



UNIVERSIDAD NACIONAL AGRARIA

LA MOLINA

COLORANTES NATURALES

para la industria de alimentos



Boletín de vigilancia tecnológica

Número 01 – Año 03

VICERRECTORADO DE INVESTIGACIÓN

Dirección de Innovación y Transferencia Tecnológica



UNIVERSIDAD NACIONAL AGRARIA

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Boletín de vigilancia tecnológica

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PRESENTACIÓN

La Universidad Nacional Agraria La Molina (UNALM) tiene como propósito fundamental potenciar la investigación, el desarrollo y la innovación (I+D+i) entre sus miembros. Para ello, el Vicerrectorado de Investigación (VRI), a través de la Dirección de Innovación y Transferencia Tecnológica (DITT), impulsa activamente la exploración y aplicación de conocimientos científicos y tecnológicos.

El presente boletín de vigilancia tecnológica se enfoca en las innovaciones y avances en el campo de los colorantes naturales para la industria alimentaria, un sector clave impulsado por la creciente demanda de los consumidores por productos alimentarios más seguros y sostenibles. Se presenta información relevante a nivel nacional e internacional sobre las tecnologías aplicadas en la obtención, estabilización y formulación de estos pigmentos. La necesidad de hallar alternativas naturales se ha intensificado debido a la percepción del reemplazo sobre los colorantes sintéticos y a una normativa reguladora cada vez más estricta.

Este boletín destaca las áreas de innovación tecnológica, que incluyen: (i) La identificación y desarrollo de nuevas fuentes de pigmentos (ii) La optimización de los métodos de extracción para mejorar su eficiencia y sostenibilidad (iii) Avances significativos en la estabilización de los colorantes (iv) Estrategias avanzadas de formulación, para proteger los pigmentos y prolongar su vida útil. Se abordan así los principales desafíos en la temática.

La finalidad del documento es: (i) Proveer ideas e insumos que incentiven a nuestros investigadores a proponer, formular, conceptualizar y desarrollar nuevas tecnologías o mejoras en las existentes para la extracción, estabilización y aplicación de colorantes naturales en la industria alimentaria, tomando como base la información técnica y científica presentada. (ii) Promover el uso de herramientas de vigilancia tecnológica específicas para el sector de los colorantes naturales, acercándolas a los miembros de nuestra comunidad universitaria para fomentar su aplicación sistemática en la identificación de oportunidades de desarrollo de nuevas tecnologías y soluciones. Se proporciona así, una visión integral de los avances y desafíos actuales en el desarrollo y aplicación de colorantes naturales en la industria alimentaria, contribuyendo a fortalecer la investigación y la innovación en este sector para el desarrollo sostenible y para la toma de decisiones estratégicas.

Dirección de Innovación y Transferencia Tecnológica
Vicerrectorado de Investigación

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I. RESUMEN

Los colorantes alimentarios desempeñan un papel fundamental en la percepción sensorial del consumidor, influyendo directamente en la decisión de compra de los alimentos procesados, que vienen experimentando una demanda creciente.

Tradicionalmente, los colorantes alimentarios sintéticos dominan el mercado debido a su estabilidad, costo y su idoneidad para la producción en masa. Sin embargo, la percepción negativa de estos aditivos por parte del público y los marcos regulatorios cada vez más estrictos han acelerado la búsqueda de alternativas derivadas de fuentes botánicas, microbianas y animales, más seguras, sostenibles y ecológicas. Aquí es donde la vigilancia tecnológica se vuelve crucial, al permitirnos identificar y comprender los avances que están marcando la pauta.

Las innovaciones tecnológicas en este campo se concentran en varias áreas clave: desde el desarrollo de nuevas fuentes de pigmentos (como algas, hongos y residuos agrícolas) hasta la optimización de los procesos de extracción para mejorar la eficiencia y sostenibilidad. También se están logrando avances significativos en la estabilización de estos colorantes frente a factores como el calor, la luz y el pH, lo que amplía su aplicabilidad en diversas matrices alimentarias. Además, la microencapsulación y otras técnicas de formulación están permitiendo proteger sus propiedades y mejorar su vida útil, superando uno de los mayores desafíos de los colorantes naturales.

El presente boletín de vigilancia tecnológica destacará precisamente estas innovaciones, ofreciendo una visión clara de las soluciones que se están creando para satisfacer tanto las expectativas de los consumidores como las necesidades operativas de la industria. Estar al tanto de estos avances no solo es una ventaja competitiva, sino una necesidad estratégica para quienes buscan liderar el camino hacia una producción de alimentos más natural y sostenible.

II. JUSTIFICACIÓN

La Universidad Nacional Agraria La Molina (UNALM), como institución líder en I+D+i del Perú, tiene un compromiso estratégico con el desarrollo y la competitividad del sector agroalimentario nacional. El presente Boletín de Vigilancia Tecnológica sobre colorantes naturales para la industria alimentaria, se alinea directamente con las líneas de investigación prioritarias de las Facultades de Industrias Alimentarias, Agronomía y Ciencias. Es indispensable que la UNALM asuma el rol de referente en la detección y difusión de información tecnológica de alto valor, facilitando así la toma de decisiones informadas, la anticipación a cambios normativos y la promoción de la innovación dentro de la industria alimentaria.

La finalidad de este documento es proporcionar información relevante y actualizada sobre los métodos, tecnologías y estrategias innovadoras para la extracción, estabilización y aplicación de colorantes naturales. Este esfuerzo busca catalizar la investigación interna, motivando a la comunidad universitaria a utilizar la información como un sólido punto de partida para la generación de nuevos proyectos de I+D+i y el desarrollo de tecnologías propias. Adicionalmente, se busca fortalecer las capacidades académicas e investigativas, identificar oportunidades de negocio basadas en la biodiversidad y fomentar la colaboración multidisciplinaria.

En consecuencia, se espera que el boletín logre un impacto positivo y medible al evitar la duplicación de esfuerzos en investigación y al impulsar soluciones eficientes que promuevan la sustitución de aditivos sintéticos por alternativas naturales y saludables. De esta manera, la UNALM reitera su compromiso como motor de conocimiento aplicado que garantiza la relevancia de su labor y contribuye directamente a la sostenibilidad y diferenciación de la industria nacional.

III. OBJETIVO DE BÚSQUEDA

El objetivo del presente documento es identificar y reportar los avances globales más relevantes en la ciencia y la tecnología, en el campo de los colorantes naturales para la industria alimentaria. Se recopila información sobre las investigaciones y desarrollos tecnológicos más recientes, con un periodo de análisis principal de los últimos cinco años para la información científica, y un foco particular en el último año para las solicitudes

de patente, con el fin de ofrecer una visión de las tendencias actuales y emergentes en la temática.

IV. CUADRO CONCEPTUAL

El objeto de estudio fue delimitado utilizando la siguiente información (Cuadro 01).

Cuadro 01. Palabras clave asociadas al objeto de estudio

	Palabras clave	Key words
Objeto de estudio	Natural Orgánico Biológico Origen Biológico Origen Vegetal	Natural Organic Biological Bio-based Plant-based
	Colorante Pigmento Aditivo colorante	Pigment Dye Colorant Coloring Color additives
Grupo objetivo	Industria Alimentaria Productos alimenticios	Food industry Foodstuffs Food products
Problema de estudio	Extracción Aislamiento Procesamiento	Extraction Isolation Processing
	Estabilidad Resistencia Solidez Durabilidad Aplicabilidad	Stability Stableness Solidness Colorstay Permanent Setting Durability Applicability

V. METODOLOGÍA

Para el presente estudio, la búsqueda de información se vio definida por las siguientes ecuaciones (Cuadro 02):

Cuadro 02. Ecuaciones de búsqueda utilizadas

Tipo de Información	Campo	Ecuación de búsqueda
Información científica	Titulo y resumen	TITLE-ABS-KEY((((("natural colorants" OR "natural pigments" OR "plant-based colorants" OR "bio-based pigments" OR "color additives") AND ("extraction" OR "isolation" OR "processing" OR "formulation" OR "microencapsulation") AND ("stability" OR "thermal stability" OR "pH stability" OR "light stability" OR "shelf life" OR "degradation") AND ("food industry" OR "food processing" OR "food technology" OR "food applications") AND ("functionality" OR "application" OR "performance" OR "bioactivity" OR "sensory impact"))))
	Tipo de documento	"ar" = Artículo "re" = Review "ch" = Chapter book "cp" = Conference Paper
	Periodo	01/01/2021– 31/07/2025
Información tecnológica (patentes)	Resumen, título y reivindicaciones:	(colorstay OR stability OR steadiness OR stable OR steady OR stableness OR solidness OR permanent OR set????) AND (green OR blue OR yellow OR red)
	Código CIP (Clasificación Internacional de Patentes)	A23L5/43 Coloración o decoloración de alimentos con adición de colorantes o pigmentos orgánicos o pigmentos naturales, sus duplicados artificiales o sus derivados. A23L5/44 Coloración o decoloración de alimentos con adición de colorantes o pigmentos orgánicos o pigmentos naturales, sus duplicados artificiales o sus derivados, utilizando carotenoides o xantofilas. A23L5/46 Coloración o decoloración de alimentos con adición de colorantes o pigmentos de origen microbiano o de algas. A23L5/47 Coloración o decoloración de alimentos con adición de colorantes o pigmentos, utilizando colorantes orgánicos

		sintéticos o pigmentos no cubiertos por los grupos A23L 5/43-A23L 5/46 C09B 61/00 Colorantes orgánicos de origen natural preparados a partir de fuentes naturales C09B67/20 Preparaciones a base de pigmentos orgánicos
	Periodo de publicación	31/07/2024 – 31/07/2025

Se utilizaron las herramientas de búsqueda citadas en el Cuadro 03.

Cuadro 03. Herramientas de búsqueda

Tipo de Información	Fuente	Enlace
Información científica	Scopus	https://www.scopus.com/search/
Proyectos de investigación	CORDIS	https://cordis.europa.eu/search
Tesis	Web of Science	https://www.webofscience.com/wos/
	Repositorio ALICIA	https://alicia.concytec.gob.pe/vufind/
Información tecnológica	Espacenet	https://worldwide.espacenet.com/patent/
	Patent Inspiration	http://www.patentinspiration.com/

Tras la aplicación de estas estrategias de búsqueda y un proceso de análisis con refinación sucesiva de las ecuaciones booleanas, se generó un corpus total de 77 registros, que incluyeron documentos de patentes, publicaciones científicas, proyectos de investigación y tesis.

El análisis de la información científica se centró en publicaciones a nivel global de los últimos cinco años (2021-2025), con el objetivo de identificar la trayectoria reciente de la investigación en el campo. Para garantizar la máxima actualidad y precisión en las referencias, se prestó especial atención a la documentación publicada en el último año (2024-2025), abordando indicadores clave como: tendencias de publicaciones científicas, principales fuentes de publicación, áreas temáticas predominantes, países e instituciones líderes en investigación.

El análisis del panorama tecnológico se ha realizado sobre los datos más recientes disponibles del último año (2024-2025) a nivel mundial, cubriendo: tendencias de

patentes, principales campos de desarrollo tecnológico, países y solicitantes de patentes destacados.

El análisis se ha enfocado en destacar información relevante y actualidad, por lo que la síntesis general del boletín está acotada al periodo 2024-2025. Las excepciones a este rango temporal se indicarán de forma explícita al presentar dicha información.

VI.RESULTADOS

A partir de la búsqueda de vigilancia tecnológica definida en la sección VI. Metodología, se ha recuperado y analizado información crucial sobre colorantes naturales para alimentos. Estos hallazgos se han desglosado en cuatro categorías clave: información científica, proyectos de investigación, tesis e información tecnológica (patentes), lo que proporciona una visión integral y multifacética para comprender las tendencias dominantes y los actores de referencia en el desarrollo del sector.

6.1 INFORMACIÓN CIENTÍFICA

Mediante la estrategia de búsqueda aplicada en la base de datos SCOPUS, se identificaron 128 publicaciones científicas en la temática de colorantes naturales, durante el periodo 2021 - 2025 [Gráfico 01]. Los datos revelan una tendencia ascendente sostenida a partir de 2022, con un incremento significativo en el 2024, señalando un pico de actividad reciente, que subraya el creciente interés y la madurez de la investigación en el sector.

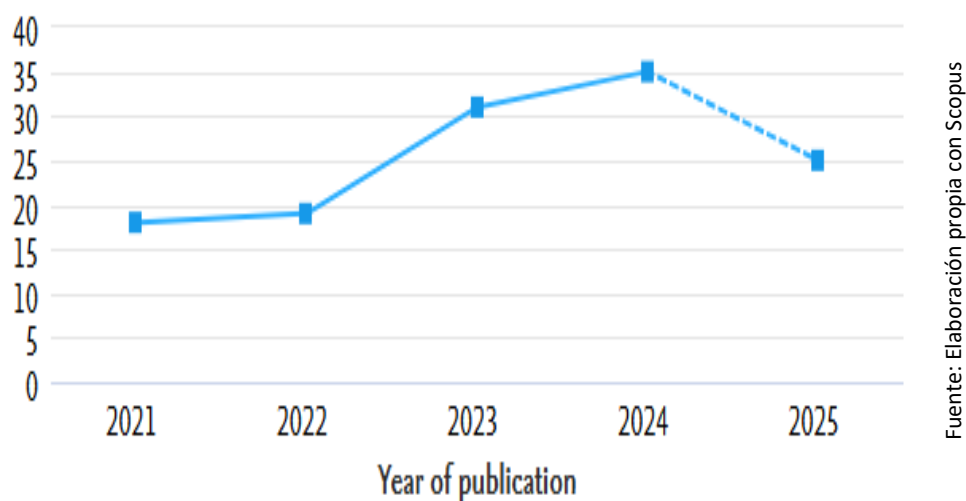
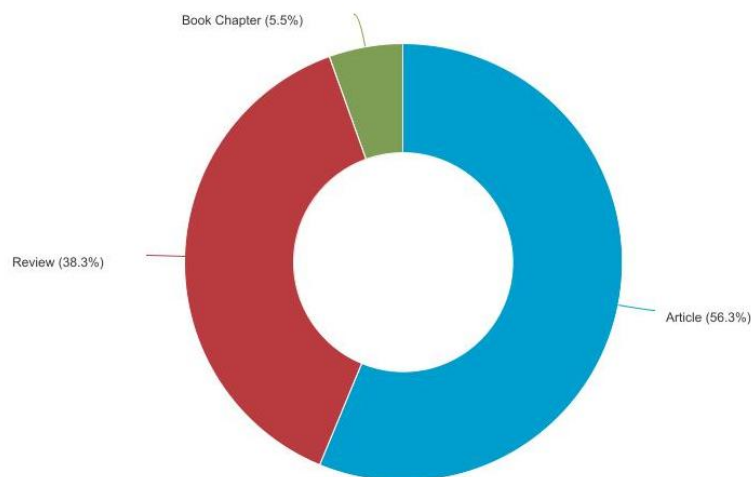


Gráfico 01. Información científica por año de publicación

La mayor proporción de la producción científica se concentra en artículos (56.3%, 72 documentos), indicando una intensa actividad de investigación primaria. Estos son seguidos de cerca por las revisiones (38.3%, 49 documentos). En tanto que los capítulos de libros representan el 5.5% (7 documentos) [Gráfico 02].



Fuente: Elaboración propia con Scopus

Gráfico 02. Información científica por tipo de publicación

Las principales fuentes de publicación en el tema son Food Chemistry (12 documentos) y Foods (11 documentos), revistas que concentran la mayor cantidad de artículos. A estas les siguen, con un volumen considerablemente menor, Critical Reviews In Food Science And Nutrition (5 documentos) e International Journal of Biological Macromolecules (4 documentos) [Gráfico 03]. Este patrón subraya que la investigación en colorantes naturales se canaliza predominantemente hacia journals de alto impacto y enfoque directo en la química y tecnología de los alimentos.

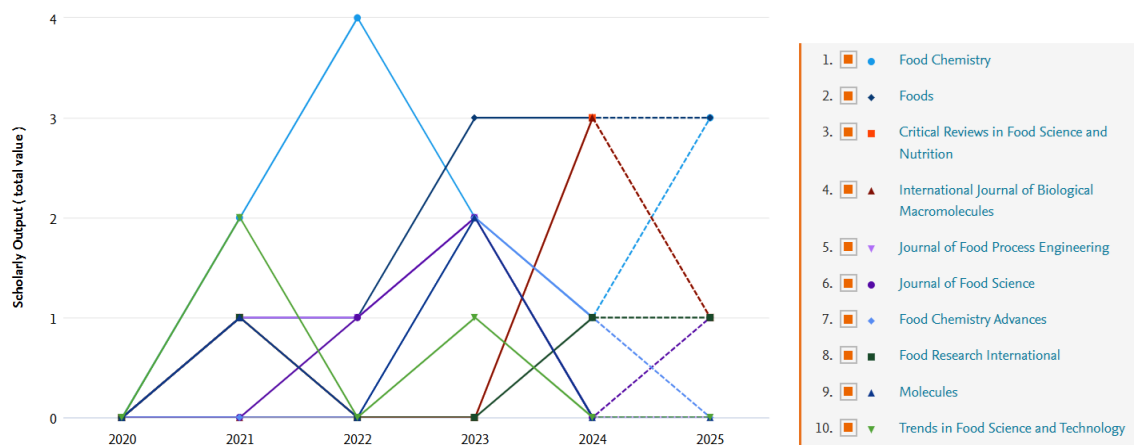


Gráfico 03. Publicaciones científicas por fuente y año de publicación

Respecto a las áreas temáticas, predominan las Ciencias Agrícolas y Biológicas (75.8%), seguidas por Química (26.6%), Bioquímica, Genética y Biología Molecular (19.5%), Ingeniería Química (17.2%) e Ingeniería (14.1%) [Gráfico 04].

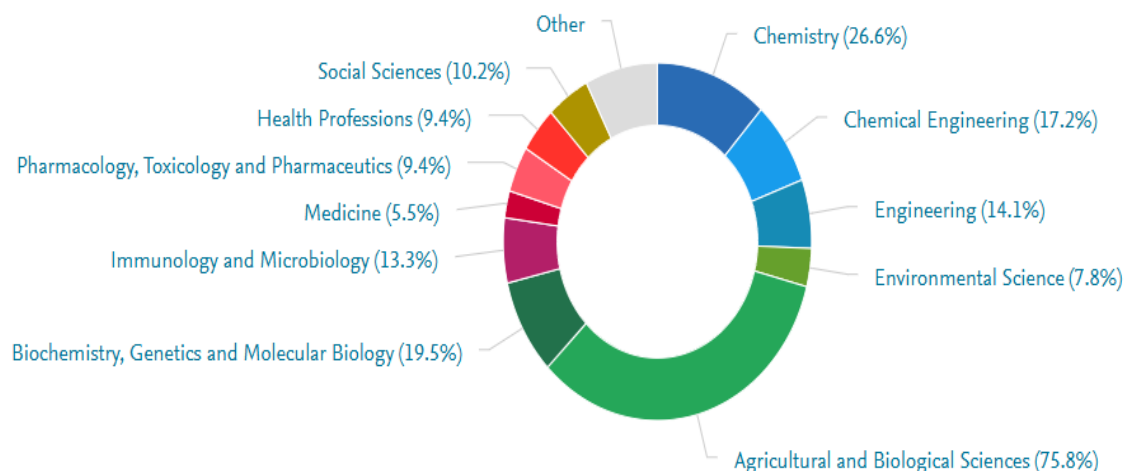
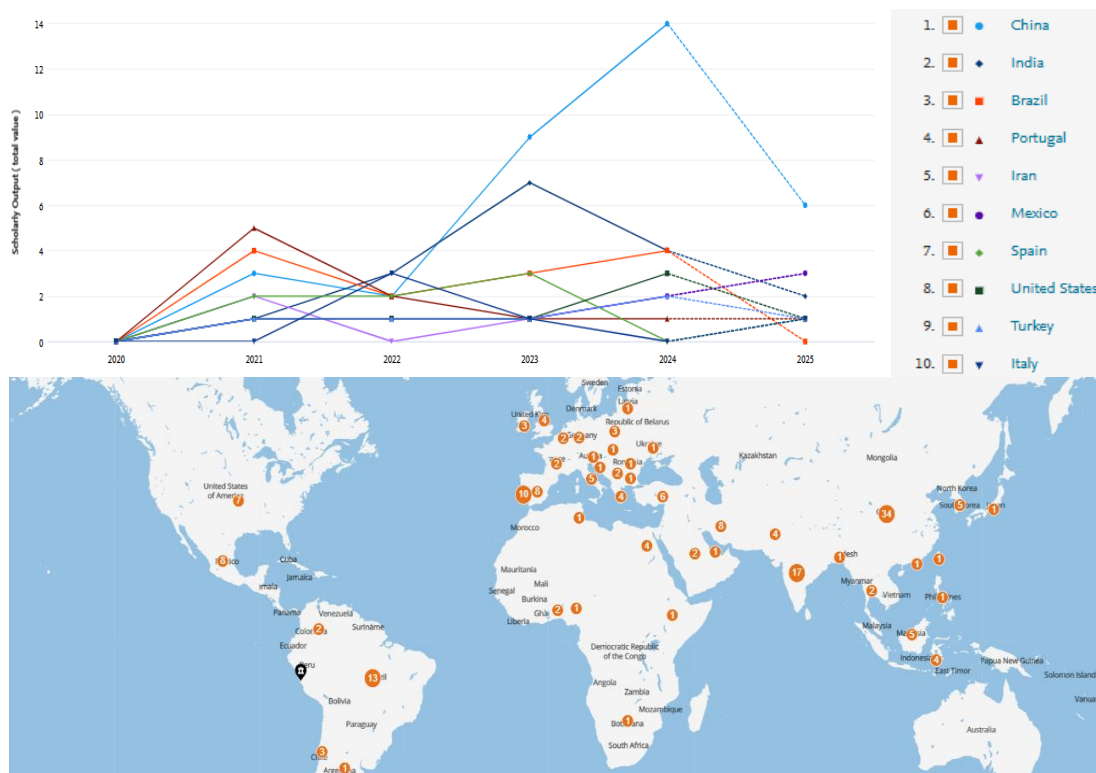


Gráfico 04. Publicaciones científicas por área temática

Al analizar la afiliación institucional de los autores, identificamos los países líderes en la generación de conocimiento científico en la temática. China se posiciona a la cabeza con la mayor producción, registrando 34 documentos. Le siguen, en orden de relevancia, India (17), Brasil (13), Portugal (10) e Irán (8) [Gráfico 05].



Las instituciones con mayor número de publicaciones en el tema son: Polytechnic Institute of Bragança – Portugal (5), seguido por Beijing Technology and Business University - China (4), Ocean University of China - China (4), Universidade Estadual de Campinas - Brasil (4) y Egyptian Atomic Energy Authority - Egipto (3), entre las primeras de un total de diez (10) instituciones de investigación [Gráfico 06].

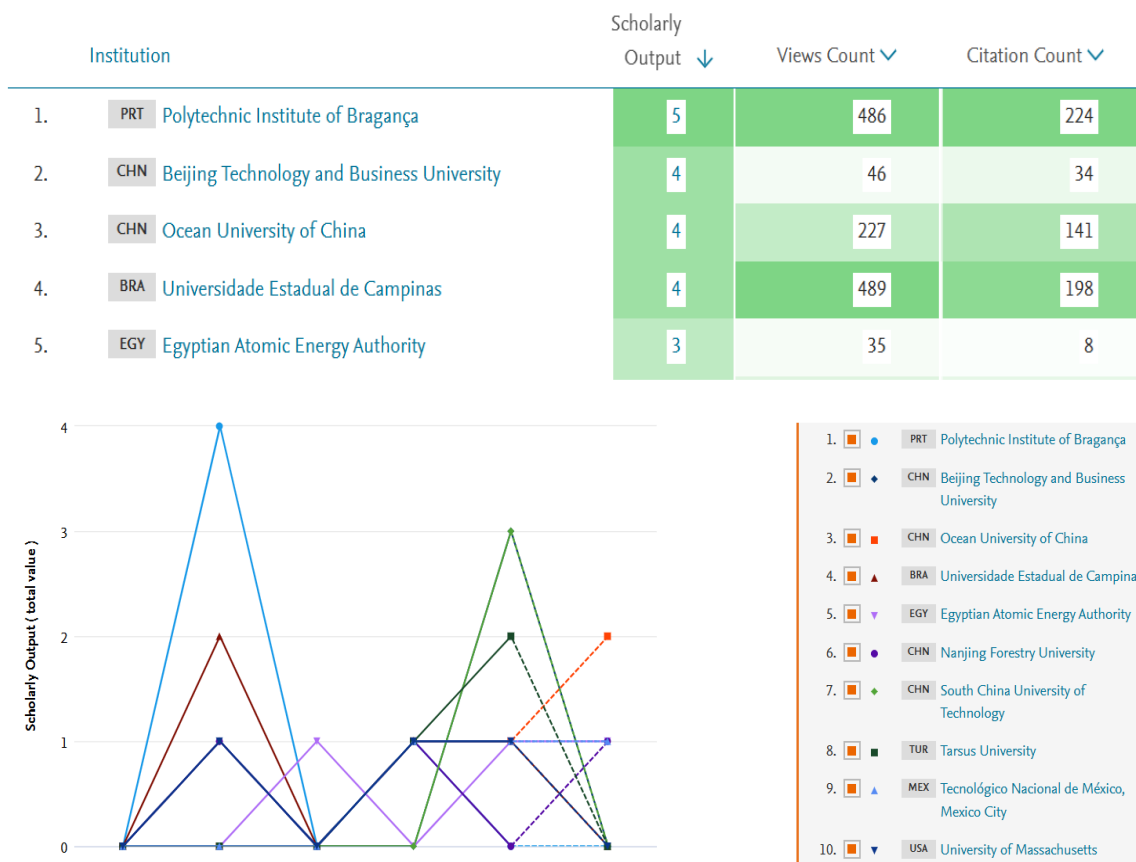


Gráfico 06. Publicaciones científicas por afiliación de sus autores

Del análisis realizado, se identificaron diez diferentes agencias financiadoras para las investigaciones publicadas. La financiación está liderada por la National Natural Science Foundation of China (13 documentos), reflejando el fuerte apoyo gubernamental de ese país. Otras agencias clave son el Conselho Nacional de Desenvolvimento Científico e Tecnológico (9 documentos), la Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (5 documentos), el European Regional Development Fund (7 documentos) y la Fundação para a Ciência e a Tecnologia (7 documentos) [Gráfico 07].

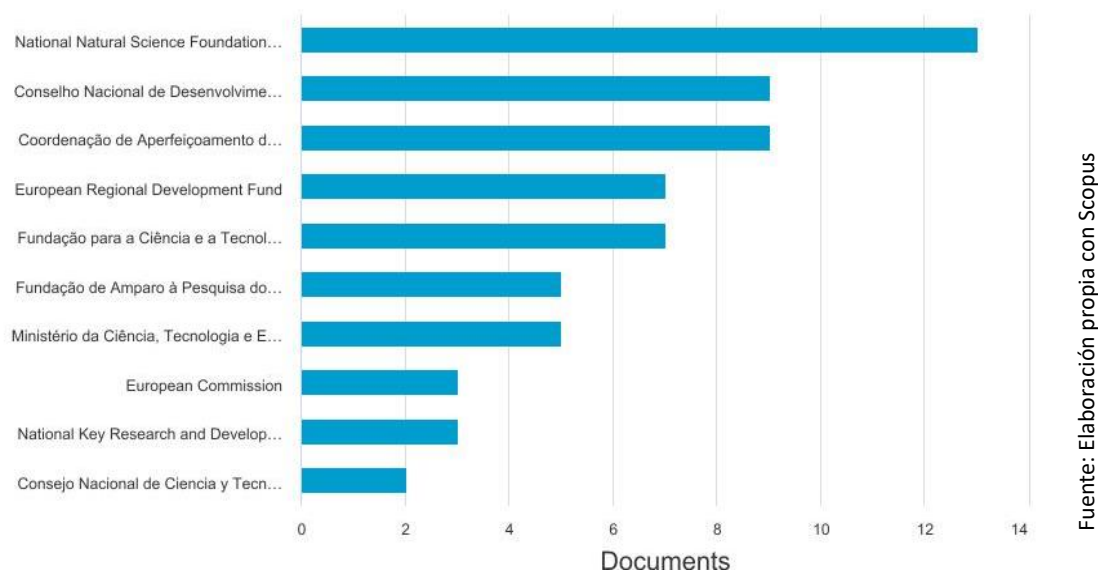


Gráfico 07. Publicaciones científicas por fuentes de financiamiento

Para una visión de prospección tecnológica, se realizó un análisis enfocado en el periodo 2024 - 2025. De las publicaciones registradas, se seleccionaron los veinte (20) artículos científicos con mayor número de citas, un indicador clave de su impacto e influencia en el entorno académico científico. Este conjunto de documentos ha sido clasificado en tres grupos según las principales estrategias y procedimientos desarrollados.

N°	Clasificación	Cantidad de documentos
1	Tecnologías de microencapsulación y nanoencapsulación para colorantes	11
2	Tecnologías de bioproducción y extracción sostenible	5
3	Interacción de colorantes con la matriz alimentaria	4

6.1.1 Tecnologías de microencapsulación y nanoencapsulación para colorantes

Effect of maltodextrin and Persian gum as wall materials and tannic acid as copigment on some properties of encapsulated sour cherry anthocyanin microcapsules

[Efecto de la maltodextrina y la goma persa como materiales de pared y del ácido tánico como copigmento sobre algunas propiedades de microcápsulas encapsuladas de antocianina de cereza ácida]

Fuente	Food Chemistry - ISSN-03088146
Año	2025
Autores / Institución	Moshfegh, N. Niakousary, M. Hosseini, S.M.H. Mazloomi, S.M. Abbasi, A. / SHIRAZ UNIVERSITY SHIRAZ UNIVERSITY OF MEDICAL SCIENCES
Resumen	Due to the instability of anthocyanins, their application as natural colorants is limited. To improve their stability, anthocyanins extracted from sour cherry were copigmented with tannic acid at varying molar ratios. The optimal anthocyanin:copigment molar ratio was determined to be 1:0.25. Subsequently, both non-copigmented and copigmented anthocyanins (using the optimal tannic acid molarity) were spray-dried with either maltodextrin alone (T1 and T2) or a combination of maltodextrin and Persian gum (T3 and T4). The anthocyanin retention in T2 and T4 was approximately 53 % and 38 %, respectively, which were higher than in the non-copigmented samples. All powders demonstrated high encapsulation efficiency (>90.37 %). Stability tests on the anthocyanins conducted over 28 days indicated that light exposure had no effect on the reduction of anthocyanin content when maltodextrin was used. Thus, the copigmentation of anthocyanins with tannic acid, combined with encapsulation in maltodextrin, presents a promising method for producing a stable natural colorant.
DOI	10.1016/j.foodchem.2024.141165

Spray-dried microencapsulation of anthocyanins from mangosteen fruit peel: Investigating the impact of pitahaya peel mucilage and/or maltodextrin as wall materials

[Microencapsulación por atomización de antocianinas de la cáscara de mangostán: Investigación del impacto del mucílago de la cáscara de pitahaya y/o la maltodextrina como materiales de pared]

Fuente	Powder Technology - ISSN-00325910
Año	2025
Autores / Institución	Otálora, M.C. Wilches-Torres, A. Gómez Castaño, J.A. / UNIVERSIDAD PEDAGÓGICA Y TECNOLÓGICA DE COLOMBIA
Resumen	Mangosteen fruit peel (MFP), a rich source of natural pigments, is an underutilized by-product with potential applications in the food industry. This study explores the development and characterization of spray-dried (SD) microcapsules containing MFP anthocyanin-rich extract obtained using aqueous ethanol as the core material and pitahaya peel mucilage (PPM) and/or maltodextrin (MD), as well as a 1:1 blend of both (PPM/MD) as the wall material. Three microcapsule formulations, SD-PPM, SD-MD, and SD-PPM/MD, were analyzed and compared using FTIR, particle size, SEM, total anthocyanin (TAC), and total polyphenol (TPC) content, as well as anthocyanin profile by UPLC-MS/MS and antioxidant activity (ORAC). The microcapsules exhibited desirable physicochemical properties with high TAC and ORAC, with a potential application in ice cream formulation, as evidenced by in vitro evaluations and color

	stability studies. This research underscores the feasibility of microencapsulating MFP pigment extracts as a novel source of natural colorants for food applications.
DOI	10.1016/j.powtec.2024.120580

Enhancing the stability and functionality of phycobiliproteins as natural food colourants through microparticle formulation

[Mejora de la estabilidad y funcionalidad de las ficobiliproteínas como colorantes alimentarios naturales mediante la formulación de micropartículas]

Fuente	Food Chemistry - ISSN-03088146
Año	2025
Autores / Institución	Vieira, M.V. Noore, S. Tiwari, B. O'Donnell, C. Gonçalves, C. Pastrana, L.M. Fuciños, P. / INTERNATIONAL IBERIAN NANOTECHNOLOGY LABORATORY TEAGASC - IRISH AGRICULTURE AND FOOD DEVELOPMENT AUTHORITY UNIVERSITY COLLEGE DUBLIN
Resumen	The food industry is increasingly turning to microalgae pigments as natural functional colourants to replace potentially harmful synthetic dyes. Among those, phycobiliproteins offer deep and vibrant colours with bioactivities, showing to be a promising alternative. However, incorporating them into a food matrix can be challenging due to their inherent instability, low bioavailability, and off-flavours. Accordingly, the present work aimed to prepare microparticles of phycocyanin (PCMP) and of an ultrasound-assisted phycoerythrin-rich extract from <i>Porphyridium purpureum</i> (PEMP) to improve these natural colourants' stability and functional properties. The microparticles were prepared by Nano spray-drying using inulin and gum Arabic as coating materials, resulting in particles with high yield, encapsulation efficiency (from 69 % to 80 %), solubility, and colour retention. Combining inulin and gum Arabic allowed the formation of smaller and more homogeneous particles with increased antioxidant potential when compared to using inulin alone. Moreover, gum Arabic improved the bioaccessibility of PEMP from 35 % to 51 %, demonstrating the potential of this microparticle formulation to enhance the stability and functionality of phycobiliproteins.
DOI	10.1016/j.foodchem.2024.142077

Enhancing phycocyanin stability through encapsulation: optimization of maltodextrin and sodium alginate ratios

[Mejora de la estabilidad de la ficocianina mediante encapsulación: optimización de las proporciones de maltodextrina y alginato sódico]

Fuente	Journal of Food Measurement and Characterization - ISSN-21934126
Año	2025
Autores / Institución	Athiyappan, K.D. Chaudhuri, R. Paramasivan, B. / NATIONAL INSTITUTE OF TECHNOLOGY ROURKELA
Resumen	Phycocyanin from <i>Spirulina</i> sp. exhibits significant nutritive benefits but faces major limitations in industrial applications due to instability toward abiotic stress factors such as light, temperature, and pH. Encapsulation is an effective solution to enhance

	phycocyanin's stability against these stressors. The present study analyzed the double encapsulation of phycocyanin by optimizing encapsulant ratios of maltodextrin (MD) and sodium alginate (SA). The testing formulations used in the study were 6.5%, 7.5%, and 8.5% w/w of MD and 3.5%, 2.5%, and 1.5% w/w of SA, formulated in the ratio of 6.5 MD:3.5SA, 7.5 MD:2.5SA, and 8.5 MD:1.5SA and encapsulated phycocyanin in 1:1 ratio. The results showed that the 8.5 MD:1.5 SA matrix achieved the highest encapsulation efficiency ($99.8 \pm 0.01\%$), supported by structural and functional analyses, including thermal degradation and antioxidant activity studies. Thermal stability of the 8.5 MD:1.5 SA encapsulated phycocyanin was retained for 30 min at 60 °C, and antioxidant activity remained high, with $90.2 \pm 0.47\%$ at 30 min. In vitro release studies further revealed that the 8.5 MD:1.5 SA matrix effectively protected phycocyanin in acidic environments, with the potential for targeted release in the small intestine. Overall, the 8.5 MD:1.5 SA encapsulated phycocyanin demonstrates enhanced stability, making it a promising candidate as a functional food and natural colorant in the food industry.
DOI	10.1007/s11694-024-03028-1

Ultrasound-assisted oligochitosan/casein complexes stabilized Pickering emulsion: Characterization, stability and its application for lutein delivery

[Emulsión Pickering estabilizada con complejos de oligoquitosán/caseína asistida por ultrasonidos: Caracterización, estabilidad y su aplicación para la administración de luteína]

Fuente	International Journal of Biological Macromolecules - ISSN-01418130
Año	2025
Autores / Institución	Wang, Y. Li, S. Yang, X. Jiang, Y. Shi, J. / NORTHEAST AGRICULTURAL UNIVERSITY
Resumen	Lutein is a natural pigment with various beneficial biological activities, but its poor water solubility, chemical instability, and low bioavailability limit its application in food processing. In this study, modified casein (CAS-OCS NPs)-based Pickering emulsions were constructed under the combined effect of TGase-type glycation and ultrasound treatment as delivery systems for lutein fortification. Pickering emulsions based on CAS-OCS NPs enhanced the encapsulation efficiency of lutein ($87.04 \pm 0.30\%$). The modification treatments improved the emulsifying properties, environmental stability, and digestive stability, as well as the delivery capability of lutein and antioxidant activity in simulated in vitro gastrointestinal digestion. After glycation modification, the lutein release rate of CAS-OCS NPs-based Pickering emulsions after in vitro digestion was higher than that of untreated casein-based Pickering emulsions, and the maximum release rate was $55.44 \pm 0.50\%$. Moreover, the CAS-OCS NPs-based Pickering emulsions showed improved lutein bioaccessibility, reaching the maximum value of $58.52 \pm 0.52\%$. These findings demonstrated the suitability of TGase-type glycation and ultrasound treatment for the preparation of Pickering emulsions to deliver bioactive compounds.
DOI	10.1016/j.ijbiomac.2025.141811

Nanoliposome modified with inulin and pea protein isolate improve the thermal stability and slow the release of anthocyanin at simulated *in vitro* digestion and hot cocoa beverage

[Nanolipsomas modificados con inulina y aislado de proteína de guisante mejoran la estabilidad térmica y ralentizan la liberación de antocianina en digestión in vitro simulada y bebida de cacao caliente]

Fuente	Foods - ISSN-23048158
Año	2025
Autores / Institución	Aniya Zhang, L. Li, Y. Fu, X. / JIANGXI ACADEMY OF AGRICULTURAL SCIENCES NANCHANG UNIVERSITY
Resumen	Anthocyanin (ACN) is a natural pigment with various biological activities, but their stability is compromised by external environmental factors, which limits their practical application in food processing. To enhance the stability of anthocyanin, double-layer-modified anthocyanin nanoliposomes (ACN-NLs) were prepared in this study using pea protein isolate (PPI) and inulin (IN) through layer-by-layer assembly in this study. The preparation conditions of unmodified, single-modified, and double-layer-modified nanoliposomes (ACN-NLs, PPI-ACN-NLs, and IN-PPI-ACN-NLs) were optimized via analysis of their average particle size, zeta potential, and encapsulation efficiency (EE). In addition, the structure of the nanoliposomes was characterized via transmission electron microscopy (TEM) and a Fourier transform infrared (FTIR) spectrometer. Furthermore, the thermal stability of nanoliposomes in hot cocoa and their release behavior during in vitro simulated digestion were evaluated. The results indicated that the optimal formulation for IN-PPI-ACN-NLs was 6% PPI and 2% IN. Under these conditions, the IN-PPI-ACN-NLs had a particle size of 270.2 ± 0.66 nm, a zeta potential of -15.76 ± 0.81 mV, and a high EE of $88.6 \pm 0.71\%$. TEM analysis revealed that IN-PPI-ACN-NLs exhibited a spherical core-shell structure, while FTIR confirmed the interaction between ACNs and the encapsulating materials (PPI and IN). Compared with unmodified or monolayer-modified nanoliposomes, IN-PPI-ACN-NLs exhibited thermal stability in beverage systems and enhanced DPPH radical scavenging activity. During in vitro digestion, IN-PPI-ACN-NLs demonstrated a sustained-release effect and improved the digestive stability of ACN. These properties make it a promising functional additive for applications in the food and pharmaceutical industry.
DOI	10.3390/foods14050731

Development and characterization of a novel bigel system based on candelilla wax oleogel and guar gum hydrogel for heat-triggered release properties

[Desarrollo y caracterización de un nuevo sistema bigel basado en oleogel de cera de candelilla e hidrogel de goma guar para propiedades de liberación activadas por calor]

Fuente	Food Hydrocolloids- ISSN-0268005X
Año	2024
Autores / Institución	Lee, G.R. Baek, Y. Jeong, E. Lee, H.G. HANYANG UNIVERSITY
Resumen	This study introduces an innovative approach for the encapsulation and heat-triggered release of natural pigment, paprika oleoresin (PO) as a model pigment, by formulating oleogel-in-hydrogel bigels incorporating candelilla wax (CW). By varying the CW concentrations, the impact on the critical physicochemical properties of bigels was

	investigated. Increasing CW concentration from 2 to 8% elevated the sol-gel transition temperature (T_g) of the oleogels significantly, ranging from 45.83 ± 0.83 to 61.38 ± 0.51 °C ($p < 0.05$). Across all CW concentrations, high encapsulation efficiency over 95% was consistently observed. Conversely, reducing CW concentration increased droplet size within the bigels, varying from 13.19 ± 2.97 to 2.97 ± 0.60 μm ($p < 0.05$). Notably, these bigels exhibited distinct heat-triggered pigment release characteristics. In specific, the amount of released PO decreased with increased CW concentration, resulting in a lower ΔE^* value. Correlation analysis highlighted CW's positive correlation with the T_g of the oleogel and bigel lightness, and its negative correlation with droplet size, cumulative pigment release content, release rate constant, redness, yellowness, and ΔE^* of the bigel. These results indicate that controlling pigment release through CW-based bigels with thermoresponsive properties can enhance color stability and preserve the integrity of pigment during heat processing. This novel bigel system with heat-triggered release properties holds promise for wider application in the food industry. Overall, it addresses the critical need to stabilize and precisely regulate natural pigment release, which is important for both product quality and consumer satisfaction in the food industry. © 2024 Elsevier Ltd
DOI	10.1016/j.foodhyd.2024.109892

Ultrasound-assisted extraction and encapsulation of betalain from prickly pear: Process optimization, in-vitro digestive stability, and development of functional gummies

[Extracción y encapsulación asistida por ultrasonidos de betalaina de higo chumbo: Optimización del proceso, estabilidad digestiva in vitro y desarrollo de gominolas funcionales]

Fuente	Ultrasonics Sonochemistry - ISSN-13504177
Año	2024
Autores / Institución	Mehta, D. Kuksal, K. Yadav, K. Kumar Yadav, S. Zhang, Y. Hariram Nile, S. / FUJIAN UNIVERSITY OF TRADITIONAL CHINESE MEDICINE CSIR - INSTITUTE OF HIMALAYAN BIORESOURCE TECHNOLOGY
Resumen	The study aimed to extract and encapsulate betalain pigment from prickly pear (<i>Opuntia ficus-indica</i>) using ultrasound-assisted extraction and eco-friendly glycerol. Subsequent analysis encompassed assessing its thermal stability, shelf-life, bio-accessibility, and biological properties. The process optimization employed Response Surface Methodology (RSM), focusing on glycerol concentration (20–50 %), sample to solvent ratio (1:10–1:20), temperature (30–60 °C), and time (10–30 min). Optimal conditions were determined as 23.15 % glycerol, 1:10 sample to solvent ratio, 10.43 min treatment time, and 31.15 °C temperature. Under these conditions, betalain content reached 858.28 mg/L with a 93.76 % encapsulation efficiency. Thermal stability tests (80–180 °C; 30 & 60 min) showed degradation of betalain with higher temperatures and longer durations, affecting the visual aspect (ΔE) of the pigment. Encapsulated betalain exhibited favorable shelf stability, with optimal storage life of 404.27 days at 4 °C in amber conditions, compared to 271.99 days at 4 °C without amber, 141.92 days at 25 °C without amber, and 134.22 days at 25 °C with amber. Bio-accessibility of encapsulated betalain was significantly higher (2.05 ± 0.03 %) than conventionally extracted pigment (1.03 ± 0.09 %). The encapsulated pigment displayed strong anti-inflammatory properties in dosages of 2–20 μL, with no cytotoxic effects. Additionally, incorporation into gummies was successful and visually approved by sensory panellists. Glycerol proved to be a green encapsulating agent for betalain, offering high shelf life and bio-accessibility, making it suitable for food industry

	applications. The encapsulated pigment demonstrated robust thermal stability and shelf life, making it suitable for food industry applications. This study highlights glycerol's potential as a sustainable alternative for natural pigment extraction.
DOI	10.1016/j.ultsonch.2024.106975

Nanoliposome of black fig anthocyanins and its application in kombucha beverage

[Nanoliposomas de antocianinas de higo negro y su aplicación en la bebida kombucha]

Fuente	Journal of Food Science and Technology (Iran) - ISSN-20088787
Año	2024
Autores / Institución	Jami, A. Fathi-Achachlouei, B. Shaddel, R. / UNIVERSITY OF MOHAGHEGH ARDEBILI
Resumen	Anthocyanin is one of the bioactive compounds, which is the main pigment of many fruits and vegetables. Since anthocyanins have low thermal stability during food processing, the use of these compounds as natural pigments in foods is associated with challenges. Therefore, microencapsulation of anthocyanin compounds with liposomes is important. Nanoencapsulation of bioactive compounds with liposomes is an effective and efficient way to increase the stability of polyphenolic compounds. Liposomes are polar lipid vesicles that form bilayer structures in polar solvents such as water. In this research, nanoliposomes in ratios of 9-1, 8-2, 7-3 and 6-4 lecithin-cholesterol were prepared using the solvent injection method. Then, the size and zeta potential tests were conducted to determine the characteristics of the produced particles. The average particle size (average hydrodynamic diameter) and particle size distribution for different lecithin-cholesterol ratios were in the range of 132-740 nm and 0.47-0.41, respectively. Zeta potential values were also obtained in the range of -26 to -42 mv. After determining the efficiency of Nanoencapsulation, FTIR test was performed to investigate possible reactions between anthocyanins and nanoliposome wall materials. The morphology of anthocyanin-loaded lecithin-cholesterol nanoliposomes with a ratio of 9-1 was shown by scanning electron microscopy (SEM). The stability of the liposomal sample with a ratio of 9-1 lecithin-cholesterol was evaluated by calculating the amount of release of encapsulated anthocyanin during 60 days of storage at ambient temperature. Samples with 9-1 lecithin-cholesterol ratio were used in Kombucha beverage formulation. Sensory properties of prepared beverages were evaluated which the results showed among the samples, smell, mouthfeel and overall acceptance parameters had no significant difference ($P>0.05$). The results obtained in this research showed that nanoliposomes are an efficient system for encapsulating of anthocyanins.
DOI	10.22034/FSCT.21.148.45

Optimization of spray drying process of buriti oil-loaded bilayer emulsions

[Optimización del proceso de secado por atomización de emulsiones bicapa cargadas con aceite de buriti]

Fuente	Colloids and Surfaces A: Physicochemical and Engineering Aspects - ISSN-09277757
Año	2024
Autores / Institución	Moser, P. Locali-Pereira, A.R. Nicoletti, V.R. / UNIVERSIDADE ESTADUAL PAULISTA JÚLIO DE MESQUITA FILHO

Resumen	Buriti oil is extracted from the fruits of a palm tree (<i>Mauritia flexuosa</i> L.) native to the Amazon rainforest, having one of the highest levels of β-carotene found in nature. The emulsification of buriti oil contributes to protecting the bioavailability of its bioactive compounds during processing. Drying oil-loaded emulsions is a way to produce microcapsules that have higher storage stability and expand the application possibilities of buriti oil. The objective of this work was to evaluate the impact of spray drying conditions on the microencapsulation of buriti oil, using response surface methodology. Bilayer emulsions were stabilized by whey protein isolate and high-methoxyl pectin and spray dried. The effects of inlet air temperature (154–196 °C) and feed flow rate (1.2–6.8 mL/min) on different properties of the microcapsules were evaluated. Higher air temperatures caused a positive effect on process yield but affected the color and encapsulation efficiency, while the increase in feed flow rate had a positive effect on the color of microcapsules. The higher drying rates negatively affected the microcapsules, resulting in larger and agglomerated particles, with the presence of holes in their surface. Surface models were obtained to predict color parameters of the microcapsules, which can be used as tools to quality control during processing. In general, the low drying rate resulted in microcapsules with suitable characteristics to ensure oil protection. The optimized spray drying process allows the production of buriti oil microcapsules with potential for application as natural pigments in the food industry.
DOI	10.1016/j.colsurfa.2024.134516

***Fusarium verticillioides* pigment: production, response surface optimization, gamma irradiation and encapsulation studies**

[Pigmento de Fusarium verticillioides: producción, optimización de la superficie de respuesta, irradiación gamma y estudios de encapsulación]

Fuente	BMC Biotechnology - ISSN-14726750
Año	2024
Autores / Institución	Mwaheb, M.A. Hasanien, Y.A. Zaki, A.G. Abdel-Razek, A.S. Al Halim, L.R.A. / AL-FAYOUM UNIVERSITY EGYPTIAN ATOMIC ENERGY AUTHORITY
Resumen	Background: Natural pigments are becoming more significant because of the rising cost of raw materials, pollution, and the complexity of synthetic pigments. Compared to synthetic pigments, natural pigments exhibit antimicrobial properties and is less allergic. Pigments from microbial sources could easily be obtained in an inexpensive culture media, produced in high yields, and microbes are capable of producing different colored pigments. Searching for new sources for natural pigments to replace synthetic ones in food applications has become an urgent necessity, but the instability of these compounds is sometimes considered one of the obstacles that reduce their application. Encapsulation provides an ideal solution for natural dye protection through a controlled release strategy. Thus, this study aims at isolation of several soil fungi and subsequent screening their pigment production ability. The chosen pigment-producing fungal strain underwent full identification. The produced pigment was extracted with ethyl acetate and estimated spectrophotometrically. As there is a necessity to obtain a high pigment yield for efficient industrial application, the best production medium was tested, optimum conditions for maximum dye production were also investigated through the response surface methodology, and gamma irradiation was also employed to enhance the fungal productivity. Encapsulation of the

	produced pigment into chitosan microsphere was tested. The pigment release under different pH conditions was also investigated. Results: A new strain, <i>Fusarium verticillioides</i> AUMC 15934 was chosen and identified for a violet pigment production process. Out of four different media studied, the tested strain grew well on potato dextrose broth medium. Optimum conditions are initial medium pH 8, 25 °C-incubation temperature, and for 15-day incubation period under shaking state. Moreover, a 400 Gy irradiation dose enhanced the pigment production. Chitosan microsphere loaded by the pigment was successfully prepared and characterized by infrared spectroscopy and scanning electron microscopy. Conclusion: This irradiated <i>Fusarium</i> strain provides a more economically favorable source for production of a natural violet dye with an optimum productivity, enhanced yield, and improved properties (such as, enhanced stability, controlled release, and bioaccessibility) by encapsulation with chitosan for efficient application in food industry.
DOI	10.1186/s12896-024-00909-7

6.1.2 Tecnologías de bioproducción y extracción sostenible

Theoretical insights into the diverse stabilizing effects of fenchyl alcohol/thymol eutectic solvent on carotenoids

[Comprensión teórica de los diversos efectos estabilizadores del disolvente eutéctico alcohol fencílico/timol sobre los carotenoides]

Fuente	Journal of Molecular Liquids - ISSN-01677322
Año	2024
Autores / Institución	Fan, C. Cheng, L. Deng, W. Wang, Q. / BEIJING TECHNOLOGY AND BUSINESS UNIVERSITY
Resumen	Carotenoids, a class of vital natural pigments, are known for their antioxidant properties and are integral to various industrial applications. However, their instability during processing and storage has limited their broader utilization. This study investigated the stabilizing effects of a fenchyl alcohol/thymol-based deep eutectic solvent (DES) on a spectrum of carotenoids, including lutein, zeaxanthin, astaxanthin, and β -carotene. Through a combination of ab initio molecular dynamics (AIMD) simulations and quantum chemical calculations, we elucidated the molecular interactions and stabilization mechanisms within the DES environment (methanol as the benchmark). Our findings reveal that the DES could exert varying degrees of influence on the stability of different types of carotenoids. The temperature-dependent behavior of carotenoids in the DES suggested a complex interplay between hydrogen bonding, dispersion forces, and the inherent structural properties of carotenoids. AIMD simulations provided a detailed picture of the structural organization and hydrogen bond network topology within the DES, highlighting the role of temperature on the stability and orientation of solvent molecules around carotenoids. Energy decomposition analysis (EDA), Hirshfeld surface analysis, and visual study of interactions further dissected the non-covalent interactions, emphasizing the significance of electrostatic and dispersion forces-driven non-covalent interactions (van der Waals dispersion interactions) in stabilizing carotenoids within the DES matrix. In comparison to methanol, the interactions between components of the eutectic system and the target molecules demonstrate enhanced dynamism, increased complementarity, and a greater variety of interaction patterns. This research presented a novel perspective on the use of DESs for the stabilization of carotenoids, offering potential solutions to enhance their industrial applicability and performance. The insights gained from this study are crucial for the development of sustainable and eco-friendly solvent systems, aligning with the growing demand for green chemistry in the pharmaceutical, cosmetic, and food industries.
DOI	10.1016/j.molliq.2024.126093

Mutation breeding of monascus to produce a high yield of orange pigment and low citrinin content using the artp method

[Cría por mutación de Monascus para producir un alto rendimiento de pigmento naranja y un bajo contenido de citrinina mediante el método ARTP]

Fuente	Journal of Fungi - ISSN-2309608X
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Año	2024
Autores / Institución	Zhang, C. Sun, Q. Yang, L. Ablimit, A. Dong, H. Wang, H. Wang, C. Wang, C. / BEIJING TECHNOLOGY AND BUSINESS UNIVERSITY
Resumen	Monascus is a filamentous fungus with a long history of application in China, which can produce a variety of secondary metabolites, including Monascus red pigments, Monascus orange pigments, Monascus yellow pigments, and citrinin. There is widespread attention being paid to natural pigments because of their safety. Among the many natural pigments, orange pigment has a wide range of applications because of its unique color, but current production levels in the orange pigment industry are limited to a certain extent due to the insufficiently wide range of sources and low production. In this study, the ARTP mutation was used to obtain a strain with high-yield orange pigment and low citrinin. The strain RS7 was obtained through two-step mutagenesis, and all three pigments were improved to different degrees. The color value of orange pigment was elevated from the original 108 U/mL to 180 U/mL, an increase of 66.7% compared to the original strain, and the citrinin content was reduced by 69%. The result of microscopic morphology showed that RS7 has more wrinkles and is more convex than the R1 strain, but there was little change between the two strains. Therefore, the ARTP mutation influenced the growth and the biosynthesis of pigments in Monascus. In addition, the conditions of ultrasonic extraction of Monascus pigments were optimized using the response surface, and the separation of pigments was achieved with the method of thin-layer chromatography. Pigment stability results showed that the temperature had no significant effect on orange pigment, while tea polyphenol could improve its stability. This study generated a strain with high-yielding orange pigment and could lay a foundation for the future application of Monascus orange pigment in the food industry.
DOI	10.3390/jof10080553

Optimization of ultrasound-assisted enzymatic extraction, chemical constituents, biological activities, and stability of *Camellia oleifera* fruit shell brown pigments

[Optimización de la extracción enzimática asistida por ultrasonidos, constituyentes químicos, actividades biológicas y estabilidad de los pigmentos marrones de la cáscara del fruto de Camellia oleifera]

Fuente	LWT - ISSN-00236438
Año	2024
Autores / Institución	Cheng, G. Zhu, J. Si, J. Wu, T. Chen, J. Xu, X. Feng, S. Chen, T. Ding, C. Zhou, L. / SICHUAN AGRICULTURAL UNIVERSITY CHINESE ACADEMY OF SCIENCES
Resumen	The need for the use of natural pigments in food manufacturing rises steadily. However, the application of natural pigments is limited by costly production and poor stability. Hence, the brown pigments from <i>Camellia oleifera</i> shells (disposal from tea oil production) were focused on in this study. The enzymatic extraction of <i>Camellia oleifera</i> fruit shell brown pigment (BP-CS) with ultrasound assistance was optimized by Box-Behnken design to cut extraction expenses. The yield of BP-CS was 38.56% under the optimized extraction parameters as extraction time of 77 min, extraction temperature of 64 °C, cellulose concentration of 10 mg/mL and liquid-solid ratio of 20mL/g. Subsequently, for promising no harmful ingredients in BP-CS, all 36 compounds were identified, and the primary constituents were flavonoids (quercitrin,

	quercetin) and organic acids (D-malic acid, citric acid). Via stability analysis, the brown pigment was pretty stable under heating, pH, and sunlight changes while was impacted by metal ions and redox agent conditions. Additionally, BP-CS was able to scavenge free radicals (DPPH, ABTS, ·OH) and prevent the growth of microorganisms. Moreover, BP-CS could reduce α-amylase and tyrosinase activity, and both quenching mechanisms were static quenching. Overall, this work reveals that BP-CS is a valuable natural pigment, and is anticipated to be employed as a premium-quality pigment additive in the food industry.
DOI	10.1016/j.lwt.2024.116625

Antioxidant ready-to-use grape pomace extracts recovered with natural eutectic mixtures for formulation of color-rich gummies

[Extractos antioxidantes de orujo de uva listos para usar recuperados con mezclas eutécticas naturales para la formulación de gominolas ricas en colorantes]

Fuente	Foods - ISSN-23048158
Año	2024
Autores / Institución	Trentin, J. Mussagy, C.U. Arantes, M.S.T. Pedro, A.C. Mafra, M.R. Farias, F.O. / UNIVERSIDADE FEDERAL DO PARANÁ PONTIFICIA UNIVERSIDAD CATÓLICA DE VALPARAÍSO UNIVERSIDADE TECNOLÓGICA FEDERAL DO PARANÁ
Resumen	The growing consumer demand for natural and eco-friendly food products motivates the development and evaluation of new and natural inputs for the food industry. So, this work explores the potential of grape pomace (GP) from winemaking, a food production residue, to obtain an anthocyanin-rich, ready-to-use extract with antioxidant activity that can confer improved color-rich gummy candies. The anthocyanins' chemical nature and the predictive COSMO-SAC model was considered for screening the best natural eutectic mixture for anthocyanin extraction. The eutectic mixtures composed of choline chloride as a hydrogen bond acceptor and acetic and citric acids as hydrogen bond donors were selected as solvents. The extraction was performed using a high-shear disperser (Ultra-Turrax®) at 45 °C and was stirred at 5000 rpm for 10 min. The extracts presented high total anthocyanin content (TAC), up to 60 µg equivalent of cyaniding-3-glucoside/g of dry GP, and high antioxidant activity as determined by DPPH and FRAP assays. The phenolic profile was also determined by high-performance liquid chromatography (HPLC) and the results corroborated with the antioxidant activity of the extracts. The results also demonstrate that eutectic mixtures enhance the extraction efficiency of anthocyanins and improve their stability, making them suitable for incorporation into functional food products such as gummies, acting as natural colorants.
DOI	10.3390/foods13172840

Evaluation of the thermal and light stability of β-carotene extracted from *Mauritia flexuosa* using ionic liquid

*[Evaluación de la estabilidad térmica y a la luz del β -caroteno extraído de *Mauritia flexuosa* utilizando líquido iónico]*

Fuente	Food Chemistry Advances - ISSN-2772753X
Año	2024
Autores / Institución	Ferreira, A.C.G. de Lima, B.R. de Matos, O.F. Hanada, R.E. Aguiar, J.P.L. do Amaral Souza, F.D.C. / INSTITUTO NACIONAL DE PESQUISAS DA AMAZÔNIA UNIVERSIDADE DO ESTADO DO AMAPÁ UNIVERSIDADE FEDERAL DO AMAPÁ
Resumen	The growing concern over the adverse effects of synthetic dyes has generated interest in the use of natural pigments by the food industry. β -carotene, a carotenoid found in various plant sources, is recognized for its antioxidant properties and provitamin A activity. The fruit of the buriti palm (<i>Mauritia flexuosa</i>), which is particularly rich in β -carotene, serves as a significant natural source of this pigment. This study aimed to extract β -carotene from buriti fruit using ionic liquids as an alternative to conventional organic solvents like acetone. β -carotene content was determined by HPLC and showed that extraction with [C4mim] [BF4] not only improved β -carotene extraction efficiency compared to acetone (19.21 and 13.13 mg/100 g, respectively) but also provided greater pigment stability during light, thermal and color stability tests. Moreover, ionic liquids are aligned with the principles of green chemistry and offer a sustainable and safe alternative for the food industry. Its favorable characteristics not only reduce environmental impacts associated with conventional solvents, but also ensure an increase in the shelf life of natural dyes, thus promoting the safety and quality of food products.
DOI	10.1016/j.focha.2024.100833

6.1.3 Tecnologías de optimización de la matriz de aplicación y nuevas funcionalidades

Walnut protein isolate based emulsion as a promising delivery system enhanced lutein bioaccessibility

[Emulsión a base de aislado proteico de nuez como prometedor sistema de administración que mejora la bioaccesibilidad de la luteína]

Fuente	International Journal of Biological Macromolecules - ISSN-01418130
Año	2024
Autores / Institución	Liu, L. Shi, L.S. Hu, C.Y. Gong, T. Yang, X.Y. Zhang, C.Q. Meng, Y.H. / UNIVERSITY OF HAWAI'I AT MĀNOA SHAANXI NORMAL UNIVERSITY
Resumen	Lutein, a natural pigment with multiple beneficial bioactivities, faces limitations in food processing due to its instability. In this study, we constructed four modified walnut protein isolate (WNPI) based emulsions as emulsion-based delivery systems (EBDS) for lutein fortification. The modification treatments enhanced the encapsulation efficiency of the WNPI-based EBDS on lutein. The modified WNPI-based EBDS exhibited improved storage and digestive stability, as well as increased lutein delivery capability in simulated gastrointestinal conditions. After in vitro digestion, the lutein retention in the modified WNPI-based EBDS was higher than in the untreated WNPI-based EBDS, with a maximum retention of 49.67 ± 1.10 % achieved after ultrasonic modification. Furthermore, the modified WNPI-based EBDS exhibited an elevated lutein bioaccessibility, reaching a maximum value of 40.49 ± 1.29 % after ultrasonic modification, nearly twice as high as the untreated WNPI-based EBDS. Molecular docking analysis indicated a robust affinity between WNPI and lutein, involving hydrogen bonds and hydrophobic interactions. Collectively, this study broadens WNPI's application and provides a foundation for fortifying other fat-soluble bioactive substances.
DOI	10.1016/j.ijbiomac.2024.133608

Understanding the molecular interactions between pandan pigment and food components for enhanced thermal stability

[Comprensión de las interacciones moleculares entre el pigmento de pandan y los componentes alimentarios para mejorar la estabilidad térmica]

Fuente	Foods - ISSN-23048158
Año	2024
Autores / Institución	Chen, J. Gu, C. Wang, M. Chang, Z. Zhou, J. Yue, M. Liu, F. Feng, Z. / CHINESE ACADEMY OF TROPICAL AGRICULTURAL SCIENCES NORTHEAST AGRICULTURAL UNIVERSITY
Resumen	Pandan pigment (<i>Pandanus amaryllifolius</i>) is widely used as a natural food coloring and flavoring agent. However, its application in food is limited because of its susceptibility to thermal degradation during food processing, which affects both pigment stability and color. Despite its growing use, there is limited research on how common food ingredients can mitigate this degradation. This study addresses this gap by exploring the effects of sucrose, lactose, rice starch, whey protein, and soy protein

	isolate on the thermal and color stability of pandan pigment under various heating conditions (65 °C, 95 °C, 115 °C, and 121 °C for 15 min). Spectroscopic techniques (UV–visible, infrared, and fluorescence) and laser confocal microscopy were used to elucidate the molecular interactions. The results revealed that rice starch provided the strongest protection, followed by whey protein, soy protein isolate, lactose, and sucrose, although the protective effects decreased at higher temperatures. These findings offer new insights into the use of sugars and proteins to increase the thermal stability of natural pigments in food applications.
DOI	10.3390/foods13213361

A review on the role of pH-sensitive natural pigments in biopolymers based intelligent food packaging films

[Una revisión sobre el papel de los pigmentos naturales sensibles al pH en las películas de envasado inteligente de alimentos a base de biopolímeros]

Fuente	International Journal of Biological Macromolecules - ISSN-01418130
Año	2024
Autores / Institución	Kumar, Y. Bist, Y. Thakur, D. Nagar, M. Saxena, D.C. / SANT LONGOWAL INSTITUTE OF ENGINEERING AND TECHNOLOGY
Resumen	As food packaging evolves, consumer interests are shifting from traditional to intelligent food packaging systems. Intelligent packaging includes active components that display changes in a visual or interactive form perceivable by consumers. This offers real-time monitoring of the quality and shelf life of the packaged food and enhances transparency. For example, pH-sensitive natural pigment-based films change color in response to variations in pH levels, enabling the film/labels to reflect alterations in the acidity or basicity of the food inside the package. Natural pigments like anthocyanins, curcumin, betalains, chlorophyll, and carotenoids have been comprehensively reported for developing biodegradable pH-sensitive films of starch, protein, chitosan, and cellulose. Natural pigments offer great compatibility with these biopolymers and improve the other performance parameters of the films. However, these films still lack the strength and versatility of petroleum-based synthetic plastic films. But these films can be used as an indicator and combined with primary packaging to monitor freshness, time-temperature, and leak for muscle foods, dairy products, fruits and vegetables, and bakery products. Therefore, this review provides a detailed overview of pH-sensitive pigments, their compatibility with natural polymers, their role in film performance in monitoring, and their food packaging applications.
DOI	10.1016/j.ijbiomac.2024.133869

Cost-effective production of kombucha bacterial cellulose by evaluating nutrient sources, quality assessment, and dyeing methods

[Producción rentable de celulosa bacteriana de kombucha evaluando las fuentes de nutrientes, la evaluación de la calidad y los métodos de teñido]

Fuente	Environmental Science and Pollution Research - ISSN-09441344
Año	2025

Autores / Institución	Cahyaningtyas, H.A.A. Renaldi, G. Fibriana, F. Mulyani, W.E. / CHIANG MAI UNIVERSITY SEMARANG STATE UNIVERSITY
Resumen	Kombucha is a popular fermented beverage that involves fermentation using a symbiotic culture of bacteria and yeast (SCOBY) and produces bacterial cellulose (BC). Carbon and nitrogen sources are essential in kombucha processing and BC production. However, studies on cost-effective BC production as an alternative source of leather have remained scarce. This study aimed to assess the effects of various nitrogen and carbon sources on the production of kombucha BC, investigate the qualities, and dye the product using natural colorant. Different nitrogen sources (such as black tea, white tea, and green tea) and carbon sources (honey, sugar cane, palm sugar, and brown sugar) were used to produce kombucha BC, as well as to appraise the product qualities, which were dyed using three distinct natural dyes (coffee, ginger, and sappan wood). The results revealed that different nitrogen and carbon sources produced different BC with different properties. Green tea (N-source) and palm sugar (C-source) containing medium produced a BC thickness of 0.194 ± 0.04 mm with the highest tensile strength (24.42 ± 3.90 g). Different dyes also result in the fabric having different colors: brownish yellow (coffee), yellowish orange (ginger), and red (sappan wood). All BC products showed color stability after 8 months of storing at room temperature. In conclusion, effective BC production could use green tea and palm sugar as the best nitrogen and carbon sources, respectively. Dyed BC showed good visual quality and is promising for its eco-friendly and sustainable application in fashion products.
DOI	10.1007/s11356-025-35915-5

6.2 PROYECTOS DE INVESTIGACIÓN

Durante el periodo 2020 – 2025, la base de datos CORDIS, registra el financiamiento de tres (03) proyectos de investigación europeos que se alinean con la temática en estudio. Dichos proyectos se enfocan en acciones internacionales y colaborativas para disminuir el uso de colorantes sintéticos perjudiciales para la salud, mediante la búsqueda y el desarrollo de colorantes naturales que cumplan la misma función en la industria alimentaria y sean escalables.

LemnaTap - Exudation agriculture: Highly efficient and continued production of carminic acid pigment for the natural colorants industry

[Agricultura por Exudación: Producción continua y de alta eficiencia de pigmento de ácido carmínico para la industria de colorantes naturales]

Fuente	European Research Council (ERC)
País / Fecha	Israel / 2025-2027
Institución Participantes	WEIZMANN INSTITUTE OF SCIENCE
Resumen	Los pigmentos naturales están cobrando importancia en la UE como alternativas más seguras y sostenibles a los colorantes sintéticos. Sin embargo, su uso también presenta desafíos que han dificultado su adopción generalizada en el mercado de colorantes, especialmente en términos de escalabilidad, coste y abastecimiento ético. El ácido carmínico se utiliza ampliamente como alternativa natural y ejemplifica estos desafíos de producción: requiere un proceso de extracción laborioso, tiene impactos éticos y ambientales negativos para el cultivo y la explotación de insectos, y su producción es impredecible debido a factores externos como las fluctuaciones climáticas. El proyecto PoC introduce una tecnología pionera para la producción sostenible de metabolitos objetivo como el ácido carmínico. El objetivo es demostrar la viabilidad de utilizar esta tecnología innovadora para producir colorantes naturales más económicos y sostenibles, y desarrollar un plan de negocios integral para garantizar la viabilidad comercial y la sostenibilidad de la tecnología. Además, se realizará un análisis de mercado exhaustivo y conversaciones con la industria para evaluar el modelo de negocio con las partes interesadas relevantes, a la vez que se identificarán posibles fuentes de financiación para apoyar futuras iniciativas de comercialización.
Link	https://cordis.europa.eu/project/id/101247244

SORTED - Synbio for compartmentalized carotenoids storage in diatoms

[Biología Sintética para el almacenamiento compartimentado de carotenoides en diatomeas]

Fuente	Horizon Europe - Marie Skłodowska-Curie Actions (MSCA)
País / Fecha	Dinamarca / 2024-2026

Institución Participantes	SYDDANSK UNIVERSITET
Resumen	Los carotenoides son pigmentos naturales presentes en plantas, algas y algunas bacterias, que aportan colores vibrantes a frutas, verduras y flores. Estos compuestos son cruciales para la fotosíntesis y funcionan como antioxidantes, protegiendo las células del estrés oxidativo y el daño de los radicales libres. Sin embargo, su compleja biosíntesis dificulta la producción de suficientes carotenoides para su uso comercial. El proyecto SORTED busca utilizar microalgas, y especialmente diatomeas, para producir carotenoides. A través de este proyecto, se prevé obtener conocimientos innovadores sobre la producción de carotenoides en diatomeas, revolucionando tanto la biotecnología como la comprensión fundamental de la dinámica celular. Los investigadores se centrarán en enzimas específicas y rediseñarán las vías biosintéticas para mejorar la producción de carotenoides. Se espera que el proyecto aporte nuevos conocimientos sobre la biotecnología de las diatomeas, allanando el camino para aplicaciones avanzadas tanto en la industria como en la investigación.
Link	https://cordis.europa.eu/project/id/101149868

CelluNANO - Cellulose scattering enhancers for replacement of Titania nanoparticles

[Potenciadores de dispersión de celulosa para el reemplazo de nanopartículas de titanio]

Fuente	European Research Council (ERC) - EXCELLENT SCIENCE
País / Fecha	Reino Unido / 2020-2022
Institución Participantes	UNIVERSIDAD DE CAMBRIDGE
Resumen	Los nanomateriales, especialmente los de origen biológico, son muy prometedores en una amplia gama de aplicaciones de importancia social para reemplazar a sus homólogos inorgánicos y sintéticos. Esto es particularmente importante en la industria de los pigmentos, que durante mucho tiempo ha dependido del uso de nanopartículas inorgánicas como potenciadores de la dispersión. Actualmente, existe una creciente demanda de alternativas naturales y sostenibles que eviten la creciente preocupación por los posibles impactos a largo plazo en la salud de los materiales inorgánicos, como las nanopartículas de dióxido de titanio (TiO ₂). El proyecto CelluNANO, financiado con fondos europeos, se propone mejorar la capacidad de dispersión de la luz de la celulosa, convirtiéndola en una alternativa natural, segura y sostenible al TiO ₂ . Esta propuesta busca aprovechar los principios de diseño que ofrecen los nanomateriales naturales para fabricar nuevos materiales de alta dispersión utilizando únicamente biopolímeros. La capacidad de controlar la eficiencia de dispersión del material celulósico nos permitirá producir potenciadores blancos verdaderamente sostenibles que puedan utilizarse en aplicaciones cotidianas como cosméticos, alimentos, envases, así como pinturas y revestimientos.
Link	https://cordis.europa.eu/project/id/963872

Durante el mismo periodo, la base de datos PERÚ CRIS, registra un (01) proyecto de investigación que subraya el interés nacional en el aprovechamiento de residuos agroindustriales, economía circular, sostenibilidad y valorización de la biodiversidad local.

Desarrollo y aplicación de polvo, fibra y extracto colorante-antioxidante obtenido a partir de cáscara de pitahaya mediante tecnología verde asistida por ultrasonido como insumo sustituto de grasa y colorante natural en salchicha de carne de alpaca

Fuente	FONDECYT
País / Fecha	Perú / 2021-2023
Institución Participantes	UNIVERSIDAD NACIONAL AGRARIA LA MOLINA
Resumen	El proyecto de investigación buscó el aprovechamiento de residuos de la agroindustria y su transformación en un producto con valor agregado, es decir la conversión de cáscara de pitahaya en un insumo alimentario aprovechable para el desarrollo de productos cárnicos más saludables. Otros dos aspectos motivadores para este estudio son el uso de tecnologías limpias o verdes como la de ultrasonido para recuperar los componentes bioactivos de la cáscara y el aporte de fuente bibliográfica publicable a nivel nacional e internacional sobre esta fruta y sus subproductos. El objetivo general fue determinar el efecto tecnológico y antioxidante de los insumos alimentarios: polvo deshidratado, fibra y extracto hidroalcohólico de la cáscara de pitahaya obtenidos por métodos de optimización con asistencia de ultrasonido, aplicados en salchicha de carne de alpaca. El resultado más relevante para este estudio fue obtener un insumo alimentario rico en fibra lo suficientemente capaz de reducir el contenido de grasa al nivel de eliminar octógono en el producto cárnico de alpaca sin perjudicar el sabor y textura, y además otorgarle un color atractivo y natural.
Link	https://www.perucris.pe/entities/project/ae40e1ad-f013-47b3-a8c0-d07c5d13b250/details

6.3 TESIS

Se realizó la búsqueda de trabajos de tesis publicados durante el periodo 2024 – 2025, utilizando la base de datos Web of Science, con soporte de la información de ProQuest™ Dissertation & Theses Citation Index y la base de datos del Repositorio Nacional Digital de Ciencia, Tecnología e Innovación (ALICIA). Se recuperaron cinco (05) trabajos de investigación relacionados con el desarrollo y aplicación de compuestos naturales, sistemas de encapsulación y modelado metabólico, orientados a mejorar la estabilidad, funcionalidad y aprovechamiento de pigmentos y antioxidantes de origen vegetal. Estos hallazgos confirman que la agenda de investigación está enfocada en resolver las limitaciones de estabilidad, funcionalidad y escalabilidad de los pigmentos naturales, con tres líneas de acción diferenciadas: el uso de estrategias de ingeniería de alimentos para estabilizar y optimizar los pigmentos en el producto final, la aplicación de pigmentos como ingredientes multifuncionales y la mejora de los rendimientos de producción, a través de ingeniería metabólica y computacional.

Polyphenol-protein interactions in pigmented cereals – A clean-label approach to tailor starch viscosity

[Interacciones polifenol-proteína en cereales pigmentados: Un enfoque limpio para adaptar la viscosidad del almidón]

Fuente	Tesis de Doctoral
País / Fecha	Arkansas, United States / 2025
Autor / Institución	Jannasch, Annegret UNIVERSITY OF ARKANSAS
Resumen	Viscosity plays an important role in the food industry as it affects the quality, processing stability, and shelf-life of food and impacts physiological responses such as satiation and satiety. Greater viscosity reduces food intake by increasing the perception of satiety, primarily by delaying gastric emptying and increasing tactile stimulation. Starch is commonly added to food products as a viscosifying ingredient, which often involves chemically modifying the starch via cross-linking, to enhance its resistance to high shear, temperature and acidity. However, chemically modified starches are not “clean-label” ingredients due to the use of toxic chemicals. Therefore, further exploration is needed to develop starch-based ingredients that are solely comprised of natural and chemical-free components while preserving the functional characteristics of chemically modified starch. Recent research demonstrated that polyphenols enhance starch viscosity by interacting with proteins, highlighting their role as natural cross-linkers. Pigmented cereals are a good source of polyphenols, which interact with endosperm proteins to affect the pasting and rheological properties of starch. Nevertheless, the nature and extent of their interactions, as affected by polyphenol and protein classes, are unknown. The present study aimed to elucidate the nature and extent of polyphenol-protein interactions and their role in the viscosity development of rice and sorghum of varying bran colors. The covalent and non-covalent nature of polyphenol-protein interactions in pigmented and non-

	pigmented rice and sorghum and their effects on pasting properties, were studied using chemical agents and at different pH environments. The changes in molecular weight and size, and the secondary and tertiary structures of proteins, as affected by polyphenol class and concentration, were monitored via sodium dodecyl sulfate-polyacrylamide gel electrophoresis (SDS-PAGE), high performance size-exclusion chromatography (HPSEC), circular dichroism spectroscopy (CD), and fluorescence spectroscopy, respectively. The viscosity development and protein structure were influenced by both polyphenol class and concentration. A low anthocyanin concentration in milled purple rice increased peak viscosity, and high anthocyanin levels in parboiled whole grain purple rice enhanced viscoelastic properties in an acidic environment due to the formation of covalent cross-links with glutelin. Black sorghum exhibited less breakdown in various pH environments as a result of hydrogen bonds and hydrophobic interactions between proanthocyanidins and prolamin. Polyphenol-protein interactions naturally enhanced and stabilized starch viscosity in both neutral and acidic environments, similar to chemically cross-linked starch, demonstrating their potential as clean-label ingredients with viscosifying and satiety-enhancing properties.
Link	https://www.webofscience.com/wos/pqdt/full-record/PQDT:123837963

Enhancing stability, delivery, and bioaccessibility of astaxanthin via the encapsulation of weakened *Haematococcus pluvialis*

[Mejora de la estabilidad, suministro y bioaccesibilidad de la astaxantina mediante la encapsulación de *Haematococcus pluvialis* debilitado]

Fuente	Tesis de Maestría
País / Fecha	Delaware, United States / 2025
Autor / Institución	Oninku, Beckham DELAWARE STATE UNIVERSITY
Resumen	The microalga <i>Haematococcus pluvialis</i> (Hpw) is the main natural source of astaxanthin (ASX), a powerful antioxidant, but its bioavailability is limited by a rigid cell wall. To improve the stability of the vulnerable free ASX, this study investigated encapsulating weakened Hpw biomass or ASX extract in alginate (ALG) hydrogels via ionic gelation. The first part demonstrated that ALG effectively encapsulates Hpw, achieving high efficiency (97±2.63%) and loading capacity (32±0.90%). The resulting ALG-Hpw hydrogels showed strong color intensity, favorable physicochemical properties (low water activity and uniform size), and maintained comparable antioxidant activity to the free extract while significantly improving thermal stability (by 40.97°C). The second part explored combined encapsulants using ALG with gum arabic, maltodextrin, pectin, lecithin (LEC), or whey protein concentrate (WPC) to encapsulate ASX-rich extract. All formulations showed very high encapsulation efficiency (~97-98%), with ALG-WPC-Hpw achieving the highest values and most intense color, and also exhibiting the greatest thermal resistance. Crucially, all hydrogels retained over 93% of ASX after 28 days of storage at 25°C, demonstrating improved stability. The ALG-LEC-Hpw formulation showed the highest ASX bioaccessibility. Overall, the study concludes that ALG-based hydrogels, particularly those combined with WPC, are highly effective for improving ASX stability, thus enhancing its potential for use in food, nutraceutical, and aquafeed applications.
Link	https://www.webofscience.com/wos/pqdt/full-record/PQDT:123509958

Production of stable anthocyanin based food colorants from *hibiscus sabdariffa* by copigmentation and their application to model foods

[Producción de colorantes alimentarios estables a base de antocianinas de *Hibiscus sabdariffa* mediante copigmentación y su aplicación a alimentos modelo]

Fuente	Tesis de Doctoral
País / Fecha	Gıda Mühendisliği Anabilim Dalı, Turkey / 2024
Autor / Institución	Eyiz, Vildan NECMETTIN ERBAKAN UNIVERSITY (Turkey)
Resumen	This study investigated the use of straight and curved nanofibrils derived from pea, rice, gluten, and whey proteins (via 24, 36, or 48 hours of heating) as copigmentation agents for <i>Hibiscus sabdariffa</i> anthocyanins, aiming to improve their thermal and storage stability. Compared to un-pretreated protein isolates, the nanofibril-copigmented samples exhibited a bathochromic shift (1-6 nm) and a significant hyperchromic effect (increased absorbance up to 40.32%), confirming successful copigmentation. FTIR and Fluorescence spectroscopy further proved the strong interaction, with shifts in the protein's secondary structure indicating complex formation. Kinetic analysis revealed that anthocyanin degradation followed second-order kinetics and accelerated with temperature. Based on optimal activation energy (E_a) and thermal resistance (z) values, four specific nanofibril-anthocyanin complexes (24NP, 24NG, 24CB, and 48CP) were selected for further study and drying into powder. The resultant powders showed good antioxidant capacity and high anthocyanin content. When incorporated into yogurt (1.5%) and soft candy (1%) and compared to natural (black carrot) and synthetic (Allura Red) controls, the copigmented samples, especially 48CP (curved rice protein nanofibril, 48 h), demonstrated superior preservation of total monomeric anthocyanin and color over the 16-day (yogurt) and 32-day (candy) storage periods. The findings conclude that copigmentation with protein nanofibrils effectively enhances the stability of hibiscus anthocyanins, supporting their potential as a natural alternative to synthetic colorants in food products.
Link	https://www.webofscience.com/wos/pqdt/full-record/PQDT:120585329

Development of systems biology approaches for the reconstruction and validation of the genome-scale metabolic model of the halophilic microalgae *Dunaliella salina*

[Desarrollo de enfoques de biología de sistemas para la reconstrucción y validación del modelo metabólico a escala genómica de la microalga halófila *Dunaliella salina*]

Fuente	Tesis de Maestría
País / Fecha	California, United States / 2024
Autor / Institución	Armstrong, Jenna R. SAN DIEGO STATE UNIVERSITY
Resumen	Systems biology approaches have resulted in genome-scale computational metabolic models (GEMs) that accurately represent the metabolism of microorganisms. Thereby, enhancing our systems level understanding and inform hypotheses for experimental design. When applied to photosynthetic microorganisms, metabolic models offer the potential to exploit natural metabolic robustness and diversity to develop

	biotechnological processes. One special interest in microalgae-based biotechnology is the production of pigments where species, such as <i>Dunaliella salina</i>, contain extraordinary genetic capabilities to produce carotenoids. Here, the genome-scale metabolic model of the halophilic microalgae <i>D. salina</i> was reconstructed to study stress response and pigment production that can be utilized in a wide range of biotechnological applications. The microalga <i>Dunaliella salina</i> has been widely recognized as a promising candidate for sustainable pigment production due to its ability to achieve high-biomass productivities under light environments. <i>D. salina</i> can attain up to 19% pigments in the dry cell biomass, making it a good marketable source for natural carotenoids. Algae biomass also contains antioxidant ingredients that can be added to food to provide therapeutic effects against disease. Development of systems biology tools, such as genome-scale metabolic models (GEMs) constructed from genome sequences, enable quantitative insights into the metabolism of eukaryotic microalgae. In this project, a method for manual curation of the metabolic network was developed and used to improve accuracy of gene-protein-reaction relationships and localizations. During this process, the model was enhanced by adding 969 reactions and 672 metabolites, mostly involved in the fatty acid biosynthesis and degradation, allowing the metabolic network to predict phenotypes under various growth conditions. During this project three stages were identified (green, yellow and orange) and the biomass compositional data, determined experimentally, was used to constrain the model. The aim of this project was to reconstruct, validate and apply the metabolic model for <i>D. salina</i>. The objective of reconstruction provides new insights into the channeling of CO₂ and light to pigments and antioxidants. Currently, the model accounts for 3,255 reactions, and 2,438 metabolites, and 938 genes, <i>D. salina</i> will be a highly comprehensive model of a eukaryotic photosynthetic organism.
Link	https://www.webofscience.com/wos/pqdt/full-record/PQDT:103091369

Identificación y estabilización de las antocianinas por acoplamiento con magnesio de <i>Dioscorea trifida</i> L. para su uso en alimentos	
Fuente	Tesis de grado
País / Fecha	Lima, Peru / 2024
Autores / Institución	Gallardo Dahua, Severino; Tamaya Andrade, Dario UNIVERSIDAD NACIONAL DE LA AMAZONÍA PERUANA
Resumen	<i>Dioscorea trifida</i> L. (Sachapapa morada) es una planta de la familia <i>Dioscoreaceae</i> de origen silvestre y utilizada en la alimentación por los grupos nativos que pueblan la amazonia desde siglos. El objetivo del presente trabajo fue extraer la matriz del colorante y estabilizar por derivatización mediante la formación de un complejo de coordinación utilizando óxido de magnesio y HCl. La muestra fue recolectada en el centro poblado de Nuevo Oriente, Distrito de Mazan, Provincia de Maynas, Región Loreto. El tubérculo fue rallado para reducirlo a partículas pequeñas. Para extraer el colorante matriz se usó metanol acidulado con ácido clorhídrico para llevarlo a medio ácido. La identificación de los componentes del colorante matriz fue mediante cromatografía de papel, y usando como solventes de resolución ácido clorhídrico concentrado - ácido acético - agua y ácido clorhídrico concentrado - ácido fórmico - agua. Las antocianidinas identificadas fueron: cianidina, peonidina, malvidina y pelargonidina, y sus respectivas antocianinas fueron: cianidina-3-rhamnosil- glucósido, peonidina-3,5-diglucósido, malvidina-3,5-diglucósido y pelargonidina- 3,5-diglucósido.

	La estabilización de las antocianinas se logró por reducción del ion flavilio al formarse el complejo de coordinación hexacoordinado de estructura geométrica octaedral denominado $[\eta 6(\text{antocianina})_6 \text{ Magnesio II}].6\text{Cl-}$ a pH 3,5 de color azul intenso. Se obtuvo 2,086g de colorante estabilizado, constituyendo un nuevo método de estabilización de los colorantes naturales que servirá en futuras investigaciones para determinar su grado de toxicidad y hacer posible su uso en la industria de colorantes naturales.
Link	https://hdl.handle.net/20.500.12737/10890

6.4 INFORMACIÓN TECNOLÓGICA

El análisis de patentes subraya la intensa actividad de innovación y el compromiso industrial global con los colorantes naturales para alimentos. La vigilancia tecnológica registró 728 solicitudes de patente (563 familias) en los últimos 20 años, con una tendencia mayormente creciente en la última década [Gráficos 08]. Este crecimiento refleja la fuerte inversión para asegurar el color natural a escala industrial.

Geográficamente, China domina el panorama, siendo el origen del 62.3% del total de solicitudes. Este liderazgo posiciona al país como el principal motor de la innovación tecnológica en el sector a nivel mundial [Gráfico 09].

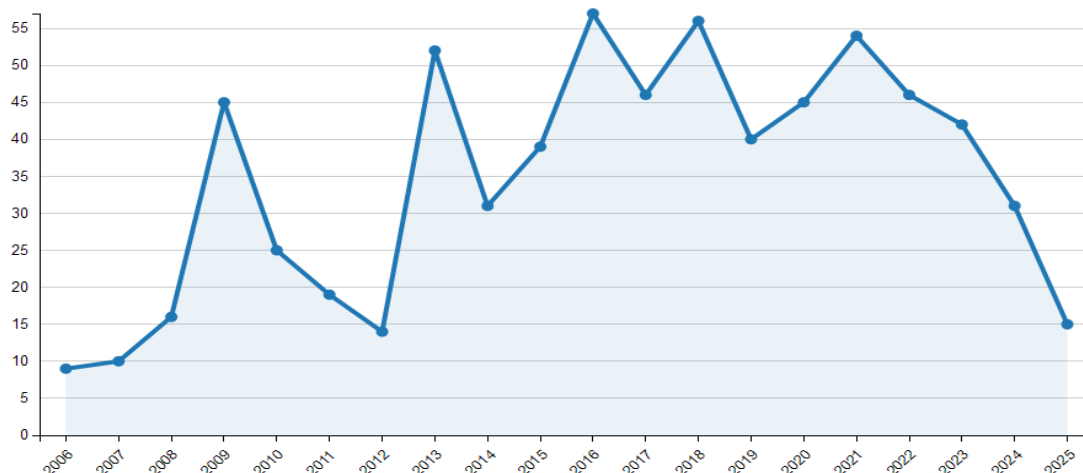


Gráfico 08. Solicitudes de patente por año de aplicación de los últimos 20 años

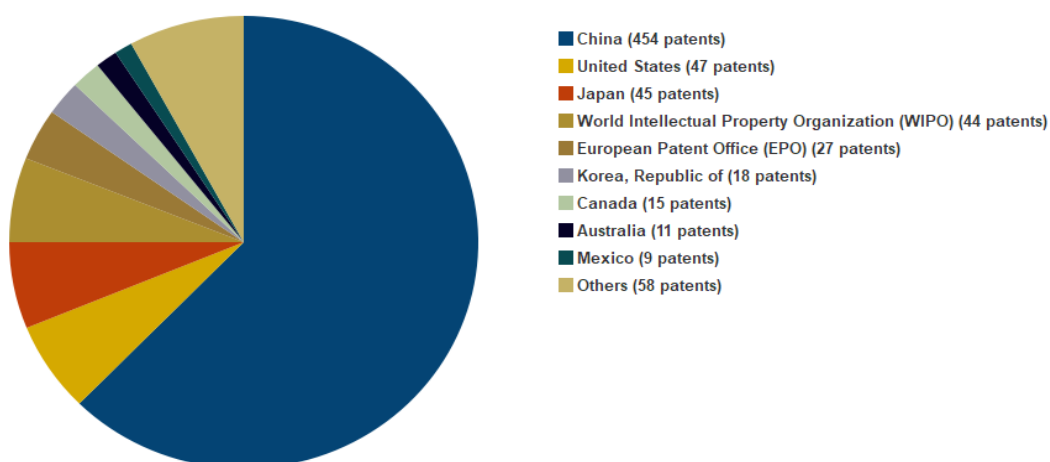


Gráfico 09. Solicitudes de patente por país de registro, de los últimos 20 años

A continuación, se evalúa la producción tecnológica a nivel mundial del último año (agosto 2024 – julio 2025). Se recuperaron 50 solicitudes de patente, pertenecientes a 46 familias.

Los campos de desarrollo tecnológico más activos [Gráfico 10] han sido: Adición de colorantes o pigmentos utilizando colorantes orgánicos o pigmentos naturales, sus duplicados artificiales o sus derivados (**A23L5/43**) – 29 registros; Colorantes de origen natural preparados a partir de fuentes naturales (**C09B61/00**) – 16 registros; Adición de colorantes o pigmentos utilizando colorantes o pigmentos de origen microbiano o de algas (**A23L5/46**) – 9 registros; Adición de colorantes o pigmentos utilizando carotenoides o xantófilas (**A23L5/44**) - 7 registros; Alimentos o productos alimenticios que contienen jarabes de hidratos de carbono; que contienen azúcares; que contienen alcoholes de azúcar (**A23L29/30**) – 6 registros; Conservación o modificación del color natural mediante el uso de aditivos (**A23L5/41**) – 5 registros. La distribución de los dominios temáticos se muestra en el Gráfico 11.

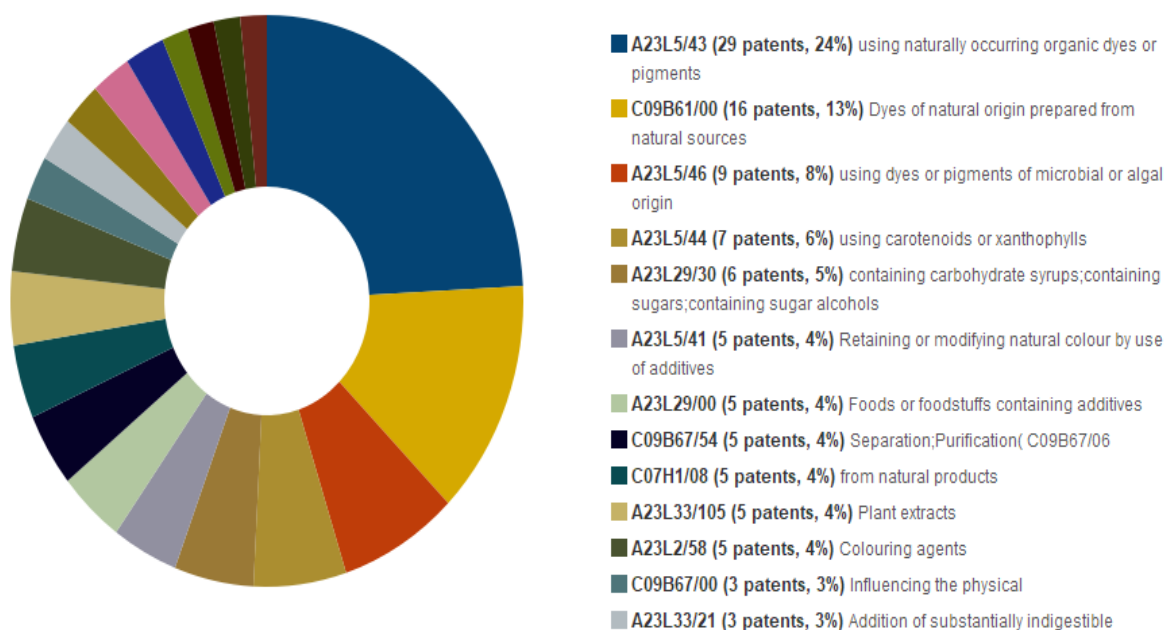


Gráfico 10. Solicitudes de patente por código IPC, en el último año

China es el país con más registros presentados en el último año (33 registros), seguidos de lejos por Estados Unidos (4 registros) y Japón (2 registros) [Gráfico 12].

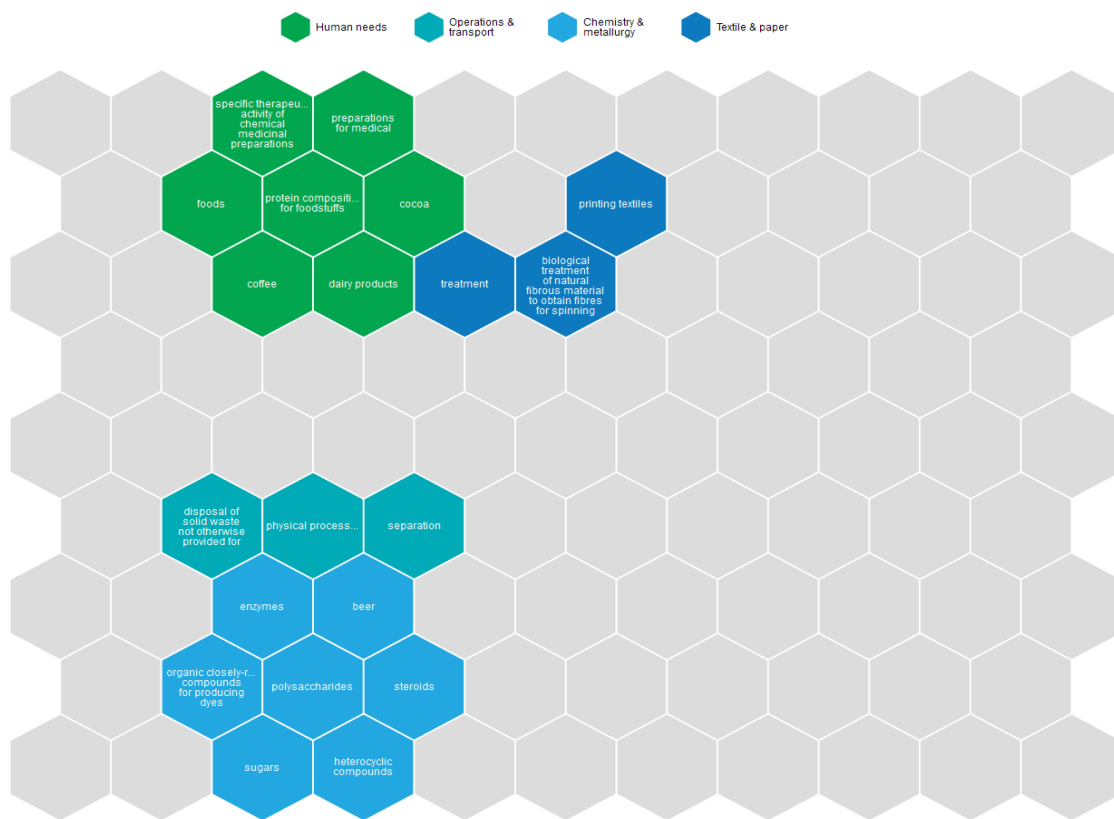


Gráfico 11. Distribución de los dominios temáticos, en el último año



Gráfico 12. Países con mayor presentación de solicitudes de patente en el último año

Nueve (9) instituciones académicas han registrado solicitudes de patente en la temática, todas ellas con un solo registro cada una. Es crucial destacar que la totalidad de estas universidades son de procedencia china [Gráfico 13], lo que refuerza la intensa actividad de I+D estatal y su transferencia de conocimiento en el sector.

UNIV CHINA AGRICULTURAL • UNIV GUIZHOU MINZU • UNIV HUBEI TECHNOLOGY • UNIV JIANGNAN
UNIV KUNMING SCIENCE & TECHNOLOGY • UNIV TIANJIN SCIENCE & TECH • UNIV XIAMEN • UNIV ZHEJIANG
UNIV ZHEJIANG SCIENCE & TECH

Gráfico 13. Instituciones académicas solicitantes de patentes, en el último año

En el sector empresarial, la actividad de patentamiento está liderada por la compañía suiza GIVAUDAN SA con cuatro (4) registros. Otras compañías realizaron un único registro cada una [Gráfico 14].

CHR HANSEN NATURAL COLORS AS • FLORIDAFOOD PRODUCTS LLC • **GIVAUDAN SA**
HEBEI STRONG FOOD CO LTD • JIANGSU COASTAL DEVELOPMENT INVEST CO LTD • JIANGXI DANXIA BIOTECHNOLOGY CO LTD
KRAFT FOODS GROUP BRANDS LLC • LES CONSERVES DE MEKNES • MUSHLABS GMBH
PAN ASIAFLAVORS WUHAN TECH CO LTD • SENSIENT COLORS LLC • SICHUAN YUNSHIHUA BIOTECHNOLOGY CO LTD
TEARES INSTITUTE CHINESE ACADEMY OF AGRICULTURAL SCIENCES • VIORICA COSMETIC SA
XIANGCHENG CITY BAIIA IND CO LTD • ZHEJIANG TASTE HANG FOOD CO LTD
ZHEJIANG ZHONGKE ZHONGZHI BIOLOGICAL TECH CO LTD

Gráfico 14. Compañías solicitantes de patentes, en el último año

A continuación, se presenta la información de las cuarenta y cinco (45) solicitudes de patente de mayor relevancia de acuerdo con lo registrado por Patent Inspiration y ESPACENET. La información ha sido categorizada en cinco grupos:

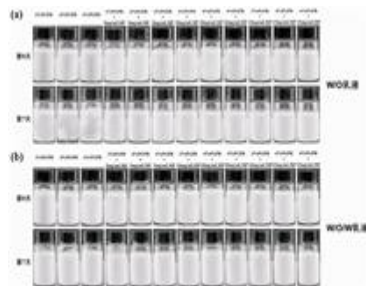
N°	Clasificación	Cantidad de documentos
1	Tecnologías de estabilización avanzada	15
2	Tecnologías de multifuncionalidad e ingredientes inteligentes	7
3	Tecnologías de bioproducción y extracción sostenible	5
4	Tecnologías de optimización de procesos de extracción	6
5	Tecnologías aplicadas a segmentos de mercado específicos	12

Se describen las tecnologías de estabilización avanzada (15 registros), enfocadas en proteger el color del calor y la luz mediante nanoemulsiones y complejas formulaciones. Le siguen de cerca las tecnologías de multifuncionalidad e ingredientes inteligentes (7 registros), donde los pigmentos presentan capacidades funcionales añadidas, como propiedades antioxidantes/ antibacterianas, indicadores de frescura o respuesta de cambio de color a estímulos. Otro grupo de solicitudes de patente se enfoca en la optimización de procesos de extracción (6 registros) para lograr mejorar la eficiencia, reducir costos, estandarizar parámetros o utilizar disolventes más ecológicos en las etapas de extracción; las tecnologías de bioproducción y extracción sostenible (5 registros), que utilizan métodos biológicos (fermentación de cepas o cultivo de biomasa) o el aprovechamiento de subproductos/residuos para la obtención de compuestos valiosos; y finalmente, las tecnologías aplicadas a segmentos de mercado específicos (12 registros) para lograr la sustitución efectiva de los colorantes sintéticos e inorgánicos.

6.4.1 Tecnologías de estabilización avanzada

Preparation method of W/O/W double emulsion based on myofibrillar protein/ polyglycerol ricinoleate co-stabilization

[Método de preparación de emulsión doble W/O/W basada en la coestabilización de proteína miofibrillar/ ricinoleato de poliglicerol]

N° de publicación	CN120203214A - 27/6/2025
País / Fecha de aplicación	CHINA - 31/3/2025
Inventor(es) / Solicitante(s)	Li Chunbao, He Hui, Su Liuyu, Zhao Di, Shan Kai, Zhou Guanghong, Zhang Nan NANJING AGRICULTURAL UNIVERSITY
	The invention belongs to the technical field of food processing, and particularly relates to a preparation method of a W/O/W double emulsion based on myofibrillar protein/polyglycerol ricinoleate co-stability. The poly myofibrillar protein (5-15 mg/mL) is used as an amphiphilic emulsifier and polyglycerol ricinoleate (2-6%, W/W) to synergistically enhance the interfacial stability of the emulsion, the prepared W/O/W double emulsion is stably stored for at least 7 days at room temperature, and the photostability and the thermal stability of water-soluble bioactive substances encapsulated in the emulsion can be obviously improved. The invention utilizes good amphipathy and emulsifying capacity of myofibrillar protein, improves the stability of the W/O/W emulsion and the protection of coating substances while reducing the use of a synthetic emulsifier, provides technical support for the preparation of stable W/O/W double emulsion and provides technical support for the application of the emulsion to the processing of emulsified foods.
Link	https://worldwide.espacenet.com/patent/search?q=CN120203214A

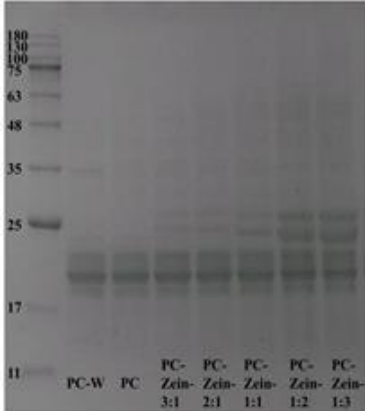
Coloring composition, method of making, and consumable

[Composición colorante, método de elaboración y consumible]

N° de publicación	WO2025120003A1 - 12/6/2025
País / Fecha de aplicación	PCT - 4/12/2024
Inventor(es) / Solicitante(s)	Jason Armao, Raja Chouket, Logan Scott Mcconkey, Jody Renner-Nantz GIVAUDAN SA
	Coloring compositions comprising one or more pelargonidins selected from pelargonidin 3-glucoside, pelargonidin 3-(6'-malonylglucoside) and pelargonidin 3,5-dimalonylglucoside, and at least one red anthocyanin. Consumables, such as foods and beverages, that include the coloring compositions, methods of making the coloring compositions and consumables, and uses of the coloring compositions are also provided.
Link	https://worldwide.espacenet.com/patent/search?q=WO2025120003A1

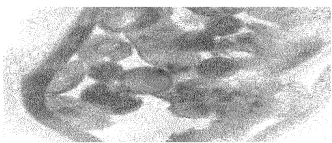
Compound for improving illumination storage stability of phycocyanin and preparation method thereof

[Compuesto para mejorar la estabilidad de la ficocianina durante el almacenamiento bajo iluminación y su método de preparación]

N° de publicación	CN119999810A - 16/5/2025
País / Fecha de aplicación	CHINA - 27/3/2025
Inventor(es) / Solicitante(s)	Yang Shufang, Sun Han, Yu Zengyu, Li Jiaxin JIANGXI UNIVERSITY OF TRADITIONAL CHINESE MEDICINE
	The invention belongs to the technical field of food processing, and particularly relates to a compound capable of improving illumination storage stability of phycocyanin and a preparation method of the compound. The compound is prepared from phycocyanin and zein through an anti-solvent precipitation method, the particle size range is 108-345 nm, the main secondary structure of the phycocyanin is reserved, and the specific blue hue and fluorescence characteristics of the phycocyanin can be maintained after continuous illumination storage at 25 DEG C for 28 days. The preparation method is simple, and the protein is composed of two natural proteins and is high in safety. On one hand, the problem that the phycocyanin easily loses the blue hue under illumination storage is solved, and on the other hand, the technical problem that the phycocyanin product can only be stored in a cold storage mode or applied to high-sugar food generally is solved.
Link	https://worldwide.espacenet.com/patent/search?q=CN119999810A

Red-colorant composition for fat-based foods and oils

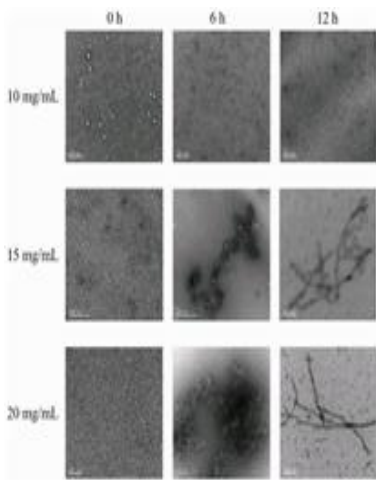
[Composición de colorante rojo para alimentos y aceites a base de grasas]

N° de publicación	US2025151761A1 - 15/5/2025
País / Fecha de aplicación	ESTADOS UNIDOS - 14/1/2025
Inventor(es) / Solicitante(s)	Dix Dina, Napier Lori, Jerominski Adina CHR. HANSEN NATURAL COLORS A/S
	Colorant particles are provided which comprise an anthocyanin-based colorant extract from red Sweet potato. The mean particle diameter (D ₅₀) of said particles provides good suspension stability. An oil-based colorant composition comprising said particles is provided, as is a food product comprising the oil-based colorant composition.
Link	https://worldwide.espacenet.com/patent/search?q=US2025151761A1

High-internal-phase emulsion loaded with oil-soluble pigment and application of high-internal-phase emulsion in lipstick

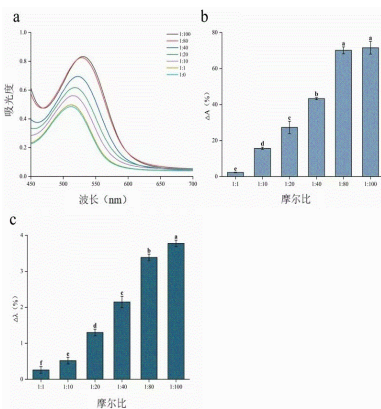
[Emulsión de alta fase interna cargada con pigmento soluble en aceite y aplicación de emulsión de alta fase interna en lápiz labial]

N° de publicación	CN119792120A - 11/4/2025
País / Fecha de aplicación	CHINA - 4/12/2024

Inventor(es) / Solicitante(s)	Ji Junfu, Yuan Xin, Dai Yaping, Ma Lingjun, Chen Fang, Hu Xiaosong CHINA AGRICULTURAL UNIVERSITY
	The invention provides a high internal phase emulsion loaded with oil-soluble pigment and application thereof in lipstick, which comprises the following steps: preparation of pea 11S globulin amyloid fibril, preparation of lycopene-loaded high internal phase emulsion with stable pea 11S globulin amyloid fibril, preparation of oil-soluble pigment-loaded high internal phase emulsion based on lycopene-loaded high internal phase emulsion, preparation of oil-soluble pigment-loaded high internal phase emulsion based on oil-soluble pigment-loaded high internal phase emulsion, preparation of oil-soluble pigment-loaded high internal phase emulsion based on oil-soluble pigment-loaded high internal phase emulsion, and preparation of oil-soluble pigment-loaded high internal phase emulsion. And adding other ingredients to prepare the edible lipstick. The stable high-internal-phase emulsion is successfully prepared, the lycopene can be protected while being loaded, the stability of the lycopene is improved, and the stable high-internal-phase emulsion can be applied to multiple fields of food, cosmetics, health care products and the like. On the basis of moistening lips and preserving moisture, the lipstick prepared by the invention has the effects of resisting oxidation, resisting inflammation and fading cheilogramma due to the lycopene, and the raw materials are natural edible substances, so that the pursuit of consumers on the health of the lipstick without side effects can be met.
Link	https://worldwide.espacenet.com/patent/search?q=CN119792120A

Method for improving color and stability of anthocyanin by combining with punicalagin

[Método para mejorar el color y la estabilidad de la antocianina mediante la combinación con punicalagina]

N° de publicación	CN119661613A - 21/3/2025
País / Fecha de aplicación	CHINA - 30/12/2024
Inventor(es) / Solicitante(s)	Zhou Linyan, Peng Yijin, Yang Yunxia, Zou Wenhui KUNMING UNIVERSITY OF SCIENCE AND TECHNOLOGY
	The invention discloses a method for improving color and stability of anthocyanin through combination with punicalagin. The method comprises the step that punicalagin and anthocyanin are subjected to an intermolecular co-pigmentation reaction. According to the invention, punicalagin is adopted as a co-pigment molecule and is subjected to a co-pigmentation reaction with anthocyanin to form a punicalagin and anthocyanin compound, so that the color attribute of the anthocyanin is remarkably enhanced, and an anthocyanin solution presents brighter red color; the punicalagin and anthocyanin compound is prepared from punicalagin and anthocyanin, the heat stability, the light stability, the pH stability and the storage stability of anthocyanin are improved, the heat stability, the light stability and the storage stability of anthocyanin are further improved when the punicalagin and anthocyanin compound is prepared into microcapsules, and the punicalagin and anthocyanin compound has the advantages of being simple in process and low in cost. According to the invention, the utilization value of the anthocyanin is obviously improved, and a new thought is provided for the application of the anthocyanin in the food industry.

Link <https://worldwide.espacenet.com/patent/search?q=CN119661613A>

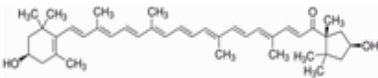
Preparation method of natural plant pigment composition and application of natural plant pigment composition in food

[Método de preparación de la composición de pigmentos vegetales naturales y aplicación de la composición de pigmentos vegetales naturales en alimentos]

N° de publicación	CN119547854A - 4/3/2025
País / Fecha de aplicación	CHINA - 3/12/2024
Inventor(es) / Solicitante(s)	Zhao Boqian, Liu Yutao GUANGZHOU WELL LAND FOOD CO. LTD.
	The invention belongs to the technical field of food additives, and particularly relates to a preparation method of a natural plant pigment composition and application of the natural plant pigment composition in food. The preparation method comprises the following steps: S1, dissolving a natural plant pigment in water to obtain a natural plant pigment solution, adjusting the pH value of the natural plant pigment solution to 7-8, then adding cyclodextrin, uniformly stirring, continuously stirring, and standing after stirring to obtain a solution I; s2, sequentially adding spirulina peptidoglycan and polyamino acid into the obtained solution I, uniformly mixing, stirring, adding halide salt after stirring, continuously stirring, standing after stirring, centrifuging, mixing an obtained solid product with edible auxiliary materials, and freeze-drying to obtain the natural plant pigment composition. The raw materials used in the invention are food-grade, safe and harmless, and can be used in food dyeing and coloring, endow food and beverage products with saturated and uniform colors, and improve the brilliance of food.
Link	https://worldwide.espacenet.com/patent/search?q=CN119547854A

Method for improving light stability of natural food coloring

[Método para mejorar la estabilidad a la luz de los colorantes alimentarios naturales]

N° de publicación	CN119405000A - 11/2/2025
País / Fecha de aplicación	CHINA - 22/11/2024
Inventor(es) / Solicitante(s)	Lei Guotai, Du Hang, Gu Yun PAN ASIA FLAVORS (WUHAN) TECHNOLOGY CO. LTD.
	The invention discloses a method for improving the light stability of a natural food coloring, which discovers the color protection function of hesperetin and phloretin on the natural food coloring, and the hesperetin and phloretin can be added into food as color fixatives to delay the stability of the natural food coloring in food processing, storage and circulation processes. The color stability of the food in the shelf life is ensured, so that the market value of the food is improved, the loss is reduced, and the application value is remarkable.
Link	https://worldwide.espacenet.com/patent/search?q=CN119405000A

Method for improving color stability of phycocyanin, phycocyanin-polysaccharide compound and application of phycocyanin-polysaccharide compound

[Método para mejorar la estabilidad del color de la ficocianina, compuesto de ficocianina-polisacárido y aplicación del compuesto de ficocianina-polisacárido]

N° de publicación	CN119257204A - 7/1/2025
País / Fecha de aplicación	CHINA - 1/8/2024
Inventor(es) / Solicitante(s)	Liu Fei, Zhu Yuanyuan, Zhou Xinghu, Wu Yinsheng, Jiao Xue, Lu Xiaomin JIANGSU COASTAL DEVELOPMENT INVESTMENT CO. LTD., JIANGNAN UNIVERSITY
	The invention discloses a method for improving the color stability of phycocyanin, a phycocyanin-polysaccharide compound and application of the phycocyanin-polysaccharide compound, the prepared compound product presents the specific blue color of the phycocyanin, the color of a solution is obviously improved compared with that of single phycocyanin in an acid environment, and the pigment retention rate is obviously increased. The advantages of high coloring power and high functional activity of phycocyanin are reserved, the used raw materials are free of toxic and harmful reagents and are all food-grade raw materials, the preparation method is green and mild, special processing equipment such as high temperature and high pressure is not needed, and expanded production is easy. The invention not only solves the defect that the phycocyanin is easy to turn green under the acidic condition in the production and processing process, but also solves the technical problems of low action efficiency, low safety and difficulty in large-scale production in the aspect of improving the acid stability of the phycocyanin.
Link	https://worldwide.espacenet.com/patent/search?q=CN119257204A

Method for improving stability of natural beet red pigment in film coating

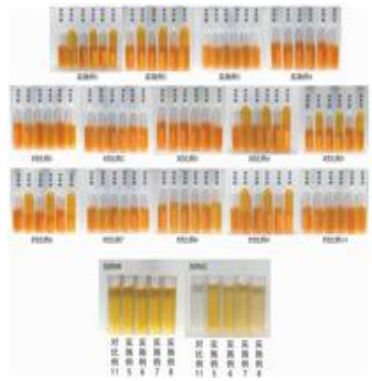
[Método para mejorar la estabilidad del pigmento rojo remolacha natural en el recubrimiento de películas]

N° de publicación	CN119214271A - 31/12/2024																														
País / Fecha de aplicación	CHINA - 22/10/2024																														
Inventor(es) / Solicitante(s)	Zhang Yong, Cai Nengqiang, Bi Jianzhe, Wu Weiwei, Xu Lin, Lee Chang-Jun ZHEJIANG NUTRASIS BIOTECH CO. LTD.																														
	The invention discloses a method for improving the stability of natural beet red pigment in a film coating, which comprises the following steps: step 1, starting a pulping barrel for stirring, slowly putting a beet red-containing film coating powder matrix into water in the pulping barrel, the weight ratio of coating powder to water is 1: (4-5), and the coating powder contains titanium dioxide; 2, citric acid is added, the weight ratio of the coating powder to the citric acid is (270-280): 1, stirring is conducted for 45 min, and coating slurry is discharged; and 3, sieving the coating slurry, and coating the tablets. The adsorption performance of titanium dioxide in the film coating slurry to beet red is improved through citric acid, so that the beet red can be better protected, no non-edible chemical additive is used, a very good inhibition effect on color fading of beet red caused by heat, oxidation and illumination																														
<table><tr><th>组别</th><th>总干粉/g (羟丙基甲基纤维素、聚乙二醇、聚乙二醇、二氯化钛、甜菜红)</th><th>柠檬酸/g</th><th>总干粉:柠檬酸</th><th>水/g</th></tr><tr><td>1</td><td>27.75</td><td>0.3</td><td>92.5:1</td><td>124.875</td></tr><tr><td>2</td><td>27.75</td><td>0.2</td><td>138.75:1</td><td>124.875</td></tr><tr><td>3</td><td>27.75</td><td>0.05</td><td>555:1</td><td>124.875</td></tr><tr><td>4</td><td>27.75</td><td>0</td><td>/</td><td>124.875</td></tr><tr><td>5</td><td>27.75</td><td>0.1</td><td>277.5:1</td><td>124.875</td></tr></table>		组别	总干粉/g (羟丙基甲基纤维素、聚乙二醇、聚乙二醇、二氯化钛、甜菜红)	柠檬酸/g	总干粉:柠檬酸	水/g	1	27.75	0.3	92.5:1	124.875	2	27.75	0.2	138.75:1	124.875	3	27.75	0.05	555:1	124.875	4	27.75	0	/	124.875	5	27.75	0.1	277.5:1	124.875
组别	总干粉/g (羟丙基甲基纤维素、聚乙二醇、聚乙二醇、二氯化钛、甜菜红)	柠檬酸/g	总干粉:柠檬酸	水/g																											
1	27.75	0.3	92.5:1	124.875																											
2	27.75	0.2	138.75:1	124.875																											
3	27.75	0.05	555:1	124.875																											
4	27.75	0	/	124.875																											
5	27.75	0.1	277.5:1	124.875																											

	can be achieved, the stability of the beet red can be effectively improved, and the service life of the beet red is prolonged. And the operation is simple and convenient.
Link	https://worldwide.espacenet.com/patent/search?q=CN119214271A

Capsanthin nano-emulsion, jelly and preparation method of capsanthin nano-emulsion

[Nanoemulsión de capsantina, gelatina y método de preparación de la nanoemulsión de capsantina]

N° de publicación	CN119184243A - 27/12/2024
País / Fecha de aplicación	CHINA - 6/11/2024
Inventor(es) / Solicitante(s)	Wei Xianling, Long Yonglin, Chen Wentian, Cheng Keyu, Xie Ziqi, Chen Jiayi, Dong Hao, Bai Weidong ZHONGKAI UNIVERSITY OF AGRICULTURE AND ENGINEERING, AAFUD INDUSTRY (ZHUHAI) CO. LTD.
	The invention belongs to the technical field of food processing and food additives, and discloses capsanthin nano-emulsion, jelly and a preparation method thereof. The preparation method of the capsanthin nano-emulsion comprises the following steps: adding capsanthin and DL-alpha-tocopherol into an emulsifier solution, stirring and dissolving to obtain an oil phase solution; ascorbic acid is added into water to be stirred and dissolved uniformly, and a water-phase solution is obtained; the oil phase solution and the water phase solution are fully mixed and then subjected to ultrasonic treatment, and the capsanthin nano-emulsion is obtained. And adding the nano emulsion into a jelly solution to obtain the paprika red pigment jelly. The preparation method is simple to operate, the raw materials are easy to obtain, the cost is low, the solubility, the light stability, the heat stability and the metal ion stability of the capsanthin in emulsion and jelly can be remarkably improved, degradation and fading of the capsanthin due to light, heat and metal ions can be effectively inhibited, and the capsanthin has a good application prospect in the food industry and related fields.
Link	https://worldwide.espacenet.com/patent/search?q=CN119184243A

High-stability pectin-monascus pigment compound, method and application

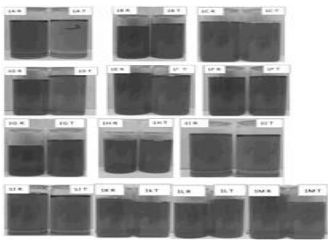
[Compuesto pigmentario de pectina-monascus de alta estabilidad, método y aplicación]

N° de publicación	CN119097062A - 10/12/2024
País / Fecha de aplicación	CHINA - 11/9/2024
Inventor(es) / Solicitante(s)	Guo Qingbin, Wang Nifei, Wang Saiyue, Wang Changlu TIANJIN UNIVERSITY OF SCIENCE & TECHNOLOGY
	The invention belongs to the technical field of nutritional food preparation, and discloses a high-stability pectin-monascus pigment compound, and a preparation method comprises the following steps: crushing; removing impurities; performing water extraction; performing alcohol precipitation; performing purification; performing enzymolysis with pectinase; and preparing the pectin-monascus pigment compound by a free radical induction method. The pectin-monascus pigment compound is helpful for improving the quality and color stability of ham sausages, and can be used as a novel food ingredient

	for product development of food or health care products. The stability of the monascus pigment can be effectively improved, and damage to the color of the monascus pigment due to conditions such as environmental factors is reduced. The dietary fiber used in the invention comes from an agricultural product processing byproduct, namely orange peel, and is wide in source and low in cost.
Link	https://worldwide.espacenet.com/patent/search?q=CN119097062A

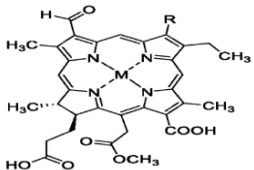
Colouring composition

[Composición colorante]

N° de publicación	US2024381911A1 - 21/11/2024
País / Fecha de aplicación	ESTADOS UNIDOS - 27/9/2022
Inventor(es) / Solicitante(s)	Raja Chouket, Yuangang Zhang GIVAUDAN SA
	The present invention provides a food colouring composition, in particular the invention provides a composition or colouring composition comprising at least one phycobilin and at least one peptide, polypeptide and/or protein. In certain embodiments, the phycobilin (such as a Phycocyanin) and the at least one peptide, polypeptide and/or protein form a complex.
Link	https://worldwide.espacenet.com/patent/search?q=US2024381911A1

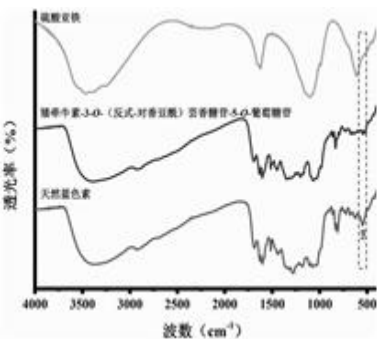
Method for preparing a colour-stable preparation of a magnesium chlorophyllin alkali metal salt or alkali earth metal salt from natural sources of chlorophyll

[Método para preparar una preparación de color estable de una sal de metal alcalino o de metal alcalinotérreo de clorofilina de magnesio a partir de fuentes naturales de clorofila]

N° de publicación	ES2981790T3 - 10/10/2024
País / Fecha de aplicación	ESPAÑA - 10/7/2018
Inventor(es) / Solicitante(s)	Andrew Kendrick, Stuart Thorpe GIVAUDAN SA
	The present invention provides a method for preparing a colour-stable preparation of a magnesium chlorophyllin alkali metal salt or alkali earth metal salt from natural sources of chlorophyll. The invention further provides a colour-stable and substantially pure pigment composition comprising a vibrant green magnesium chlorophyllin in the form of an alkali metal or alkali earth metal salt, e.g. those prepared by the methods of the invention, and the use of the salts and compositions of the invention as colouring agents, in particular as food colouring agents, and as medicaments and disinfectants. (From US2024166882 A1)
Link	https://worldwide.espacenet.com/patent/search?q=ES2981790T3

Petunidin anthocyanin and blue pigment as well as preparation method and application thereof

[Antocianina de petunidina y pigmento azul, así como su método de preparación y aplicación]

N° de publicación	CN118652293A - 17/9/2024
País / Fecha de aplicación	CHINA - 27/5/2024
Inventor(es) / Solicitante(s)	Chen Wei, Xie Jiahong, Xie Lianghua, Xu Yang ZHEJIANG UNIVERSITY
	The invention belongs to the technical field of pigment preparation, and provides petunidin anthocyanin and blue pigment as well as a preparation method and application thereof. The anthocyanin in the lycium ruthenicum is extracted by alcohol extraction and concentration; removing impurities such as carbohydrates, proteins and the like in the lycium ruthenicum anthocyanin crude extract by using macroporous resin; and purifying the anthocyanin freeze-dried powder by using a preparative liquid chromatography system, and collecting to obtain petunidin anthocyanin which takes petunidin 3-O-(trans-p-coumaroyl) rutin-5-O-glucoside as a main component. After the petunidin anthocyanin obtained by the invention is complexed with metal ions, the obtained blue pigment is good in color generation and stability. Compared with the technical scheme of improving the stability of the natural blue pigment by adding polysaccharide in the prior art, the petunidin anthocyanin disclosed by the invention can ensure the stability of the blue pigment under the condition of not adding the polysaccharide; meanwhile, the color value of the blue pigment is not reduced.
Link	https://worldwide.espacenet.com/patent/search?q=CN118652293A

6.4.2 Tecnologías de multifuncionalidad e ingredientes inteligentes

Improvement in or with respect to organic compounds

[Mejora en o con respecto a los compuestos orgánicos]

N° de publicación	JP2025520935A - 3/7/2025
País / Fecha de aplicación	JAPON - 15/6/2023
Inventor(es) / Solicitante(s)	Raja Chouket, Kerry Ward-Rotherham, Bryan Aviles, Jennifer Jarvis-Conley, Kelly Polte GIVAUDAN SA
	The present invention relates to a colorant composition which, when incorporated into food and beverage products, stabilizes the storage period and, if necessary, gives a desired color transition in response to stimulation, e.g. heating. The coloring composition is based on an innovative combination of a dye and an encapsulated alkali material, an acid material, a metal cation and/or a salt.
Link	https://worldwide.espacenet.com/patent/search?q=JP2025520935A

The invention relates to a natural pigment in black-black corn powder for use as a food and cosmetic additive

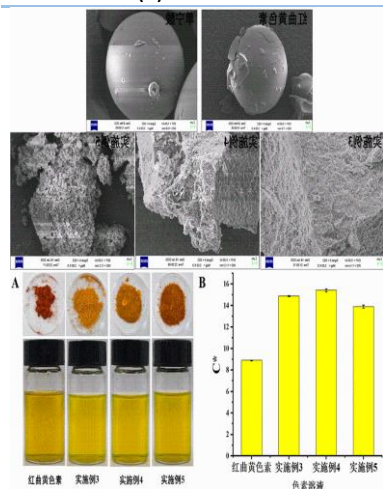
[La invención se relaciona a un pigmento natural en polvo de maíz negro-negro para su uso como aditivo alimentario y cosmético]

N° de publicación	MX2025001049A - 7/3/2025
País / Fecha de aplicación	MEXICO - 27/1/2025
Inventor(es) / Solicitante(s)	Claudia Muro Urista, Juan Cruz Ordoñez, Elizabeth López Solorzano CLAUDIA MURO, JUAN CRUZ, ELIZABETH LÓPEZ
s/d	The present invention relates to an anthocyanin pigment product of powdered black-black corn steum which is obtained by capturing the outer layer of the dry corn pericarp with subsequent grinding and sieving, obtaining a powder of homogeneous particle size which, when dispersed in semi-solid and colloidal foods and cosmetics, provides pink, red, purple or blue colour, according to the pH of the dispersing medium, the anthocyanin pigment of the purple-black corn tamp does not require extraction, separation-purification and encapsulation to be applied as a natural pigment of anthocyanins ; it does not provide calories to the foods, neither smell and flavour to the products in which it is dispersed; by its natural encapsulation in cellulose has a shelf life greater than 12 months, and as it is a powdered product, its packaging, transport and storage allows the use of flexible containers, bags, boxes and cans. The invented product can be produced, marketed and used as an additive in the food industry for semi-solid and colloidal foods and cosmetics. The coloring intensity of the dispersing medium is obtained according to the amount of added mass of purple corn amine anthocyanin pigment, and can be applied in any production volume. The black-black corn chip anthocyanin pigment can be packaged and transported in large or small volumes according to the needs of use and consumption.
Link	https://worldwide.espacenet.com/patent/search?q=MX2025001049A

Antibacterial and antioxidant monascus yellow pigment as well as preparation method and application thereof

[Pigmento amarillo monascus antibacteriano y antioxidante, así como su método de preparación y aplicación]

N° de publicación	CN120173430A - 20/6/2025
País / Fecha de aplicación	CHINA - 31/3/2025
Inventor(es) / Solicitante(s)	Wu Zhenqiang, Zheng Kaize, Tan Xueling, Huang Zhenfeng SOUTH CHINA UNIVERSITY OF TECHNOLOGY



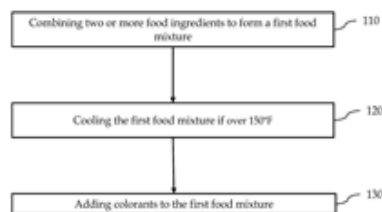
The invention discloses an antibacterial and antioxidant monascus yellow pigment as well as a preparation method and application thereof. The preparation method comprises the following steps: reacting monascus yellow pigment with tannic acid in a solution state, carrying out solid-liquid separation on the obtained product, washing to remove uncombined pigment, and drying the obtained solid to obtain the antibacterial and antioxidant monascus yellow pigment. The preparation method is simple in process, mild in reaction condition, low in cost and suitable for large-scale production; the obtained anti-bacterial and anti-oxidation monascus yellow pigment has the characteristics of safety, anti-bacterial and anti-corrosion effects, high stability, bright color and the like, and can be popularized and applied as a food additive in the food industry.

Link <https://worldwide.espacenet.com/patent/search?q=CN120173430A>

Color-changing food product and method of making a color-changing food product

[Producto alimenticio que cambia de color y método para elaborar un producto alimenticio que cambia de color]

N° de publicación	US2025176584A1 - 5/6/2025
País / Fecha de aplicación	ESTADOS UNIDOS - 1/12/2023
Inventor(es) / Solicitante(s)	Moser Hanna E., Yang Jessica, VerLee Lydia Anderson, Henderson Zachary KRAFT FOODS GROUP BRANDS LLC, SENSIENT COLORS LLC



Food products that change color upon exposure to high heat are provided. In one aspect, the food product includes a primary colorant that exhibits significant loss of color or change in color upon exposure to high heat and at least one additional colorant. The food product may be a marshmallow, marbit, or meringue.

Link <https://worldwide.espacenet.com/patent/search?q=US2025176584A1>

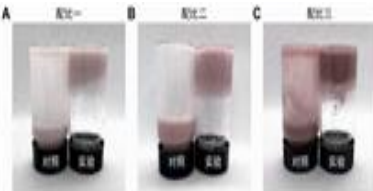
Color generation substance, preparation method and application of color generation substance in color mixing of tea beverage and food

[Sustancia generadora de color, método de preparación y aplicación de la sustancia generadora de color en la mezcla de colores de bebidas de té y alimentos]

N° de publicación	CN119118982A - 13/12/2024
País / Fecha de aplicación	CHINA - 8/7/2024
Inventor(es) / Solicitante(s)	Fu Yanqing, Xu Yongquan, Zhao Zixin, Wang Jieqiong, Yin Junfeng TEA RESEARCH INSTITUTE, CHINESE ACADEMY OF AGRICULTURAL SCIENCES
	The invention discloses a color generation substance, a preparation method and application of the color generation substance in color mixing of tea beverages and food, and the preparation method comprises the following steps: S1, mixing according to a proportion to prepare a phosphate buffer solution with a certain pH value; s2, weighing catechin substances, dissolving the catechin substances in the phosphate buffer solution obtained in the step S1, and fully dissolving the catechin substances to prepare a catechin buffer solution system; s3, heating the buffer system in the step S2 at high temperature to promote chemical reaction in the system; and S4, rapidly cooling by using an ice-water bath after heating is finished, and adding a protective solution to stop the reaction, so as to obtain a colored system containing the coloring substance. On the basis of an in-vitro simulation system, low-molecular-weight color generation substances are found, an efficient preparation method is established, the influence rule of concentration change on color generation is studied, the antioxidant capacity of the color generation substances is proved, and a material and theoretical basis is provided for quality regulation and control of tea and development and utilization of natural pigment substances; the color generation substance can be applied to color mixing of tea beverages and food.
Link	https://worldwide.espacenet.com/patent/search?q=CN119118982A

Color-changeable 3D printing material based on inulin compound and printing method of color-changeable 3D printing material

[Material de impresión 3D de color cambiante basado en un compuesto de inulina y método de impresión de material de impresión 3D de color cambiante]

N° de publicación	CN118975659A - 19/11/2024
País / Fecha de aplicación	CHINA - 19/8/2024
Inventor(es) / Solicitante(s)	Chen Ronghe, Liu Jiamin, Li Hongwei, Ni Linjie, He Shasha, Peng Minmin XIAMEN UNIVERSITY
	The invention provides a color-changeable 3D printing material based on an inulin compound. The color-changeable 3D printing material comprises inulin, calcium salt, magnesium salt and zinc salt. According to the color-changeable 3D printing material, the gelling performance of the pure inulin is remarkably improved, the gelling time of the pure inulin is greatly shortened, the 3D printing formability, the printing precision and the water-holding capacity of pure inulin gel are remarkably improved, and the color-changeable 3D printing material has rich color changing performance and color stability.

Link

<https://worldwide.espacenet.com/patent/search?q=CN118975659A>

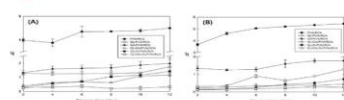
pH indicators using a red cabbage natural pigment extract for determining freshness of cold-chain fresh food

[Indicadores de pH que utilizan un extracto de pigmento natural de col lombarda para determinar la frescura de alimentos frescos de la cadena de frío]

N° de publicación	KR20240137759A - 20/9/2024
País / Fecha de aplicación	REPUBLICA DE COREA - 9/3/2023
Inventor(es) / Solicitante(s)	Min Sea Cheol, Kwak Min Young SEOUL WOMEN'S UNIVERSITY INDUSTRY-UNIVERSITY COOPERATION FOUNDATION

도면

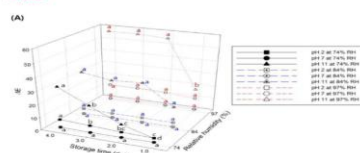
도면



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The present invention relates to a stabilizer of a freshness indicator molecule included in a freshness indicator for determining freshness of fresh food, particularly, food having high moisture activity and weak alkalinity, and a freshness indicator composition for detecting spoilage of food including the stabilizer, wherein anthocyanin stability is excellent when anthocyanin derived from a natural plant is mixed and gelatin and gallic acid are used together as a stabilizer, and thus anthocyanin is mixed with a packaging material as a freshness indicator for fresh food to be commercialized.

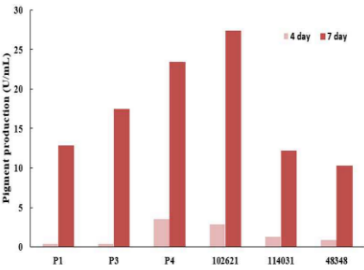
Link

<https://worldwide.espacenet.com/patent/search?q=KR20240137759A>

6.4.3 Tecnologías de bioproducción y extracción sostenible

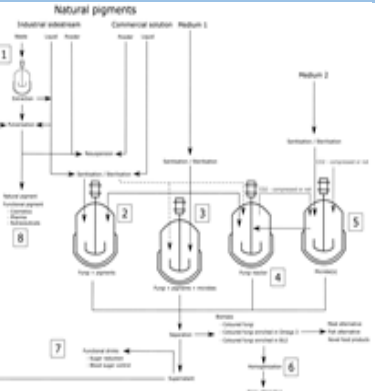
SRCM102621 *Monascus purpureus* SRCM102621 strain having excellent pigment producing ability and uses thereof

[SRCM102621 Cepa de *Monascus purpureus* SRCM102621 con excelente capacidad para producir pigmentos y sus usos]

N° de publicación	KR20250100808A - 4/7/2025
País / Fecha de aplicación	REPUBLICA DE COREA - 26/12/2023
Inventor(es) / Solicitante(s)	Kim Jun Tae, Lee Jeong Ha, Cho Sung Ho MICROBIAL INSTITUTE FOR FERMENTATION INDUSTRY
	The present invention relates to a <i>Monascus purpureus</i> SRCM102621 strain having excellent pigment production, and a use thereof, wherein the <i>M. purpureus</i> SRCM102621 strain of the present invention has excellent red pigment production, and thus can be effectively used for the production of fermented foods such as red liquor, red rice, red yeast rice, and the like, or for the production of edible pigments for food addition, and the like.
Link	https://worldwide.espacenet.com/patent/search?q=KR20250100808A

Production of coloured fungal mycelium

[Producción de micelio fúngico coloreado]

N° de publicación	US2025207082A1 - 26/6/2025
País / Fecha de aplicación	ESTADOS UNIDOS - 5/12/2024
Inventor(es) / Solicitante(s)	Thibault Godard, Marian Nassar, Cindy Lau Chin Yee, Wassim W. Ayass MUSHLABS GMBH
	The present invention relates to a method for the production of a composition comprising a fungal biomass, characterized in that said composition has a particular colour, as well as a composition and a supernatant obtainable according to the method of the present invention, and their use in the production of a food product, in particular a food product characterized by a particular colour.
Link	https://worldwide.espacenet.com/patent/search?q=US2025207082A1

Method for completely recycling waste bamboo shoot shell brown pigment, dietary fiber and sodium carboxymethyl cellulose

[Método para reciclar completamente los residuos de cáscara de brotes de bambú: pigmento marrón, fibra dietética y carboximetilcelulosa sódica]

N° de publicación	CN120059490A - 30/5/2025
País / Fecha de aplicación	CHINA - 26/2/2025
Inventor(es) / Solicitante(s)	Yang Cheng, Pan Guiying, Peng Yan, Zeng Guangneng, Fan Bailing GUIZHOU MINZU UNIVERSITY
	The invention provides a complete recycling preparation method of waste bamboo shoot shell brown pigment, dietary fiber and sodium carboxymethyl cellulose. The complete recycling preparation method of the waste bamboo shoot shell brown pigment, the dietary fiber and the sodium carboxymethyl cellulose comprises the following steps: a, adding waste bamboo shoot shell powder into a 2% sodium hydroxide solution according to a solid-to-liquid ratio of 1: 10, extracting for 60 minutes under a micro-boiling condition, directly filtering and concentrating the extracted filtrate without adjusting the pH value, and drying and storing, the filter residues are used for subsequent preparation of dietary fibers and sodium carboxymethyl cellulose, the concentration of the filtrate is 99.0%, and the obtained concentrated brown pigment liquid is used in the fields of food and cosmetics. The complete resource preparation method of the waste bamboo shoot shell brown pigment, the dietary fiber and the sodium carboxymethyl cellulose solves the complete resource utilization of the waste bamboo shoot shells, and the preparation method is energy-saving and green; the product is safe, and the application range is wide. By optimizing the extraction process, the brown pigment, the dietary fibers and the sodium carboxymethyl cellulose can be efficiently extracted from the waste bamboo shoot shells.
Link	https://worldwide.espacenet.com/patent/search?q=CN120059490A

Method for producing water-soluble monascus red pigment by liquid fermentation of soy sauce residues

[Método para producir pigmento rojo monascus soluble en agua mediante fermentación líquida de residuos de salsa de soja]

N° de publicación	CN118931972A - 12/11/2024
País / Fecha de aplicación	CHINA - 21/8/2024
Inventor(es) / Solicitante(s)	Wang Weiping, Wang Xuan, Chen Xin, Shi Xinyun HUBEI UNIVERSITY OF TECHNOLOGY
	The invention belongs to the technical field of bioengineering fermentation, and particularly relates to a method for producing water-soluble monascus red pigment through liquid fermentation of soy sauce residues. The method comprises the following steps: 1) preparing a soy sauce residue liquid fermentation culture medium; performing activation culture on a monascus strain; 2) inoculation and liquid state fermentation: inoculating monascus seed liquid into the soy sauce residue liquid state fermentation culture medium prepared in the step 1), and carrying out liquid state fermentation to

	generate water-soluble monascus red pigment; wherein the name of the monascus ruber HS 4000 is monascus ruber HS 4000, and the preservation number of the monascus ruber HS 4000 is CCTCC (China Center for Type Culture Collection) NO: M2013082. The water-soluble monascus red pigment is produced by using the soy sauce residues as a substrate for liquid fermentation, so that the water-soluble monascus red pigment with relatively good light stability and thermal stability can be prepared, the problem of environmental pollution caused by untimely treatment or improper treatment of the soy sauce residues can be solved, and the soy sauce residues are utilized.
Link	https://worldwide.espacenet.com/patent/search?q=CN118931972A

Process for producing a biologically active extract from red grape pomace

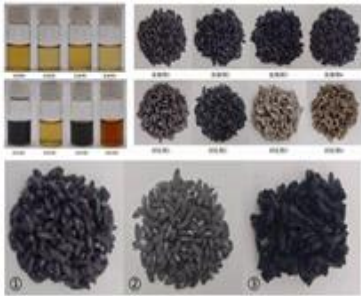
[Procedimiento para la producción de un extracto biológicamente activo a partir de orujo de uva roja]

N° de publicación	MD4901B1 – 31/8/2024
País / Fecha de aplicación	MARRUECOS – 30/8/2023
Inventor(es) / Solicitante(s)	Timur Andrusenco, Iurie Golovco VIORICA-COSMETIC SA
s/d	The invention relates to processes for processing raw materials of plant origin, in particular to a process for producing a biologically active extract from red grape pomace for the cosmetic and perfume industry, medicine, food industry, etc. The process, according to the invention, provides that the original red grape pomace is dried and crushed for further processing, for example, dried in the infrared range at a temperature not exceeding 35°C until a moisture content of 5% is achieved. The prepared pomace is subjected to supercritical fluid extraction with carbon dioxide and the lipid-wax fraction is separated. After which, the resulting meal is soaked in an aqueous solution containing an organic acid and a preservative, and final extraction is carried out by maceration with a polyol solvent, represented by glycerin or 1,2-propylene glycol or a mixture thereof, to obtain a biologically active extract – a product registered as ViePhenol. The invention provides for the production of a product, in which the original content of grape polyphenols is preserved almost in its native, unchanged state, at the same time the extract has high antioxidant and biological activity, stable over a long period of storage.
Link	https://worldwide.espacenet.com/patent/search?q=MD4901B1

6.4.4 Tecnologías de optimización de procesos de extracción

Method for dyeing glutinous rice by using maple leaf aqueous extract

[Método para teñir arroz glutinoso mediante extracto acuoso de hoja de arce]

N° de publicación	CN120360204A – 25/7/2025
País / Fecha de aplicación	CHINA – 24/4/2025
Inventor(es) / Solicitante(s)	Hong Yan, Xiao Yaxuan, Gu Zhengbiao, Li Lingjin, Jin Danli, Zhang Yayuan, Cheng Li, Li Zhaofeng, Li Caiming JIANGNAN UNIVERSITY, JIAXING FUTURE FOOD RESEARCH INSTITUTE
	The invention relates to a method for dyeing glutinous rice by using a maple leaf aqueous extract, belonging to the technical field of food processing. According to the dyeing method, the glutinous rice is dyed efficiently under the condition that heating or chemical reagent addition is not needed during pretreatment of the dye liquor. The method mainly reduces the step of boiling the dye liquor before dyeing by regulating and controlling the temperature (45-65 °C) and the time (3-6 h) and the feed liquid ratio (1:1-1:5) in the dyeing process, retains more natural pigments and other effective substances, ensures that the combination degree of the dyed substances and the glutinous rice is tighter and firmer by the combined action of chemical bond combination and physical adsorption through regulating and controlling the temperature in the dyeing process, and the dyed glutinous rice has dark and transparent color and no fading phenomenon after being steamed. The invention simplifies the production flow, reduces the energy consumption, improves the controllability and repeatability of the dyeing process through parameter standardization, ensures that the dyeing is more stable, and provides technical support for the industrial production and cultural heritage inheritance of the five-color glutinous rice.
Link	https://worldwide.espacenet.com/patent/search?q=CN120360204A

Method for improving viscosity of caramel pigment

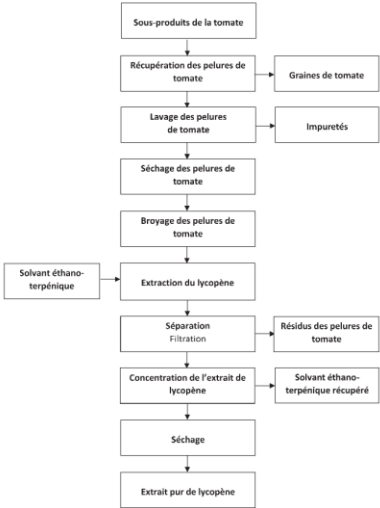
[Método para mejorar la viscosidad del pigmento de caramelo]

N° de publicación	CN120248650A - 4/7/2025
País / Fecha de aplicación	CHINA - 29/3/2025
Inventor(es) / Solicitante(s)	Xu Nuoran, Dai Haojun, Yue Hang, Zhao Weiling, Xu Chenyu, Chen Jiangbo, Ma Qingqing, An Yanlong, Xu Weidong, Yang Wulong, Li Mian ZHEJIANG HUAKANG PHARMACEUTICAL CO LTD
	The invention belongs to the technical field of sugar alcohol preparation, and relates to a method for improving the viscosity of caramel pigment, which comprises the steps of adding a catalyst and xylose mother liquor according to the mass ratio of 15-25% into a reaction kettle, adjusting the pH value in the reaction kettle to 3.0-7.0, setting the browning reaction temperature to 100-150 °C, simultaneously starting a stirring device of the reaction kettle to stir feed liquid, starting the browning reaction, controlling the opening of a tail gas valve of the reaction kettle in the browning reaction process, discharging waste gas generated in the browning reaction process through the tail gas valve, keeping the pressure

	in the reaction kettle to be 0.01-0.1 MPa, enabling the browning reaction time to be 5-10 h, and carrying out back blowing on the reaction kettle by using compressed air when the red index of the feed liquid in the reaction kettle reaches an expected value of 5.5-6.5 at the end of the browning reaction until the browning reaction is finished. Under the condition of not increasing the reaction time and the reaction temperature, the invention can not only effectively improve the viscosity of the caramel pigment, but also can not negatively affect other properties of the caramel pigment, improve the yield and quality of the caramel pigment and reduce the production cost.
Link	https://worldwide.espacenet.com/patent/search?q=CN120248650A

Innovative process for extraction of natural, pure and stable lycopene using a green solvent

[Proceso innovador para la extracción de licopeno natural, puro y estable utilizando un disolvente verde]

N° de publicación	MA62378A1 - 28/3/2025
País / Fecha de aplicación	REPUBLICA DE MOLDAVIA - 21/9/2023
Inventor(es) / Solicitante(s)	Hajar El Basett, Hassan Hajjaj LES CONSERVES DE MEKNES
	The present invention discloses an innovative process for extracting natural lycopene from the peels of tomato by-products from industrial processing. Said process involves a mild solid-liquid extraction based on the use of ethano-terpene green solvent which is highly selective towards lycopene. Said process being characterized in that it comprises the following steps: recovering tomato peels, washing said peels to remove impurities, drying and grinding the purified peels, contacting the tomato peel powder with the ethanoterpene solvent, removing tomato peel residues, concentrating the lycopene extract and recycling the extraction solvent, drying said lycopene extract so as to remove traces of ethanol and obtain a pure lycopene extract enriched in terpenes. The said lycopene extract is pure, stable, endowed with biological properties, and characterized by a high extraction yield of the order of 99%, for use in food, nutraceutical, pharmaceutical and cosmetic applications.
Link	https://worldwide.espacenet.com/patent/search?q=MA62378A1

Methods and systems for tea extraction

[Métodos y sistemas para la extracción del té]

N° de publicación	WO2025059370A1 - 20/3/2025
País / Fecha de aplicación	WIPO - 12/9/2024
Inventor(es) / Solicitante(s)	Kenneth Simone, Lineback D., Rajesh Jetty, Danish Yazdani, Gregg Lehmberg FLORIDA FOOD PRODUCTS LLC

	This disclosure relates to methods, systems and compositions for food coloring. Embodiments disclosed herein may include methods and systems for combining tea leaves and water to form a feed slurry; processing a feed slurry to at least partially remove a tea essence from the feed slurry, thereby obtaining a tea extract with a predetermined amount of one or more of an aroma or a flavor; and adjusting a color of the tea extract, thereby obtaining a coloring agent with a predetermined color-related feature, wherein the coloring agent is added in a predetermined amount to a food product to adjust a color of the food product. Embodiments may also including coloring compositions, which may include a dry tea extract, wherein an essence has been removed from the dry tea extract to a predetermined amount, and a color of the dry tea extract has been adjusted to have a predetermined color- related feature.
Link	https://worldwide.espacenet.com/patent/search?q=WO2025059370A1

Preparation method and application of deodorized beet red

[Método de preparación y aplicación del rojo de remolacha desodorizado]

N° de publicación	CN119506373A - 25/2/2025																																							
País / Fecha de aplicación	CHINA - 20/11/2024																																							
Inventor(es) / Solicitante(s)	Xiong Yong,Zhang Junbing,Ding Xiaoqiang,Wu Sheng,Peng Shengfeng,Qiu Yun,Luo Zhongguo,He Zhirong,Jiang Shenhua,Zhang Shuijun JIANGXI DANXIA BIOTECHNOLOGY CO. LTD.																																							
<table><tr><th>组别</th><th>波长 (nm)</th><th>成品色价</th></tr><tr><td>实施例 1</td><td>535</td><td>103.5</td></tr><tr><td>实施例 2</td><td>535</td><td>92.0</td></tr><tr><td>实施例 3</td><td>535</td><td>94.6</td></tr></table>	组别	波长 (nm)	成品色价	实施例 1	535	103.5	实施例 2	535	92.0	实施例 3	535	94.6	The invention provides a preparation method and application of deodorized beet red, and the preparation method comprises the following steps: peeling and crushing red beet, centrifugally separating, adding sugar, adding cultured bacterial liquid for fermentation to obtain fermented beet slurry, adsorbing the fermented beet slurry with macroporous adsorption resin to remove impurities, resolving with an ethanol solution, concentrating with a nanofiltration membrane, and sterilizing to obtain the deodorized beet red. The deodorized beet red concentrated solution is obtained. The preparation process of the deodorized beet red is simple, the beet red is high in stability, free of unpleasant odor and suitable for large-scale production, technical support is provided for industrial application of natural pigments, and the prepared deodorized beet red can be applied to the fields of food, medicine and cosmetics.																											
组别	波长 (nm)	成品色价																																						
实施例 1	535	103.5																																						
实施例 2	535	92.0																																						
实施例 3	535	94.6																																						
<table><tr><td>对比例 1</td><td>535</td><td>88.9</td></tr><tr><td>对比例 2</td><td>535</td><td>35.4</td></tr><tr><td>对比例 3</td><td>535</td><td>200.4</td></tr><tr><td>对照</td><td>535</td><td>176.8</td></tr></table>	对比例 1	535	88.9	对比例 2	535	35.4	对比例 3	535	200.4	对照	535	176.8																												
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<table><tr><th>组别</th><th>2 小时菌液红剂余量 (%)</th><th>4 小时菌液红剂余量 (%)</th><th>6 小时菌液红剂余量 (%)</th><th>8 小时菌液红剂余量 (%)</th></tr><tr><td>实施例 1</td><td>98.7</td><td>95.1</td><td>93.6</td><td>91.0</td></tr><tr><td>实施例 2</td><td>99.0</td><td>94.3</td><td>92.5</td><td>90.7</td></tr><tr><td>实施例 3</td><td>99.6</td><td>95.4</td><td>93.2</td><td>91.8</td></tr><tr><td>对比例 1</td><td>96.3</td><td>92.6</td><td>88.7</td><td>85.0</td></tr><tr><td>对比例 2</td><td>95.9</td><td>93.5</td><td>89.4</td><td>83.4</td></tr><tr><td>对比例 3</td><td>87.5</td><td>85.4</td><td>81.9</td><td>79.1</td></tr><tr><td>对照</td><td>83.1</td><td>79.9</td><td>76.0</td><td>73.2</td></tr></table>	组别	2 小时菌液红剂余量 (%)	4 小时菌液红剂余量 (%)	6 小时菌液红剂余量 (%)	8 小时菌液红剂余量 (%)	实施例 1	98.7	95.1	93.6	91.0	实施例 2	99.0	94.3	92.5	90.7	实施例 3	99.6	95.4	93.2	91.8	对比例 1	96.3	92.6	88.7	85.0	对比例 2	95.9	93.5	89.4	83.4	对比例 3	87.5	85.4	81.9	79.1	对照	83.1	79.9	76.0	73.2
组别	2 小时菌液红剂余量 (%)	4 小时菌液红剂余量 (%)	6 小时菌液红剂余量 (%)	8 小时菌液红剂余量 (%)																																				
实施例 1	98.7	95.1	93.6	91.0																																				
实施例 2	99.0	94.3	92.5	90.7																																				
实施例 3	99.6	95.4	93.2	91.8																																				
对比例 1	96.3	92.6	88.7	85.0																																				
对比例 2	95.9	93.5	89.4	83.4																																				
对比例 3	87.5	85.4	81.9	79.1																																				
对照	83.1	79.9	76.0	73.2																																				
Link	https://worldwide.espacenet.com/patent/search?q=CN119506373A																																							

High-purity crocin extraction and separation method and application thereof

[Método de extracción y separación de crocina de alta pureza y su aplicación]

N° de publicación	CN119462788A - 18/2/2025
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País / Fecha de aplicación	CHINA - 22/11/2024
Inventor(es) / Solicitante(s)	Zhang Quan,She Aimin,Qiu Weiwei ZHEJIANG ZHONGKE ZHONGZHI BIOLOGICAL TECHNOLOGY CO. LTD.
	The invention provides a high-purity crocin extraction and separation method and application thereof, and relates to the field of industrial dyestuff, the high-purity crocin extraction and separation method comprises the following steps: S1, raw material preparation, S2, device preparation, S3, crude extraction for later use, S4, preliminary purification and S5, advanced purification. The industrial dye is prepared from the following components in parts by weight: 0.3 to 0.7 part of high-purity crocin, 3 to 6 parts of ethanol, 0.1 to 0.3 part of citric acid, 3 to 5 parts of urea, 5 to 7 parts of table salt, 0.03 to 0.06 part of vitamin C, 0.04 to 0.07 part of sodium benzoate, 1.2 to 1.5 parts of natural plant color fixing agent, 1.2 to 1.5 parts of bio-based color fixing agent and the balance of deionized water. By using a multi-stage dynamic countercurrent ultrasonic extraction technology, crocin in a crushed gardenia raw material can be efficiently extracted, the concentration difference between a solvent and the raw material is gradually increased, the extraction efficiency is improved through multi-stage extraction, full contact of the solvent and the raw material is ensured, the extraction efficiency is improved through dynamic stirring, and plant cell walls are destroyed; ultrasonic-assisted acceleration of release of effective components is realized, and extraction efficiency is improved.
Link	https://worldwide.espacenet.com/patent/search?q=CN119462788A

6.4.5 Tecnologías aplicadas a segmentos de mercado específicos

Cod surimi product and preparation method thereof

[Producto de surimi de bacalao y método de preparación del mismo]

N° de publicación	CN120203199A - 27/6/2025
País / Fecha de aplicación	CHINA - 11/4/2025
Inventor(es) / Solicitante(s)	YAO WEIWEI ZHONGSHAN ZHENWEI FOOD IND CO LTD
	The present invention relates to a cod mince product and its preparation method. The cod mince product is prepared from raw materials containing the following mass percentages: frozen cod mince 70% to 75%, soybean oil 3% to 6%, protein solution 4% to 6%, drinking water 6% to 7%, phosphate bistrarch 4% to 6%, trehalose 1% to 3%, seasoning 2.5% to 5%, coloring agent 0.5% to 1%. The preparation method of the cod mince product includes the steps of frozen cod mince chopping, mixing, forming, shaping, demolding, etc. The cod mince product of the present invention can maintain its original form for a long time after thawing, and the preparation method is simple.
Link	https://worldwide.espacenet.com/patent/search?q=CN120203199A

Method for preparing vegetarian whole eggs based on lotus seed resistant starch-protein-based oil body emulsion filling gel

[Método para preparar huevos enteros vegetarianos a base de gel de relleno de emulsión corporal de aceite a base de almidón resistente y proteína de semilla de loto]

N° de publicación	CN120130658A - 13/6/2025
País / Fecha de aplicación	CHINA - 23/4/2025
Inventor(es) / Solicitante(s)	Xu Duoxia, Wang Yanbo, Wu Chengcheng, Li Xiaoyu, Zhang Yi, Zheng Baodong, Chen Wei, Lyu Wenwen, Du Bingqian, Zhang Fengru BEIJING TECHNOLOGY AND BUSINESS UNIVERSITY
	The invention discloses a method for preparing vegetarian whole eggs based on lotus seed resistant starch-protein-based oil body emulsion filling gel, and belongs to the field of food processing. According to the vegetarian whole egg prepared by the invention, the selected raw materials are high in nutritional value, and yeast protein and soy isolate protein are compounded to simulate the protein content and amino acid characteristics in natural egg white; the oil body is rich in lecithin and polyunsaturated fatty acid so as to simulate high-quality fat and color of yolk; lotus seed resistant starch is RS3 type resistant starch capable of relieving allergy, and it is found that the lotus seed resistant starch can improve the gel characteristic in a certain concentration range so as to be matched with the egg texture. The method disclosed by the invention is simple in processing technology, green and environment-friendly, vegetarian whole eggs with nutrient composition, texture and color similar to those of eggs are obtained, and a diversified

	nutritional supplement is provided for egg allergic persons and vegetarian persons.
Link	https://worldwide.espacenet.com/patent/search?q=CN120130658A

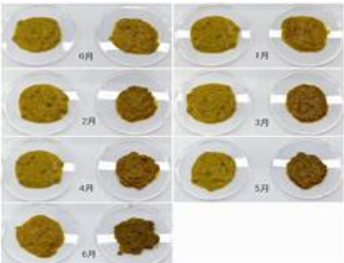
Preparation method of coated peanuts containing black rice anthocyanin

[Método de preparación de cacahuets recubiertos que contienen antocianina de arroz negro]

N° de publicación	CN120078139A - 3/6/2025
País / Fecha de aplicación	CHINA - 15/4/2025
Inventor(es) / Solicitante(s)	Sun Hanju, Zhou Yuxin, Li Youwu, He Shudong HEFEI ZHENTAI LAOYEYE FOOD CO., LTD.
	The invention relates to the technical field of food processing, in particular to a preparation method of coated peanuts containing black rice anthocyanin. Peanuts, waxy corn starch, pregelatinized starch, flour, glutinous rice flour, maltitol, black rice extract and blueberry concentrated juice are used as main raw materials, preheated peanuts are wrapped with wrapping slurry and wrapping powder in a wrapping machine and then baked, and wrapped peanuts are obtained; dissolving the black rice extract in an edible ethanol solution, mixing with the blueberry concentrated juice, mixing with a magnetic stirrer, and adjusting the pH value to obtain an anthocyanin ethanol solution; spraying an anthocyanin ethanol solution on the surface of the coated peanut under a rolling condition, and drying by hot air to completely remove the edible ethanol to obtain a finished product. The prepared coated peanuts are low in sugar content, smooth in surface, moderate in crispness and bulkiness and good in taste, meanwhile, the anthocyanin spraying method is simple and convenient, the production cost is low, the color endowing and fresh keeping effects are achieved, and the quality loss in the storage process is reduced. 
Link	https://worldwide.espacenet.com/patent/search?q=CN120078139A

Golden soup seasoning sauce and preparation method thereof

[Salsa condimentada para sopa dorada y método de preparación]

N° de publicación	CN119745040A - 4/4/2025
País / Fecha de aplicación	CHINA - 1/8/2025
Inventor(es) / Solicitante(s)	Wang Suqin, Wang Yihan, Xu Wenlong, Gan Maosen, Zhang Lu, Chen Yonghui, Zhao Gang SICHUAN BAIJIA AKUAN FOOD IND CO LTD
	The invention discloses a golden soup flavoring sauce and a preparation method thereof, and relates to the technical field of food processing. The golden soup flavoring sauce comprises, by weight, 300-350 parts of edible oil, 8-12 parts of minced garlic, 8-12 parts of minced white onion, 8-12 parts of bubble Jiang Rong, 35-45 parts of bubble two-chaste tree fruit and chilli, 2-6 parts of color fixative, 100-180 parts of toner and 0.01-0.5 part of sweetener. The turmeric powder with the antioxidation function reduces the dosage of additives, accords with the health concept better, uses 

	natural sweetener to replace sucrose, reduces browning reaction, effectively prolongs the shelf life of the golden soup seasoning sauce, keeps the color stable, uses vegetable powder to replace fresh pumpkin, has longer storage period of raw materials, breaks the nodular restriction of preparing the golden soup seasoning sauce, and is simple to prepare, thereby being more suitable for industrial production.
Link	https://worldwide.espacenet.com/patent/search?q=CN119745040A

Preparation method of spicy fermented bean curd

[Método de preparación de tofu fermentado picante]

N° de publicación	CN119745017A - 4/4/2025
País / Fecha de aplicación	CHINA - 3/1/2025
Inventor(es) / Solicitante(s)	Zhang Xunwei, Zhan Xuren, Cui Qian QINGDAO WOTU DADI BIOLOGICAL SCIENCE & TECH CO LTD
	The invention relates to the technical field of food fermentation, in particular to a preparation method of spicy fermented bean curd, which comprises the following raw materials, by weight, 10-15 parts of soybean, 30-45 parts of water, 0.1-0.3 part of gypsum powder, 0.5-0.8 part of mutor, 0.1-0.3 part of lactobacillus bulgaricus, 0.4-1.2 part of composite multifunctional particles, 1-10 parts of saline, 1-5 parts of chilli powder, 1-3 parts of star anise, 0.4-0.6 part of cinnamon, 0.5-0.7 part of pepper, 0.1-0.3 part of ginger, 0.8-1.2 parts of salt, 1-2 parts of rice wine and 0.6-0.8 part of vegetable oil; S1.2, pretreatment of raw materials and preparation of bean curd blocks, S1.3, preparing spicy yellow fermented bean curd by flavor fermentation, and endowing a product with rich flavor quality, visual attraction and antioxidant effects by adopting the antioxidant effect and the natural pigment effect of cryptoxanthin, improving the stability of the cryptoxanthin by using acetylated double starch phosphate, prolonging the antioxidant effect of the cryptoxanthin, and enabling the cryptoxanthin to stably play the antioxidant effect in the fermentation process and after the fermentation is finished.
Link	https://worldwide.espacenet.com/patent/search?q=CN119745017A

实施/对比例	色泽	风味	口感	发酵时间 h
实施例1	7.7	7.5	7.2	114
实施例2	8.3	8.1	7.6	119
实施例3	8.9	9.0	8.5	128
实施例4	8.8	8.7	8.1	123
实施例5	7.9	7.4	7.4	108
实施例6	8.4	8.2	7.9	115
对比例1	3.2	3.8	2.4	78
对比例2	5.6	6.1	5.3	96
对比例3	3.8	4.4	4.7	83

Extraction method of natural gardenia yellow and application of natural gardenia yellow in roasted seeds and nuts

[Método de extracción de gardenia amarilla natural y aplicación de gardenia amarilla natural en semillas y nueces tostadas]

N° de publicación	CN119498473A - 25/2/2025
País / Fecha de aplicación	CHINA - 16/10/2024
Inventor(es) / Solicitante(s)	Yang, Liqi, Cui Shucheng, Xiang Fangxian, Ni Jie, Zhang Chaomeng ZHEJIANG TASTE HANG FOOD CO., LTD.
	The invention provides an extraction method of natural gardenia yellow and application of the natural gardenia yellow in roasted seeds and nuts. The roasted seeds and nuts comprise nut raw materials, seasonings, liquorice, pepper, fennel, galangal, a sweetening agent and a gardenia yellow extract.

	The gardenia yellow extract obtained by the invention can be used as a natural coloring agent, has no peculiar smell, does not influence the original taste and fragrance of the roasted seeds and nuts, does not contain substances harmful to human bodies, such as heavy metals and harmful additives, adds golden yellow color to the roasted seeds and nuts, makes the appearance more attractive, and improves the purchase desire and visual enjoyment of consumers.
Link	https://worldwide.espacenet.com/patent/search?q=CN119498473A

Fórmula and making method of armpit

[Fórmula y método de elaboración de alimento]

N° de publicación	CN119279149A - 10/1/2025
País / Fecha de aplicación	CHINA - 14/11/2024
Inventor(es) / Solicitante(s)	Song Shuhui SONG SHUHUI
s/d	The invention relates to the field of food, in particular to an armpit making method which comprises the following steps: S1, preparing pure mung bean flour, five spice powder, edible salt and drinking water; s2, mung bean flour is made, and five spice powder and edible salt with the set amount are weighed; s3, making flour paste: adding five spice powder and edible salt into pure mung bean flour, uniformly mixing, adding a small amount of drinking water for multiple times to obtain pasty flour paste, and standing; s4, spreading a flour cake: spreading the flour cake on a heated flat plate to form a cake shape; s5, slicing: before the dough cake in the step S4 is not completely dried, cutting the dough cake into slices by using a cutter, and drying the slices; s6, frying and taking out of a pan: frying the cylindrical noodle sections in the step S5 in an oil pan, taking out of the pan after the color is light green, and controlling oil and cooling to obtain the armpit food. The armpit food prepared by the method is crisp and delicious after being fried, the crisp time can be prolonged, the possibility is provided for diners to take away and eat, the sales volume of merchants can be increased, and the income can be increased.
Link	https://worldwide.espacenet.com/patent/search?q=CN119279149A

Preparation of high-stability natural blue pigment and application of high-stability natural blue pigment in leisure food for children

[Preparación de pigmento azul natural de alta estabilidad y aplicación de pigmento azul natural de alta estabilidad en alimentos recreativos para niños]

N° de publicación	CN119157221A - 20/12/2024
País / Fecha de aplicación	CHINA - 14/9/2024
Inventor(es) / Solicitante(s)	Li Yongjun HEBEI STRONG FOOD CO., LTD.
	The invention relates to preparation of high-stability natural blue pigment and application of the high-stability natural blue pigment in leisure food for

	children, which comprises the following steps: preparation of geniposide, purification of geniposide, preparation of natural blue pigment, preparation of jelly containing gardenia blue pigment, and preparation of milk tea containing gardenia blue pigment. The jelly product containing the blue gardenia pigment is creatively prepared by using a macroporous adsorption resin purification geniposide technology, a geniposide enzymolysis technology, ammonia process catalysis of natural blue pigment and sol blending, and the jelly product has the characteristics of easiness in operability, stable pigment, good ornamental value, difficulty in fading and the like.
Link	https://worldwide.espacenet.com/patent/search?q=CN119157221A

Method for degumming and dyeing silk by using soapberry and safflower to improve antibacterial property

[Método para desgomar y teñir seda utilizando jaboncillo y cártamo para mejorar la propiedad antibacteriana]

N° de publicación	CN118581747A - 3/9/2024
País / Fecha de aplicación	CHINA - 18/4/2024
Inventor(es) / Solicitante(s)	He Qi, Zhu Chengyan, Tian Wei, Ji Ziyang, Wu Ying ZHEJIANG SCI-TECH UNIVERSITY
	The invention relates to a method for degumming and dyeing silk by using soapberry and safflower to improve antibacterial property, which comprises the following steps: mixing and fermenting rhizopus, rice meal and deionized water in proportion for 24 hours, continuously mixing and fermenting saccharomycetes and rhizopus fermentation liquor in proportion for 48 hours, retaining supernate, drying and powdering mature soapberry pericarp and safflower, and drying to obtain the silk degumming and dyeing method. The preparation method comprises the following steps: mixing soapberry with deionized water in proportion to prepare soapberry turbid liquid and safflower dyeing liquid, mixing the fermentation liquid and the turbid liquid in proportion to fully ferment, fully extracting safflower yellow in safflower, filtering impurities by using a vacuum suction filter, heating the filtered soapberry fermentation liquid, putting the soapberry fermentation liquid into dried cocoon slices in proportion to degumming, and drying to obtain the finished product. After drying, the cocoon slices are fully soaked in a safflower dyeing solution in proportion for dyeing. By comparing the weight difference of cocoon pieces before and after degumming, the degumming rate of the scheme is 20-23%, and the antibacterial rate can reach 95-99%. The method is natural and pollution-free, does not influence the fibroin strength, and ensures the color fastness and improves the antibacterial property while realizing efficient degumming of the silk.
Link	https://worldwide.espacenet.com/patent/search?q=CN118581747A

Fermented bean curd powder and production process thereof

[Polvo de tofu fermentado y su proceso de producción]

N° de publicación	CN118556823A - 30/8/2024
País / Fecha de aplicación	CHINA - 25/4/2024
Inventor(es) / Solicitante(s)	Wang Yingying, Zhang Dongxia, Fu Weichao, Hao Fengxia, Fan Yanli, Wang Yunfeng, Liu Gaozhan, Xie Hejia XIANGCHENG CITY BAIJIA INDUSTRY CO., LTD.
s/d	According to the fermented bean curd powder production process provided by the invention, the fermented bean curd powder is taken as a raw material, red yeast rice is added for color modulation, and secondary sterilization is performed, so that bacterial colony control is relatively good, and infectious microbe exceeding is prevented. The production process of the fermented bean curd powder is realized according to the following mode: the fermented bean curd powder is prepared according to the following steps: step (1) material picking: weighing raw materials according to a mass ratio of fermented bean curd to red yeast rice to edible salt to maltodextrin to water being 26 to 1 to 2 to 6 to 15; the preparation method comprises the following steps: (1) preparing raw materials, (2) pretreating the raw materials, (3) preparing raw powder, and (4) reacting, weighing and packaging. According to the method, large fermented bean curds are firstly crushed and pass through a colloid mill, and obtained particles are 20-30 meshes, are uniform and fine and are beneficial to a powder spraying process; maltodextrin is added for embedding, and red yeast rice is added for color modulation. In the reaction process, sterilization is carried out twice, drying is carried out through a drying tower, and then powder spraying is carried out through a powder spraying tower. The total number of bacterial colonies of the fermented bean curd powder prepared by the process is controlled below 500 CFU/g.
Link	https://worldwide.espacenet.com/patent/search?q=CN118556823A

Preparation method of instant cassava rice

[Método de preparación de arroz de yuca instantáneo]

N° de publicación	CN118511965A - 20/8/2024
País / Fecha de aplicación	CHINA - 12/6/2024
Inventor(es) / Solicitante(s)	Yoo Chang-Hun YOO CHANG-HUN
s/d	The present invention discloses a cassava instant rice preparation method, and relates to the field of food processing, and the cassava instant rice preparation method comprises the following steps: selecting corresponding parts of high-quality cassava and rice, cleaning, peeling, cutting into blocks, soaking, mixing, putting the uniformly mixed cassava blocks and rice into a cooking boiler, cooking thoroughly, and taking out the cooked cassava blocks and rice; and finally, cooling the mixture of the cassava blocks and the rice, feeding the cooled mixture into split charging equipment for split charging, and sealing. According to the prepared food, coarse grains and fine grains are mixed according to a reasonable proportion, nutrition is balanced, the requirement of people for nutrition can be met, meanwhile, the defects that traditional white rice is single in nutritional composition, low in nutrition balance and the like are overcome, and after rice and

	cassava are mixed and cooked, the food has the good taste. When eating the food, an eater only needs to place the food together with a packaging box in a microwave oven to be heated for 2-3 minutes or steamed for 6-8 minutes in a water separation manner, so that the problems that the cassava is long in cooking time and contains trace toxins are effectively solved, and the requirements of modern fast-paced life are met.
Link	https://worldwide.espacenet.com/patent/search?q=CN118511965A

Prefabricated bean curd and preparation method thereof

[Tofu prefabricado y su método de preparación]

N° de publicación	CN118452407A - 9/8/2024																																																																
País / Fecha de aplicación	CHINA - 24/6/2024																																																																
Inventor(es) / Solicitante(s)	Long Haisheng, Huang Qiang, Jin Lu, Sun Bo SICHUAN YUNSHIHUA BIOTECHNOLOGY CO., LTD.																																																																
<table><tr><th>组别</th><th>L*</th><th>a*</th><th>b*</th></tr><tr><td>实施例 1</td><td>76.36</td><td>1.52</td><td>48.37</td></tr><tr><td>实施例 2</td><td>75.41</td><td>1.48</td><td>47.22</td></tr><tr><td>实施例 3</td><td>75.72</td><td>1.5</td><td>48.61</td></tr><tr><td>实施例 4</td><td>73.23</td><td>1.68</td><td>55.36</td></tr><tr><td>对比例 1</td><td>68.44</td><td>0.78</td><td>32.11</td></tr><tr><td>对比例 2</td><td>70.65</td><td>1.06</td><td>39.95</td></tr><tr><td>对比例 3</td><td>67.3</td><td>1.24</td><td>38.35</td></tr><tr><td>对比例 4</td><td>71.62</td><td>1.16</td><td>37.48</td></tr><tr><td>对比例 5</td><td>69.05</td><td>1.03</td><td>36.15</td></tr><tr><td>对比例 6</td><td>70.36</td><td>3.25</td><td>62.81</td></tr><tr><td>对比例 7</td><td>71.26</td><td>0.69</td><td>29.24</td></tr><tr><td>对比例 8</td><td>65.78</td><td>1.59</td><td>49.03</td></tr><tr><td>对比例 9</td><td>70.36</td><td>0.49</td><td>25.39</td></tr><tr><td>对比例 10</td><td>66.26</td><td>1.26</td><td>40.71</td></tr><tr><td>对照组</td><td>67.93</td><td>1.49</td><td>49.37</td></tr></table>	组别	L*	a*	b*	实施例 1	76.36	1.52	48.37	实施例 2	75.41	1.48	47.22	实施例 3	75.72	1.5	48.61	实施例 4	73.23	1.68	55.36	对比例 1	68.44	0.78	32.11	对比例 2	70.65	1.06	39.95	对比例 3	67.3	1.24	38.35	对比例 4	71.62	1.16	37.48	对比例 5	69.05	1.03	36.15	对比例 6	70.36	3.25	62.81	对比例 7	71.26	0.69	29.24	对比例 8	65.78	1.59	49.03	对比例 9	70.36	0.49	25.39	对比例 10	66.26	1.26	40.71	对照组	67.93	1.49	49.37	The invention belongs to the technical field of food processing, and discloses prefabricated bean curd and a preparation method thereof. Firstly, turmeric juice prepared through low-temperature grinding is added in the second fermentation stage of soybean milk, it is avoided that the turmeric juice directly makes contact with the soybean milk and becomes red, the initial bean curd is evenly golden yellow, the contained turmeric active ingredient is stable and does not decompose at a short high temperature, and then high-temperature curing and non-thermal sterilization treatment are combined, so that the bean curd is obtained. The color fading phenomenon of the initial bean curd in the curing and sterilizing processes is prevented, and meanwhile, the color brightness of the initial bean curd is improved, so that the appearance quality of the prepared prefabricated bean curd is remarkably improved, and the prepared prefabricated bean curd has a relatively good shelf life at normal temperature. The prefabricated bean curd disclosed by the invention is uniform and bright golden yellow and has relatively good appearance quality, and the shelf life of the prefabricated bean curd at normal temperature can reach 30-34 days.
组别	L*	a*	b*																																																														
实施例 1	76.36	1.52	48.37																																																														
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6.5 ANÁLISIS DE COMPETIDORES

En base a la producción científica albergada en Scopus e información de documentos de patente, se destaca la participación de China Agricultural University, Givaudan SA y Polytechnic Institute of Bragança.

China Agricultural University



La Universidad Agrícola de China es una de las principales instituciones superiores para estudios agrícolas de su país. Su apoyo a la investigación en la industria alimentaria ha sido crucial, promoviendo tecnologías avanzadas para mejorar la eficiencia en el manejo de los colorantes naturales. La universidad también ha fomentado la presentación de patentes, reflejando el compromiso del país con la innovación tecnológica. Tiene registrado un alto número de solicitudes de patentes (12,453 patentes) durante el periodo de 2020-2025, de las cuales 12 patentes pertenecen al campo de investigación desarrollado en el presente boletín. A nivel científico, posee un importante volumen de publicaciones en Scopus, teniendo 14 documentos en áreas relacionadas con colorantes naturales en la industria alimentaria.

web

<https://en.cau.edu.cn/>

Givaudan SA



Es una multinacional suiza fabricante de aromas, fragancias e ingredientes cosméticos activos con más de 60 años en el mercado. Los aromas y sabores de la empresa se desarrollan para fabricantes de alimentos y bebidas, y también se utilizan en artículos para el hogar, así como en productos de aseo y cuidado personal y perfumes. Respecto a su producción científica posee 1,022 publicaciones en Scopus, aunque ninguna en la temática desarrollada en este boletín. En los últimos 5 años ha registrado 1760 patentes pertenecientes 460 familias, de las cuales 53 patentes (19 familias) se desarrollaron en el campo de colorantes naturales para la industria alimentaria.

web

<https://www.givaudan.com/>

Polytechnic Institute of Bragança (IPB)



Es una de las instituciones de educación pública superior e investigación más destacadas de Portugal. A través de sus centros de investigación, como la Unidad de Investigação em Ciências Químicas e Biológicas (CQB) y el Centro de Investigação de Montanha (CIMO), el IPB impulsa aprovechamiento sostenible de los recursos naturales y el desarrollo de soluciones para la industria alimentaria. Su actividad incluye el desarrollo de tecnologías innovadoras para mejorar la calidad, estabilidad y funcionalidad de compuestos bioactivos, así como la valorización de recursos vegetales, lo que contribuye indirectamente al conocimiento y uso de pigmentos de origen natural en distintos sectores. En el ámbito de la propiedad intelectual, el IPB fomenta la generación de patentes y la colaboración con empresas para la transferencia de tecnología. A nivel científico, ha producido un volumen significativo de publicaciones indexadas en Scopus (7783), consolidándose como un referente académico y tecnológico en el sector.

web

<http://www.moe.gov.cn/>

VII. CONCLUSIONES

- La microencapsulación y nanoencapsulación se consolidan como las soluciones tecnológicas de vanguardia en la temática de colorantes naturales en alimentos, dominando la investigación científica reciente y reflejándose en la literatura científica relevante (11 registros) y las solicitudes de patente del último año en el campo de la estabilización avanzada (15 registros), siendo su fin primordial la protección de los pigmentos y la extensión efectiva de la vida útil.
- La actividad en el tema de colorantes naturales en alimentos se caracteriza por una producción científica diversa con el Polytechnic Institute of Bragança (Portugal) liderando los registros relevantes del último año (5 publicaciones), seguido por Beijing Technology and Business University y la Ocean University of China (4 publicaciones cada una). La información tecnológica académica muestra la participación de nueve (9) instituciones académicas chinas, cada una con un registro; en tanto que, en el ámbito empresarial, la compañía suiza Givaudan SA lidera claramente la actividad de patentamiento con cuatro (4) registros.
- La investigación y el desarrollo tecnológico en colorantes naturales para la industria alimentaria están dominados por China, que lidera ampliamente la producción científica (26.5% de los documentos) y tecnológica (66% de los documentos) del último año, evidenciando una sólida inversión estratégica y un fuerte compromiso del país con el sector. A nivel científico, la base de conocimiento se diversifica con contribuciones significativas de India (13.3%), Brasil (10.2%) y Portugal (7.8%). En tanto que, en el ámbito tecnológico, se tiene participación minoritaria de registros procedentes de Estados Unidos (8%) y Japón (4%)
- A pesar del importante avance global en la temática, se observa una brecha en la investigación y la producción tecnológica de colorantes naturales en Perú y la región sudamericana. Iniciativas locales, como el proyecto de investigación desarrollado por la UNALM para el aprovechamiento de cáscaras de pitahaya, subraya la importancia de valorizar la biodiversidad y la colaboración internacional para generar soluciones específicas para la región.
- La producción científica y tecnológica en la temática se alinea con la economía circular. Se han desarrollado iniciativas como el aprovechamiento de residuos agroindustriales (como el orujo de uva o la cáscara de brotes de bambú), buscando fuentes de pigmentos más sostenibles. Esta tendencia también se evidencia en los proyectos de investigación locales. Asimismo, se han desarrollado importantes avances en tecnologías con enfoque

en química verde y la optimización de los procesos de extracción para reducir el impacto ambiental.

- Los proyectos de investigación recuperados en este documento (4 registros), reflejan un enfoque estratégico de la I+D+i en la sustitución de aditivos. La meta central de estas iniciativas es reemplazar los colorantes inorgánicos perjudiciales para la salud por alternativas biológicas seguras y escalables. El patrón de inversión subraya la prioridad global en la seguridad alimentaria y la búsqueda de soluciones sostenibles y de producción limpia.



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