

CERTIFICACIÓN DE CREDITO PRESUPUESTARIO
NOTA N° 0000011030
(EN SOLES)

SECTOR : 10 EDUCACION

PLIEGO : 518 U.N. AGRARIA LA MOLINA

EJECUTORA : 001 UNIVERSIDAD NACIONAL AGRARIA LA MOLINA [000096]

MES : DICIEMBRE

FECHA DE DOCUMENTO: 16/12/2024

TIPO DOCUMENTO : MEMORANDUM

JUSTIFICACIÓN : CCMN-011975: SERVICIO DE UNA COINVESTIGADORA UO 019000386

FECHA APROBACION 6/12/2024

ESTADO CERTIFICACION APROBADO

N° DE DOCUMENTO 00079

DETALLE DEL GASTO

SECUENCIA PRG PROD/PRXCT/AIOBFRN. DIVF GRPF META FFRB CGTTGSGSGDESIESPD	MONTO
0001 INICIAL	
0137 3000742 5005296 22 048 0110 APOYO A PROYECTOS DE INVESTIGACION EN CIENCIA, TECNOLOGIA E INNOVACION	3,900.00
0039 APOYO A PROYECTOS DE INVESTIGACION EN CIENCIA, TECNOLOGIA E INNOVACION TECNOLOGICA	3,900.00
4 DONACIONES Y TRANSFERENCIAS	3,900.00
13	
5 GASTOS CORRIENTES	3,900.00
2.3 BIENES Y SERVICIOS	3,900.00
2.3.2 CONTRATACION DE SERVICIOS	3,900.00
2.3.2 7 SERVICIOS PROFESIONALES Y TECNICOS	3,900.00
2.3.2 7.14 SERVICIOS TÉCNICOS Y PROFESIONALES DESARROLLADOS POR PERSONAS NATURALES	3,900.00
2.3.2 7.14 98 OTROS SERVICIOS TÉCNICOS Y PROFESIONALES DESARROLLADOS POR PERSONAS NATURALES	3,900.00
TOTAL	3,900.00
TOTAL CERTIFICACION	3,900.00
TOTAL NOTA	3,900.00



UNIVERSIDAD NACIONAL AGRARIA
LA MOLINA

Econ. Cipriano Alberto Sánchez Cochachi
Jefe de la Oficina de Planeamiento



La presente no convalida actos o acciones
que no se ciñan a la normatividad legal y
no constituye sustento técnico y legal para
autorizar la ejecución de gastos en el
presente Ejercicio Fiscal.

CERTIFICACION DE CREDITO PRESUPUESTARIO Nro.: 010079

N° CCP SIAF: 0000011030

1.-Información del Proc.

Tipo de Proc. de Selección : ADJUDICACION SIN PROCEDIMIENTO
Objeto del Proc. : SERVICIOS
Síntesis del CCMN : SERVICIO DE UNA COINVESTIGADORA UO 01.900.03.86
Nro. de Ref. en el PAC :
Incluido en el PAC mediante Resolución:
Base Legal : Artículo 5° de la Ley de Contrataciones del Estado

2.-Contenido del Expediente de Contratación

Requerimiento : PEDIDO DE SERVICIO N°3764
Informado con Documento N° : 3764
Valor Referencial : S/ 3,900.00 Soles

Fecha 16/12/2024


Econ. SAMUEL MORALES MICHELOT
Jefe de la Unidad de Abastecimiento
Firma del Responsable de Logística

3.- Disponibilidad Presupuestal

FF/Rb	Meta / MNEMO	Cadena Funcional	Centro de Costo	Clasificador Gasto	Valor Ref. S/
2024					
4-13	0039	22.048.0110.0137.3000742.5005296	01.900.03.86 PE501083020-2023-PROCIENCIA	2.3. 2 7.14 98	3,900.00
Sub Total					3,900.00
Total					3,900.00

Resumen Presupuestal por Producto / Proyecto

FF/Rb	Producto / Proyecto	Valor Ref. S/
4-13	3000742 FACILIDADES Y DESARROLLO DE LA INVESTIGACION, INNOVACION Y TRANSFERENCIA TECNOLÓGICA	3,900.00
Total		3,900.00

Visto el expediente de: ADJUDICACION SIN PROCEDIMIENTO

cuyo contenido se detalla en los numerales 2 y 3 del presente documento y al amparo de lo dispuesto en el Artículo 19° del Reglamento de la Ley de Contrataciones del Estado y al Artículo 41° del Decreto Legislativo N°1440, Decreto Legislativo del Sistema Nacional de Presupuesto Público, se aprueba la presente certificación para que se continúe con el trámite respectivo.

UNIVERSIDAD NACIONAL AGRARIA
LA MOLINA

Fecha


Econ. Florencia Rosales
Jefe de la Unidad de Presupuesto

PEDIDO DE SERVICIO N°

003764

UNIDAD EJECUTORA : 001 UNIVERSIDAD NACIONAL AGRARIA LA MOLINA
NRO. IDENTIFICACIÓN : 000096



Tipo Uso : Consumo

Dirección Solicitante : PE501083020-2023-PROCIENCIA
Entregar a Sr(a) : CONDEZO HOYOS LUIS ALBERTO
Fecha : 12/11/2024
Actividad Operativa : C0588 INULINAS MULTIFENÓLICAS COMO PREBIÓTICOS PERSONALIZADOS MODULADORES DE LA
Motivo : SERVICIO DE UNA CO-INVESTIGADORA PARA APOYAR EL
DESARROLLO DEL PROYECTO DE INVESTIGACIÓN DEL
CONTRATO N° PE501083020 - 2023 - PROCIENCIA. PAGOS
SEGUN TDR.
U.OP. 01.900.03.86

FF/Rb	META / MNEMONICO	Función	División Func.	Grupo Func.	Programa	Prod/Pry	Act/Ai/Obr
4-13	0039	22	048	0110	0137	3000742	5005296

Código	Descripción / Términos de Referencia	Clasificador	Valor S/.	Unidad Medida
071100383423	SERVICIO DE ASISTENCIA EN TEMAS DE INVESTIGACION	2.3. 2 7.14 98	3,900.00	SERVICIO
	DESCRIPCION	SERVICIO DE UNA CO-INVESTIGADORA PARA APOYAR EL DESARROLLO DEL PROYECTO DE INVESTIGACIÓN DEL CONTRATO N° PE501083020 - 2023 - PROCIENCIA. PAGOS SEGUN TDR. U.OP. 01.900.03.86		
	TRANSFERENCIA N°	2023-1736-0078		
	TIPO DE RECURSO	TR-18		
	OBSERVACION	COORDINAR CON CHAMPI CHAVEZ, LIZBETH. CEL 994691859 EMAIL:LIZBETHCHAMPI@LAMOLINA.EDU.PE		

FINANCIADO POR
CONTRATO N° PE501083020-2023 PROCIENCIA

Dr. Condezo Hoyos, Luis Alberto
Responsable Técnico

Firma del Solicitante

EDWIN MELLISHO
Director
Firma Autorizada

11975



TÉRMINOS DE REFERENCIA – PARA LA CONTRATACIÓN DE SERVICIOS PERSONA NATURAL

UNIDAD OPERATIVA:	01.900.03.86– Contrato N° PE501083020-2023-PROCIENCIA
FINALIDAD PÚBLICA:	Contar con el servicio de una CO-INVESTIGADORA, para apoyar el desarrollo del Proyecto de Investigación CONTRATO N° PE501083020-2023-PROCIENCIA.

1. DENOMINACIÓN DE LA CONTRATACIÓN

Contratación del servicio de una CO-INVESTIGADORA, para el Proyecto de Investigación que se desarrolla dentro del CONTRATO N° PE501083020-2023-PROCIENCIA que es gestionado por la Dirección de Gestión de Investigación a través de la Unidad de Administración de Proyectos de Investigación.

2. OBJETIVOS

Contar con el servicio de una CO-INVESTIGADORA, para apoyar el desarrollo del Proyecto de Investigación del CONTRATO N° PE501083020-2023-PROCIENCIA.

3. DESCRIPCIÓN DEL SERVICIO

La ejecución del servicio se realizará de la siguiente manera:

ENTREGABLE 1

- Elaboración del protocolo para la identificación y cuantificación de compuestos fenólicos de camu camu, carambola y sauco
-

ENTREGABLE 2

- Análisis de datos de compuestos fenólicos
- Revisión de artículo científico 1

ENTREGABLE 3

- Análisis de datos de actividad prebiótica
- Revisión de artículo científico 2

4. PLAZO DE EJECUCION

El plazo de Servicio es de 10 días calendarios como máximo:

INFORMES	ENTREGABLES	PLAZO MÁXIMO DE ENTREGA
Único Informe	Entregable 1, 2 y 3	Hasta 10 días calendarios, a partir del día siguiente de la NOTIFICACIÓN de la Orden de Servicio

5. MONTO Y FORMA DE PAGO

El monto total del servicio es de S/ 3,900.00

El pago se efectuará en una (01) armada de la siguiente forma:

N°	ARMADA	CONDICIÓN DE PAGO	MONTO A PAGAR S/
1	Único Pago	Conformidad del Primer, Segundo y Tercer entregable por parte del Responsable técnico.	S/ 3,900.00
TOTAL S/			S/ 3,900.00

6. COMISION DE SERVICIO

Al presente locador se le podrá asignar viáticos por concepto de comisión de servicios para realizar actividades según el plan operativo del proyecto de investigación, el cual será sustentado de acuerdo a la directiva interna de la UNALM.

FINANCIADO POR
CONTRATO N° PE501083020-2023-PROCIENCIA

Dr. Condezo Hoyos, Luis Alberto
Responsable Técnico

7. PERFIL DEL PROVEEDOR

CAPACIDAD TÉCNICA Y PROFESIONAL:

- Doctor en ciencias alimentarias y/o afines.
- Publicaciones en revistas, 02 mínimo.

EXPERIENCIA:

- Experiencia relacionada en el tema de investigación

8. CONFIDENCIALIDAD

El proveedor no podrá divulgar o proporcionar información o documentación alguna referente a los servicios de locación materia del presente servicio, salvo autorización expresa de LA UNALM.

9. LUGAR DE EJECUCIÓN DEL SERVICIO

Por las características del servicio que prestará el proveedor, éste se llevará a cabo en la ciudad de Lima, debiendo realizar las coordinaciones con el Responsable Técnico del proyecto de investigación.

10. CONFORMIDAD DE SERVICIO

La conformidad de la prestación será dada expresamente por el Responsable Técnico del proyecto.

11. PENALIDADES

Penalidad por mora en la ejecución de la prestación: En caso de retraso injustificado del contratista en la ejecución de las prestaciones objeto del contrato, la Entidad le aplica automáticamente una penalidad por mora por cada día de atraso, de acuerdo a la siguiente formula:

Penalidad diaria: $0.10 \times \text{monto}$

$F \times \text{plazo en días}$

Donde F tiene los siguientes valores:

- Para plazos menores o iguales a sesenta (60) días, para bienes, servicios en general, consultorías y ejecución de obras: $F = 0.40$
- Para plazos mayores a sesenta (60) días:
 - Para bienes, servicio y consultorías: $F = 0.25$
 - Para obras: $F = 0.15$

Tanto el monto como el plazo se refieren, según corresponda, a la ejecución total del servicio o a la obligación parcial, de ser el caso, que fuera materia de retraso.

Se considera justificado el retraso, cuando el contratista acredite, de modo objetivamente sustentado, que el mayor tiempo transcurrido no le resulta imputable. En calificación del retraso como justificado no da lugar al pago de gastos generales de ningún tipo.

FINANCIADO POR
CONTRATO N° PE501083020-2023 PROCIENCIA

.....
Dr. Condezo Hoyos, Luis Alberto
Responsable Técnico

"Año del Bicentenario, de la consolidación de nuestra Independencia, y de la conmemoración de las heroicas batallas de Junín y Ayacucho"

PROPUESTA ECONOMICA

La Molina, 14 de Diciembre del 2024

A : UNIVERSIDAD NACIONAL AGRARIA LA MOLINA
UNIDAD DE ABASTECIMIENTO

ASUNTO : CONTRATACIÓN DE UNA CO-INVESTIGADORA EN EL PROYECTO DE INVESTIGACION.

Mediante la presente me dirijo a usted para saludarlo y a la vez hago llegar mi propuesta económica de acuerdo con los Términos de Referencia para la Contratación de una Co-investigadora en el proyecto "INULINAS MULTIFENÓLICAS COMO PREBIÓTICOS PERSONALIZADOS MODULADORES DE LA COMPOSICIÓN Y LA ACTIVIDAD DE LA MICROBIOTA INTESTINAL EN OBESIDAD OBTENIDAS MEDIANTE LA TECNOLOGÍA VERDE DE ULTRASONIDOS MULTIFRECUENCIA INTERMEDIA A PARTIR DE COMPUESTOS FENÓLICOS PUROS Y EXTRACTOS FENÓLICOS DE RESIDUOS DE FRUTAS TROPICALES Y ANDINAS", en el marco del Contrato N° PE501083020-2023-PROCIENCIA.

1. PROPUESTA ECONOMICA:

Por el servicio propuesto, mi cotización es de TRES MIL NOVECIENTOS CON 00/100 SOLES (S/. 3,900.00) por la totalidad del servicio, incluido todos los impuestos a Ley. Siendo pagado, según los términos de referencia del servicio.

2. PLAZO DE EJECUCION:

Según los términos de referencia del servicio.

3. FORMA DE PAGO:

Según los términos de referencia del servicio.

4. DATOS DEL PROVEEDOR:

NOMBRE : BAORU YANG YANG
PASAPORTE : FP4799795
DOMICILIO LEGAL : Vyyhtikatu 19, 20660, Kaarina - Finlandia
TELEFONO : +358 29 450 2917
CORREO : bayang@utu.fi

Atentamente,



BAORU YANG YANG
PASAPORTE: FP4799795

Baoru Yang

<https://orcid.org/0000-0001-5561-514X>

Country

Finland

Other IDs

Scopus Author ID: 7404472022 ([http://www.scopus.com/inward/authorDetails.url?](http://www.scopus.com/inward/authorDetails.url?authorID=7404472022&partnerID=MN8TOARS)

[authorID=7404472022&partnerID=MN8TOARS](http://www.scopus.com/inward/authorDetails.url?authorID=7404472022&partnerID=MN8TOARS))

SciProfiles: 369548 (<https://sciprofiles.com/profile/369548>)

Email

baoru.yang@utu.fi

Employment (7)

University of Turku: Turku, FI

2013-01-01 to present | Professor (Food Chemistry and Food Development)

Employment

Source:Baoru Yang

University of Turku: Turku, FI

2013-01-01 to 2015-05-31 | Professor, Food Development(Department of Biochemistry and Food Chemistry) Employment

Source:Baoru Yang

University of Turku: Turku, FI

2009-06-01 to 2012-12-31 | Senior Lecturer (Department of Biochemistry and Food Chemistry) Employment

Source:Baoru Yang

Aromtech Ltd: Tornio, FI

2002-08-01 to 2009-05-31 | Director (Research and Development)

Employment

Source:Baoru Yang

University of Turku: Turku, FI

1999-01-01 to 2002-02-07 | Researcher, doctoral candidate(Department of Biochemistry and Food Chemistry) Employment

Source:Baoru Yang

Shanxi Aixin Biotechnological Development Center :

Taiyuan , Shanxi Province , CN

1993-01-01 to 1996-03-31 | Director (Research and Development)

Employment

Source:Baoru Yang

Shanxi Academy of Agricultural Sciences: Taiyuan,

<https://orcid.org/0000-0001-5561-514X/print>

Analytical Chemistry

2024-08-13 | journal-article

DOI: 10.1021/acs.analchem.4c02513

Source:Crossref

Reduced seed viability in exchange for transgenerational plant protection in an endophyte-symbiotic grass: does the defensive mutualism concept pass the fitness test?

Annals of Botany

2024-08-12 | journal-article

DOI: 10.1093/aob/mcae133

Source:Crossref

Effect of feed supplementation with docosahexaenoic acid in regio- and enantiopure triacylglycerols on gut metabolome and microbiota in rats

Food Bioscience

2024-06 | journal-article

DOI: 10.1016/j.fbio.2024.103875

Source:Crossref

Flavonoid diversity in bitter and debittered seeds of Andean lupin (*Lupinus mutabilis* Sweet)

Food Chemistry

2024-06 | journal-article

DOI: 10.1016/j.foodchem.2024.138411

Source:Crossref

Mildly preheating induced conformational changes of soy protein isolates contributed to the binding interaction with blueberry anthocyanins for stabilization FOOD HYDROCOLLOIDS

2024-05-16 | journal-article

Source:Baoru Yang

Advanced Tandem Mass Spectrometric Analysis of

Complex Mixtures of Triacylglycerol Regioisomers: A Case Study of Bovine Milk Fat

Journal of Agricultural and Food Chemistry

2024-04-17 | journal-article DOI:

10.1021/acs.jafc.3c08536

Source:Crossref

Growth conditions trigger genotype-specific metabolic responses that affect the nutritional quality of kale cultivars

Journal of Experimental Botany

2024-04-17 | journal-article DOI:

10.1093/jxb/erae169

Source:Crossref

Chemoenzymatic Synthesis of ABC-Type Enantiostructured Triacylglycerols by the Use of the p- Methoxybenzyl Protective Group

Root vegetable side streams as sources of functional ingredients for food, nutraceutical and pharmaceutical applications: The current status and future prospects *Trends in Food Science & Technology*

2023-07 | journal-article

DOI: 10.1016/j.tifs.2023.05.006

Source:Crossref

Hepatoprotective effect of cyanidin-3-O-glucoside-lauric acid ester against H2O2-induced oxidative damage in LO2 cells

2023-06-25 | journal-article

OTHER-ID: 279a61ca-0328-4a4a-bbd8-6c59d70ae2c7

DOI: 10.1016/j.jff.2023.105642

WOSUID: 001023137000001

Source:University of Turku

Composition of Sugars, Organic Acids, Phenolic Compounds, and Volatile Organic Compounds in Lingonberries (*Vaccinium vitis-idaea* L.) at Five Ripening Stages

Foods

2023-05-26 | journal-article DOI:

10.3390/foods12112154

Source:Crossref

Combined Use of *Schizosaccharomyces pombe* and a *Lachancea thermotolerans* Strain with a High Malic Acid Consumption Ability for Wine Production

Fermentation

2023-02-11 | journal-article

DOI: 10.3390/fermentation9020165

Source:Crossref

Corrigendum to 'Bioavailability of docosahexaenoic acid 22:6(n-3) from enantiopure triacylglycerols and their regioisomeric counterpart in rats' [Food Chem. 283 (2019) 381-389]

2023-02-03 | other

OTHER-ID: 2ce41b4b-4ff3-410b-b771-b9e787c1505b

DOI: 10.1016/j.foodchem.2023.135430

WOSUID: 000935607400001

Source:University of Turku

Docosahexaenoic acid in regio- and enantiopure triacylglycerols: Oxidative stability and influence of chiral antioxidant

Food Chemistry

2023-02 | journal-article

DOI: 10.1016/j.foodchem.2022.134271

Source:Crossref

Phenolic compounds in Nordic berry species and their application as potential natural food preservatives

Critical Reviews in Food Science and Nutrition

Source:Crossref

A novel UHPLC-ESI-MS/MS method and automatic calculation software for regiospecific analysis of triacylglycerols in natural fats and oils

Analytica Chimica Acta

2022-06 | journal-article

DOI: 10.1016/j.aca.2022.339887

Source:Crossref

Similarity Index for the Fat Fraction between Breast Milk and Infant Formulas

Journal of Agricultural and Food Chemistry

2022-05-25 | journal-article DOI:

10.1021/acs.jafc.1c08029

Source:Crossref

Chemical Composition of Juices Made from Cultivars and Breeding Selections of European Pear (*Pyrus communis* L.)

Journal of Agricultural and Food Chemistry

2022-04-27 | journal-article DOI:

10.1021/acs.jafc.2c00071

Source:Crossref

Potential of brewers' spent grain in yogurt fermentation and evaluation of its impact in rheological behaviour, consistency, microstructural properties and acidity profile during the refrigerated storage

Food Hydrocolloids

2022-04 | journal-article

DOI: 10.1016/j.foodhyd.2021.107412

Source:Crossref

Supercritical CO₂ Extraction of Triterpenoids from Chaga Sterile Conk of *Inonotus obliquus* Molecules

2022-03-14 | journal-article

DOI: 10.3390/molecules27061880

Source:Crossref

Use of Non-Saccharomyces Yeasts in Berry Wine Production: Inspiration from Their Applications in Winemaking

Journal of Agricultural and Food Chemistry

2022-01-26 | journal-article DOI:

10.1021/acs.jafc.1c07302

Source:Crossref

Quality of Protein Isolates and Hydrolysates from Baltic Herring (*Clupea harengus membras*) and Roach (*Rutilus rutilus*) Produced by pH-Shift Processes and Enzymatic Hydrolysis

Foods

Enzyme-Assisted Extraction of Fish Oil from Whole Fish and by-Products of Baltic Herring (*Clupea harengus membras*)

Foods

2021-08-05 | journal-article DOI:

10.3390/foods10081811

Source: Crossref

Influence of genetic background, growth latitude and bagging treatment on phenolic compounds in fruits of commercial cultivars and wild types of apples (*Malus* sp.)

European Food Research and Technology

2021-05-12 | journal-article

DOI: 10.1007/s00217-021-03695-0

Source: Crossref

¹H NMR Metabolomics and Full-Length RNA-Seq Reveal Effects of Acylated and Nonacylated Anthocyanins on Hepatic Metabolites and Gene Expression in Zucker Diabetic Fatty Rats

Journal of Agricultural and Food Chemistry

2021-04-21 | journal-article DOI:

10.1021/acs.jafc.1c00130

Source: Crossref

Phenolic metabolites in the urine and plasma of healthy men after acute intake of purple potato extract rich in methoxysubstituted monoacylated anthocyanins.

Molecular nutrition & food research

2021-03-09 | journal-article

PMID: 33687145

DOI: 10.1002/mnfr.202000898

Source: Baoru Yang

Impact of malolactic fermentation with *Lactobacillus plantarum* on volatile compounds of sea buckthorn juice

European Food Research and Technology

2021-03-08 | journal-article

DOI: 10.1007/s00217-020-03660-3

Source: Crossref

Strategy for stereospecific characterization of natural triacylglycerols using multidimensional chromatography and mass spectrometry.

Journal of chromatography. A

2021-02-12 | journal-article

PMID: 33706165

DOI: 10.1016/j.chroma.2021.461992

Source: Baoru Yang

Green technologies for production of oils rich in n-3 polyunsaturated fatty acids from aquatic sources.

Effect of oat β -glucan of different molecular weights on fecal bile acids, urine metabolites and pressure in the digestive tract - A human cross over trial.*Food chemistry*

2020-10-08 | journal-article

PMID: 33077284

DOI: 10.1016/j.foodchem.2020.128219

Source:Baoru Yang**Phenolic Compound Profiles in Alcoholic Black Currant Beverages Produced by Fermentation with *Saccharomyces* and Non-*Saccharomyces* Yeasts***Journal of Agricultural and Food Chemistry*

2020-09-16 | journal-article DOI:

10.1021/acs.jafc.0c03354

Source:Crossref**Influence of enzymatic treatment on the chemical composition of lingonberry (*Vaccinium vitis-idaea*) juice.***Food chemistry*

2020-09-10 | journal-article

PMID: 33152863

DOI: 10.1016/j.foodchem.2020.128052

Source:Baoru Yang**Sensory Characteristics Contributing to Pleasantness of Oat Product Concepts by Finnish and Chinese Consumers.***Foods (Basel, Switzerland)*

2020-09-04 | journal-article

PMID: 32899688

PMC: PMC7556016

DOI: 10.3390/foods9091234

Source:Baoru Yang**Diet, Perceived Intestinal Well-Being and Composition of Fecal Microbiota and Short Chain Fatty Acids in Oat-Using Subjects with Celiac Disease or Gluten Sensitivity.***Nutrients*

2020-08-25 | journal-article

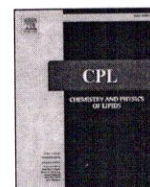
PMID: 32854216

PMC: PMC7551214

DOI: 10.3390/nu12092570

Source:Baoru Yang**Effects of Anthocyanin Extracts from Bilberry (*Vaccinium myrtillus* L.) and Purple Potato (*Solanum tuberosum* L. var. 'Synkeä Sakari') on the Plasma Metabolomic Profile of Zucker Diabetic Fatty Rats.***Journal of agricultural and food chemistry*

2020-08-20 | journal-article



Effect of phosphatidylcholine regioisomerism on lateral segregation of milk sphingomyelin in bilayer membranes

Md Abdullah Al Sazzad^a, Max Lönnfors^b, Baoru Yang^{a,*}

^a Food Sciences, Department of Life Technologies, University of Turku, FI-20500, Turku, Finland

^b Cell Biology, Faculty of Science and Engineering, Åbo Akademi University, Turku, Finland

ARTICLE INFO

Keywords:

Fluorescence
Lipid phase separation
Membrane bilayers
Phospholipid
Regioisomers
Trans-parinaric acid

ABSTRACT

Milk fat globule membrane (MFGM) promotes the lateral phase separation of milk lipids and stabilizes the fat globules in milk. The composition and structures of lipids have a significant impact on physicochemical properties of MFGM, which in turn influences the digestion and absorption of milk lipids. Phospholipids (PL), sphingolipids, and cholesterol are the major lipid constituents of MFGM. While the effects of the head-group and structure of the fatty acids (FAs) on membrane properties are commonly studied, little is known on the impact of PL regioisomerism. The present study investigated the impact of phosphatidylcholine (PC) regioisomerism on lateral segregation of milk-sphingomyelin (milk-SM) as well as the influence on the interaction of milk-SM with ceramide and cholesterol in simulated membrane systems. The regioisomer pairs of four molecular species PC 16:0/18:1n-9, PC 16:0/18:2n-6, PC 16:0/18:3n-3, and PC 16:0/20:4n-6 were included in this study. The lateral segregation was determined using lifetime analysis of *trans*-parinaric acid (*tPA*) fluorescence. Thermostability of the domains was detected using steady-state anisotropy of *tPA*. Our results demonstrated a clear impact of PC regioisomerism on membrane properties. PC regioisomers having the unsaturated FAs at the *sn*-2 position enhanced the lateral segregation of milk-SM with and without the presence of ceramide and cholesterol compared to the regioisomers having 16:0 at the *sn*-2 position. Furthermore, the characteristics i. e. the acyl chain length and degree of unsaturation of *sn*-2 FA of the PCs had a major impact on the milk-SM gel phase and the intermolecular forces between milk-SM and ceramide/cholesterol. This work is the first investigation showing the effect of PL regioisomerism on milk-SM domains, which might have significant influence on functional properties of MFGM.

1. Introduction

Mammalian milk is one of the most ideal and complete natural food because of its dynamic role as a source of essential nutrients and bioactive compounds (Park, 2009; Gaucheron, 2011). In human milk, fats are secreted as lipid droplets known as milk fat globules (MFG), which serve as vehicles for triacylglycerols (TAGs) and fat-soluble bioactive molecules essential for the growth and development of infants (Zheng et al., 2019). These specialized colloidal assemblies are surrounded by a biological membrane called the milk fat globule membrane (MFGM). MFGM and its various components have a significant impact on the development of the brains of the infants, immune system, and intestines, as well as reducing the likelihood of infection in infants (Gila-Diaz et al., 2019). The complex structure of MFGM, which constitutes around 2–6 % of the entire fat globule, is composed of several

bioactive molecules, including polar lipids, proteins, glycoproteins, cholesterol, enzymes, and other minor components (Dewettinck et al., 2008). In spite of their high importance for infants, the structure-functional role of lipids on the physicochemical properties of milk fat globule membranes is still a poorly understood aspect of milk.

The MFGM is a trilayer membrane that stabilizes the globules as an emulsion and promotes lateral phase separation of milk lipids. The composition and structure of lipids significantly influence the physical structure, phase behavior, and overall physicochemical properties of MFGM. This, in turn, affects the digestion and absorption of milk lipids, as well as the maintenance of the nutritional and physiological functions of milk (Alshehab et al., 2019; Bourlieu et al., 2020; Dong et al., 2021; Lin et al., 2021). The major lipid constituents of MFGM include various phospholipids (PLs), sphingolipids, and cholesterol. Phospholipids contain two fatty acids (FAs) linked to the *sn*-1 and *sn*-2 positions of their

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β-Lactoglobulin Separation from Whey Protein: A Comprehensive Review of Isolation and Purification Techniques and Future Perspectives

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ABSTRACT

Cow milk, although rich in essential nutrients, is a well-known allergic food that can cause allergic reactions in infants and young children. β-Lactoglobulin accounts for 10% of the total protein in milk and 50% of the whey protein, which has high nutritional value and excellent functional properties but is also the main allergen leading to milk protein allergy. Exploring the mechanism of milk allergy and selecting suitable separation and purification methods to obtain high-purity β-Lactoglobulin is the premise of research on reducing allergenicity. In this review, the research progress in membrane technology, gel filtration chromatography, ion exchange chromatography, affinity chromatography, precipitation and aqueous 2-phase system separation for the separation and purification of milk β-Lactoglobulin is reviewed in detail to promote the further development of milk β-Lactoglobulin separation and purification methods and provide a new method for the development of hypoallergenic dairy products in the future. Among these methods, ion exchange chromatography and gel chromatography are widely used, precipitation is generally used as a crude purification step, and high-performance liquid chromatography and membrane technology are used for further purification to improve the purity of allergens.

Keywords: milk allergy, allergy mechanism, β-lactoglobulin, separation and purification techniques, hypoallergenic dairy

INTRODUCTION

Cow milk (CM) contains protein, fat, carbohydrates, vitamins, minerals and probiotics, making it an excellent

source of nutrients. It is easy to digest and absorb and plays a crucial role in human nutrition and health. However, CM is also one of the 8 major common food groups that cause food allergies. Since CM is a high-quality protein source, when breast-feeding is not possible, milk formula becomes the first choice for supplementing infants and young children with nutrients. As a result, milk becomes one of the first allergens to which newborns are exposed, and milk allergies are extremely common in infants and young children because of the immature development of the gastrointestinal tract (Pessato et al., 2016). Several studies have indicated that approximately 8% of children are allergic to food, and the incidence rate is increasing (Sicherer and Sampson, 2018).

Cow milk allergy (CMA) is usually a type of immune disease caused by milk protein; its pathogenesis is relatively complex, and the most common is an IgE-mediated type I hypersensitivity reaction (Keith, 2020). This type of reaction is also known as a rapid hypersensitivity reaction; it begins within an hour after the ingestion of allergens; is the most serious type of food allergy; often involves multiple systems of the body; leads to complex clinical symptoms, such as acute urticaria, eczema, allergic rhinitis or asthma; and, in severe cases, can lead to anaphylactic shock symptoms, even those that are life-threatening (Venter et al., 2018). The pathogenesis includes 2 stages. The first stage is the sensitization stage, in which the immune system abnormally programs and stimulates B lymphocytes to produce IgE antibodies after exposure to milk allergens. The second stage is the allergy stage, in which exposure to the same milk allergen again induces IgE binding to epitopes on the milk allergen and promotes the release of bioactive mediators, leading to severe allergic symptoms (Crittenden and Bennett, 2005). Currently, with the increasing diversity of food materials, milk is frequently used as a component or processing aid in the food industry and is widely added to various foods. Therefore, milk protein components are inevitably present during food processing, transporta-

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The list of standard abbreviations for JDS is available at adsa.org/jds-abbreviations-24. Nonstandard abbreviations are available in the Notes.

Enantiomeric Separation of Triacylglycerols Consisting of Three Different Fatty Acyls and Their Chiral Chromatographic Elution Behavior

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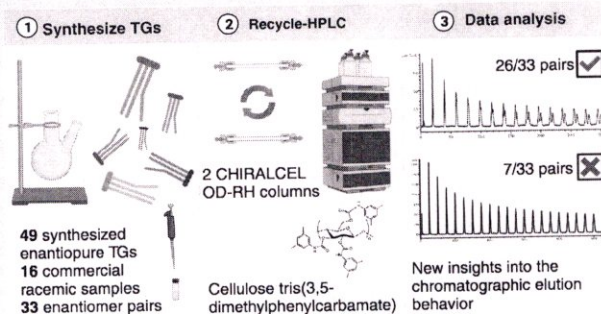
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ABSTRACT: Chromatographic separation of triacylglycerol (TG) enantiomers is a highly challenging task of analytical chemistry because of the similar physicochemical properties. The analysis of chiral TGs is crucial for improving the knowledge of lipid biochemistry and for understanding the nutritional properties of fats and oils. Thus, this study aimed to systematically investigate the chiral resolution of TGs consisting of three different fatty acyls (FAs). Thirty-three asymmetric TG enantiopairs, including 49 synthesized enantiopure TGs and racemic TGs, were analyzed with a recycling chiral HPLC system. Twenty-six enantiopairs were successfully separated. Overall, having both unsaturated and saturated FAs in the outer positions or a difference in carbon chain length between two saturated FAs at the outer positions favored the separation of enantiomers. The retention time at separation correlated negatively with the *sn*-3 carbon number of the early eluting enantiomer and positively with the carbon number difference between *sn*-1 and *sn*-3. When the samples were studied in separate groups based on unsaturation and regioisomers, both the acyl carbon number and the degree of unsaturation of FAs in all three positions influenced the separation and elution behavior of chiral TGs, indicating an active role of both intermolecular interactions and steric hindrances. This is the first systematic study of the chiral separation of TGs consisting of three different FAs using a large number of enantiopairs. The novel findings on the behavior of TG enantiomers in a chiral environment provide important guidance and reference for a stereospecific study of the chemistry and biochemistry of natural lipids.



INTRODUCTION

The chromatographic separation of triacylglycerol (TG) regioisomers and enantiomers has long remained a challenge despite the increasing interest in chiral chromatographic analysis of TGs.^{1–3} Already in 1958, Mattson and Lutton⁴ claimed that the natural distribution of fatty acyls (FAs) on the glycerol backbone is not random, a fact that is generally accepted. The TG molecule becomes chiral if different FAs are esterified to the outer positions (*sn*-1 and *sn*-3) of glycerol. Thus, TGs consisting of three different FAs (ABC-TGs) are chiral. Enantiomers differ in their three-dimensional configuration at the *sn*-2 stereogenic center⁵ and thus typically show different biochemical behaviors^{6,7} and physiological properties⁸ despite identical chemical composition. For example, the melting behavior of a mixture of TG enantiomers is different from pure enantiomers,⁹ and the crystallization behavior of asymmetric TGs affects the physical properties of fat-based products¹⁰.

Although most common TGs in edible oils and fats are composed of one (such as O_O_O, L_L_L) or two kinds of FAs (such as O_O_P, O_P_P, P_L_L, P_L_P, and O_O_S), ABC-TGs also often represent characteristic compounds of some oils,¹¹ including P_Po_L, Po_L_S, P_Po_O, and P_O_A in olive oil^{12,13} or P_O_M in palm oil.^{14,15} In some oils, the abundance of ABC-TGs is remarkable, for example, lard contains P_O_S, P_L_O, and P_L_S as major TG species, with ABC-TGs accounting for more than 37% of the total TGs.¹⁶ Further interesting examples are human milk containing O_P_L up to 20% and ABC-TGs up to 50%^{17,18} and cocoa butter containing 38% of P_O_S.¹⁹

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DECLARACIÓN JURADA

Yo, Luis Alberto Condezo Hoyos Responsable Técnico del proyecto "INULINAS MULTIFENÓLICAS COMO PREBIÓTICOS PERSONALIZADOS MODULADORES DE LA COMPOSICIÓN Y LA ACTIVIDAD DE LA MICROBIOTA INTESTINAL EN OBESIDAD OBTENIDAS MEDIANTE LA TECNOLOGÍA VERDE DE ULTRASONIDOS MULTIFRECUENCIA INTERMEDIA A PARTIR DE COMPUESTOS FENÓLICOS PUROS Y EXTRACTOS FENÓLICOS DE RESIDUOS DE FRUTAS TROPICALES Y ANDINAS" en el marco del Contrato N° PE501083020-2023-PROCIENCIA, con D.N.I. N° 09606892.

Declaro bajo juramento:

Que me comprometo a realizar las coordinaciones y seguimiento con la Dra. Baoru Yang Yang, proveedor extranjero, hasta la culminación del servicio, y para que así conste a los efectos oportunos, firmo la presente declaración.

La Molina, 14 de Diciembre del 2024

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Dr. Condezo Hoyos, Luis Alberto
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Luis Alberto Condezo Hoyos

DNI: 09606892



UNIVERSIDAD NACIONAL AGRARIA LA MOLINA

La Molina, 14 de Diciembre del 2024

Lic. Samuel Hector Morales Michelot

Jefe de la Unidad de Abastecimiento -UNALM

De mi consideración

Me dirijo a usted para saludarlo y a la vez solicitarle tenga a bien ordenar a quien corresponda gestionar el pago al proveedor extranjero vía transferencia bancaria, de acuerdo a los datos especificados en los documentos adjuntos, en el marco del Contrato N° PE501083020-2023-PROCIENCIA.

Agradeciendo la atención brindada, quedo de usted.

Atentamente.

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La Molina, 14 de Diciembre del 2024

CPC Lucila Prado García
Jefa de la Unidad de Tesorería

Presente:

Asunto: Solicito transferencia Bancaria

Me dirijo a usted para saludarla y a la vez solicitarle se sirva realizar la transferencia bancaria correspondiente al Pedido de Servicio N° 2024-3764 de la fuente de financiamiento 4.13 (Contrato N° PE501083020-2023-PROCIENCIA) por el monto de \$ 975.00 Dólares, con el tipo de cambio referencial de S/4.00 de acuerdo al siguiente detalle y en las cuales se incluyen los siguientes datos:

1. Datos de la empresa

Beneficiario: Baoru Yang Yang
Dirección: Vyyhtikatu 19, 20660, Kaarina - Finlandia
País del beneficiario: Finlandia
Estado del beneficiario: Researcher
Pasaporte N°: FP4799795

2. Datos del Banco

Banco: Nordea Bank Abp
País del banco: Finlandia
Estado del banco: Turku, Finlandia
Dirección del Banco: Satamaradankatu 5, FI-00020 NORDEA, Helsinki
Número de Cuenta : FI1912093500018297
BIC/SWIFT: NDEAFIHH
SWIFT (8 caracteres): NDEAFIHH
Importe \$: 975.00 Dólares
Importe S/ (Referencial): S/ 3,900.00

Agradeciendo la atención brindada, quedo de usted.

Atentamente.

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