference between the earlier stages of food quality and stage 4.0 is the level of digitalization and data integration. Earlier stages relied mainly on manual inspection, prevention, and improvement methods, while stage 4.0 uses digital technologies and data analytics to automate and optimize quality management processes.

Please answer the following questions:

41. According to this article, the consumer interest in procuring high-quality food products has been growing over the years. Which of the following reasons is not responsible for this rising demand?
    (A) legislation advances
    (B) factory locations
    (C) health concerns
    (D) market pressures
42. The article classifies the evolution of food quality into several stages. Which of the following best describes food quality at the 1.0 stage?
    (A) defective foods removal
    (B) nutrient supplementation
    (C) pathogen identification
    (D) organic farming
43. Which of the following is the key term for stage 2.0 to assure food quality?
    (A) big data
    (B) AI
    (C) fashion-driven
    (D) prevention-based
44. Food quality at the 3.0 stage focuses on satisfying and exceeding consumer expectations. Which of the following methods is not included to achieve the 3.0 stage?
    (A) advanced technologies
    (B) total quality management principles
    (C) reducing manufacturing expenses
    (D) regulatory and industry efforts
45. What is the main difference between food quality 4.0 and former stages?
    (A) the logistics of product distribution
    (B) the materials used for packaging
    (C) the detection techniques used for assuring safety
    (D) the level of digitalization and data integration

Article 8
(Source: Food Engineering Reviews, 2023, 15:420-437)

The major component in fruit is water which is required for metabolic processes and to maintain cell turgor. Water content can range from 85 to 93% in citrus fruit juices. The solids are a mixture of hundreds of identified components composed of natural and/or polymer sugars such as glucose, fructose, starch, cellulose, pectin, and hemicellulose, representing a large portion of the total solids. The solid contents are classified into soluble and non-soluble. Soluble solids refer to the solids readily presented in the juice, whereas non-soluble solids are mainly the residues obtained after pressing, such as the pulps. Nutrients like protein, fats, vitamins, and minerals vary significantly between the types of fruit. Fruit acids are present in some fruits, especially citrus, which cause a sour taste and low pH. The protein content in fruit juice is generally lower than 1% but higher in oily fruits and fruit seeds. Lipid percentage in fruit juice usually accounts for less than 0.5%, except in olive, oil palm, avocado, and fruit seeds. The very low lipid contents are responsible for the low calorific amount of fruit juice.

The concentration of fruit juices is carried out to extend the shelf-life of products by reducing microbial activities (low water activity) and costs (volume for storage and transportation). The concentration of fruit juices was traditionally carried out at a high temperature which ultimately evaporates the water molecules, leaving a juice concentrate. This process is known as thermal drying or concentrating, which has been applied since ancient times to preserve juice for long-term storage and transport. Thermal treatments can be categorized by the heat treatment intensity, heating duration, and the methods employed. The typical means of thermal

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treatments of fruit juices include the conventional techniques of a high-temperature long time (HTLT), high-temperature short time (HTST), medium temperature long time (MTLT), medium-temperature short time (MTST), and the non-conventional methods of microwave heating and Ohmic heating. However, thermal drying has always been associated with adverse effects on fruit juices' quality, antioxidant activities, shelf-life, and nutritional attributes. For example, orange, lemon, grapefruit, and lime juices heated at 74–88 °C will experience cloud stabilization through complete or partial inactivation of pectic enzymes. The heating of fruit juices also leads to the escape of flavors and aromas, which are volatile in nature. To prevent the loss of valuable contents in the juice, membrane filtration can be used to concentrate fruit juices at a low operating temperature. Currently, forward osmosis (FO), reverse osmosis (RO), osmotic distillation (OD), and membrane distillation (MD) are broadly used to concentrate various types of prefiltered fruit juices such as apple, pomegranate, grape, watermelon, citrus, date, and orange.

46. What is the main component in fruit?
(A) protein
(B) carbohydrate
(C) water
(D) lipid

47. After juice extraction, the non-soluble portion of fruits will be mainly separated into
(A) pulps
(B) juices
(C) cooling water
(D) organic layer

48. Which of the following is not one of the purposes for concentrating fruit juice?
(A) reduce juice volume
(B) extend the shelf-life
(C) lower water activity
(D) remove suspended solids

49. Thermal concentration of fruit juices is associated with multiple adverse effects that do not currently include
(A) microbial contamination
(B) loss of flavors
(C) cloudy appearance
(D) reduction in quality attributes

50. Which technique can concentrate fruit juices at a relatively low operating temperature?
(A) carbon adsorption
(B) thermal drying
(C) membrane filtration
(D) centrifugation

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