Oficina: RECURSOS HUMANOS
D.R.H. 137/17.
ASUNTO: Carta de adscripción

MTRO. MANUEL QUINTERO QUINTERO
DIRECTOR GENERAL DEL TECNOLÓGICO
NACIONAL DE MÉXICO
PRESENTE

El que suscribe Jefe del Departamento de Recursos Humanos del Instituto Tecnológico de Durango, por este conducto hace **CONSTAR** que de acuerdo a la documentación existente en los archivos del Dpto de Recursos Humanos, el **C. Dr. Rubén Francisco González Laredo,** con RFC **GOLR560415JA5** y con clave PRESUPUESTAL E386300.0000001, con status **(10)**, y fecha de ingreso al SNIT el **16 DE OCT DE 1978** cuenta con **36 años** de adscripción a este Instituto.

Se extiende la presente a petición del interesado para los fines legales a que hubiera lugar, en la ciudad de Durango Dgo. a 13 de Marzo de 2017

ATENTAMENTE
"La Técnica al Servicio de la Patria"

ING. JUAN VANEGAS RENTERÍA
JEFE DEL DEPARTAMENTO DE
RECURSOS HUMANOS

CONACYT

Consejo Nacional de Ciencia y Tecnología

El Sistema Nacional de Investigadores otorga al

DR. RUBEN FRANCISCO GONZALEZ LAREDO

la distinción de

INVESTIGADOR NACIONAL NIVEL II

Durante el periodo del 1 de enero de 2017 al 31 de diciembre de 2021 en virtud de sus logros en la realización de investigación original, reconocida, apreciable y de manera consistente, así como en la formación de recursos humanos para la investigación.

Dra. Julia Tagüeña Parga
Secretaria Ejecutiva del SNI

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Documento firmado electrónicamente.

9 de septiembre de 2016

México, D. F., 21 de Julio de 2015
Oficio No. DSA/103.5/15/8557

Gonzalez Laredo Ruben Francisco
Instituto Tecnológico de Durango
Presente

Me complace informarle que el Comité Evaluador externo al PRODEP, de acuerdo con las Convocatorias 2015, resolvió positivamente su solicitud de Reconocimiento a Perfil Deseable.

En consecuencia, la SES acredita que usted tiene el perfil deseable para profesores de tiempo completo.

La acreditación tiene validez por 3 años a partir de esta fecha y servirá para los fines establecidos en la propia convocatoria, en el entendido de que dejar de laborar en esta institución conlleva la cancelación del reconocimiento.

Sin otro particular, aprovecho la oportunidad para enviarle un saludo.

Atentamente

M. en C. Guillermina Urbano Vidales

Directora

CÉDULA 7235077

SEP

México D.F. 9 de Noviembre del 2011

FIRMA DEL TITULAR

SECRETARÍA DE EDUCACIÓN PÚBLICA

DIRECCIÓN GENERAL DE PROFESIONES

CÉDULA 7235077

EN VIRTUD DE QUE

RUBÉN FRANCISCO
GONZÁLEZ
LAREDO

CURP: GOLR560415HDGNRB01

CUMPLIÓ CON LOS REQUISITOS EXIGIDOS POR LA LEY REGLAMENTARIA DEL ARTÍCULO 5o. CONSTITUCIONAL RELATIVO AL EJERCICIO DE LAS PROFESIONES EN EL DISTRITO FEDERAL Y SU REGLAMENTO SE LE EXPIDE

EN EDUCACIÓN DE TIPO SUPERIOR LA

CÉDULA

PERSONAL CON EFECTOS DE PATENTE PARA EJERCER PROFESIONALMENTE EN EL NIVEL DE

DOCTORADO EN

CIENCIAS EN ALIMENTOS E
INGENIERÍA BIOQUÍMICA

VÍCTOR EVERARDO BELTRÁN CORONA
DIRECTOR GENERAL DE PROFESIONES

México, D.F., 09 de Abril del 2015
Oficio Nº DSA/103.5/15/2779

Integrantes
José Alberto Gallegos Infante
Martha Roció Moreno Jiménez
Nuria Elizabeth Rocha Guzmán
Rubén Francisco González Laredo

Instituto Tecnológico de Durango
Presentes

Me complace informarles que el Comité Evaluador externo al Programa, de acuerdo con lo establecido en las Reglas de Operación 2014, ha dictaminado que el Cuerpo Académico "**Alimentos funcionales y nutracéuticos**" con clave **ITDUR-CA-5** se encuentra **CONSOLIDADO**.

En consecuencia, la Subsecretaria de Educación Superior (SES), a través de este Programa, acredita el registro de este Cuerpo Académico por **5** años a partir de esta fecha, por lo que será evaluado nuevamente en el año **2020** o cuando le sea requerido por la Dirección de Superación Académica con el propósito de valorar los avances en su desarrollo.

Sin otro particular, aprovecho la oportunidad para reiterarle la seguridad de mis más distinguidas consideraciones.

Atentamente

M. en C. Guillermina Urbano Vidales
Directora

"Este programa es de carácter público, no es patrocinado ni promovido por partido político alguno y sus recursos provienen de los impuestos que pagan todos los contribuyentes. Está prohibido el uso de este programa con fines políticos, electorales, de lucro y otros distintos a los establecidos. Quien haga uso indebido de los recursos de este programa deberá ser denunciado y sancionado con la ley aplicable y ante la autoridad competente".

Ciudad de México, 25 de Noviembre de 2016
Oficio No. DSA/103.5/16/15091

Ing. Mecán Pérez Jesús Astorga
Director
Instituto Tecnológico de Durango
Presente

Acerca del informe de resultados del tercer año presentado por la red temática de colaboración académica aprobada en el marco de la convocatoria 2011, le informo el resultado del proyecto en el que participa un cuerpo académico de su Institución:

I. Red con informe aprobado:

Nombre de la Red	Cuerpo Académico iniciador	Integrantes	Institución de los Integrantes
Nanotecnología y Omics para el Estudio de Nutracéuticos	ITDUR-CA-5 - Alimentos Funcionales y Nutracéuticos	Calidad, Seguridad y Bioactividad de Alimentos Vegetales (Responsable:ITDUR-CA-5)	Centro de Edafología y Biología Aplicada del Segura - CSIC
		ITCEL-CA-2 - Biotecnología Molecular	Instituto Tecnológico de Celaya
		Grupo de Investigación en Metabolismo, Microbiota Intestinal y Salud (Responsable:ITCEL-CA-2)	Universidad Europea de Madrid, España
		Reologia y Nanomateriales de Liberación Controlada (Responsable:ITDUR-CA-5)	Universidad Nacional Autónoma de México, México

II. Grupos de investigación externos al PRODEP que se encuentran bajo la responsabilidad del cuerpo académico de su Institución:

Nombre de la Red	Cuerpo Académico responsable de las actividades del grupo de investigación externo	Grupo de investigación externo	Institución
Nanotecnología y Omics para el Estudio de Nutracéuticos	ITDUR-CA-5 - Alimentos funcionales y nutracéuticos	Calidad, Seguridad y Bioactividad de Alimentos Vegetales	Centro de Edafología y Biología Aplicada del Segura - CSIC
		Reologia y Nanomateriales de Liberación Controlada	Universidad Nacional Autónoma de México, México

El dictamen y el acuse que debe firmar el responsable del cuerpo académico han sido enviados por correo electrónico al Representante Institucional con la solicitud de que el acuse se entregue en esta Dirección a más tardar el **24 de enero de 2017**.

Por último, le comento que para finalizar el compromiso adquirido por el cuerpo académico es necesario que se envíe a esta Dirección, a más tardar el 24 de febrero de 2017, el reporte financiero sobre el ejercicio de los recursos recibidos. Este reporte debe entregarse desglosado por cada uno de los tres años de apoyo y de acuerdo con los rubros y montos autorizados, tanto para el cuerpo académico de su Institución como para los grupos de investigación externos que hayan tenido a su cargo.

Sin otro particular, aprovecho la oportunidad para reiterarle la seguridad de mis más distinguidas consideraciones.

Atentamente

M. en C. María de Jesús Guillermina Urbano Vidales
Directora

C.c.p. **Mtro. Manuel Quintero Quintero**, Director General del Tecnológico Nacional de México. Presente.
C.c.p. **L.E. Rosario Otilia Salazar Herrera**, Representante Institucional ante el Programa. Para su conocimiento.

MJGUV/MEGR/PRR

RED NACIONAL DE INVESTIGACIÓN, INNOVACIÓN Y DESARROLLO TECNOLÓGICO EN

ALIMENTOS

FUNCIONALES Y NUTRACÉUTICOS

CONACYT

La Red de Nacional de Investigación, Innovación y Desarrollo Tecnológico en Alimentos Funcionales y Nutracéuticos "AlFaNutra"

del Consejo Nacional de Ciencia y Tecnología (CONACyT)

hace que constar que el (la):

Dr. Rubén Francisco González Laredo

Es miembro ACTIVO de la Red, como parte del Cuerpo Académico de Alimentos Funcionales y Nutracéuticos del Instituto Tecnológico de Durango, participando en las reuniones generales de trabajo durante el 2014.

Dr. Gustavo Adolfo González-Aguilar

Dr. Aarón Fernando González-Córdova

Coordinadores de la Red AlFaNutra

CIAD

ASOCIACIÓN MEXICANA DE CIENCIA DE ALIMENTOS

CERTIFICADO DE MEMBRESÍA

El presente documento acredita que:

Dr. Rubén F. González Laredo

forma parte de la`asociación en el período de octubre del 2016 a octubre del 2018 en calidad de

MIEMBRO ACTIVO

AMECA

Dr. J. Hugo Sergio García Galindo
(Presidente)

Dr. Nicolás Oscar Soto Cruz
(Secretario)

El **Gobierno del Estado de Durango** a través de la **Secretaría de Salud** otorga la presente

Constancia

A:

Villegas Novoa Cecilia, Rocha Guzmán Nuria Elizabeth, Moreno Jiménez Martha Rocío, Gallegos Infante José Alberto, González Laredo Rubén Francisco.

Por haber obtenido **PRIMER LUGAR** con el trabajo: "***EFECTO DE UN EXTRACTO DE SALVILLA (Buddleja scordioides K.) SOBRE LA EXPRESIÓN DIFERENCIAL DE MEDIADORES INFLAMATORIOS INDUCIDOS CON LIPOPOLISACÁRIDO EN CÉLULAS EPITELIALES DE HUMANO"***

en la categoría: *INVESTIGACIÓN EN BIOTECNOLOGÍA E INNOVACIÓN*

en el XV Concurso de Trabajos de Investigación en Salud

realizado en el marco I Jornada Nacional de Investigación en Salud Durango 2017

José Rosas Aispuro Torres
Gobernador del Estado de Durango

Dr. César Humberto Franco Mariscal
Secretario de Salud y Dir. Gral. de los Servicios de Salud

Victoria de Durango, Dgo. a Agosto de 2017

El **Gobierno del Estado de Durango** a través de la **Secretaría de Salud** otorga la presente

Constancia

A:

Reyna-Rojas, J.A., Moreno-Jimenez, M.R., Rocha-Guzmán, N.E., Gallegos-Infante, J.A., Gonzalez-Laredo, R.F., y Rojas-Contreras, J.A.

Por haber obtenido **SEGUNDO LUGAR** con el trabajo: "***POTENCIAL PREBIÓTICO DE FRIJOL (Phaseolus vulgaris L.) BAYO VICTORIA PROCESADO"***

en la categoría: *INVESTIGACIÓN EN BIOTECNOLOGÍA E INNOVACIÓN*

en el XV Concurso de Trabajos de Investigación en Salud

realizado en el marco I Jornada Nacional de Investigación en Salud Durango 2017

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Gobernador del Estado de Durango

Dr. César Humberto Franco Mariscal

Secretario de Salud y Dir. Gral. de los Servicios de Salud

Victoria de Durango, Dgo. a Agosto de 2017

El **Gobierno del Estado de Durango** a través de la **Secretaría de Salud** otorga la presente

Constancia

A:

Julio C Ramírez-España, Nuria E. Rocha-Guzmán, Rubén F. González-Laredo Alberto Gallegos-Infante. Claudia I. Gamboa-Gómez

Por haber obtenido **TERCER LUGAR** con el trabajo: "***Biodisponibilidad y actividad antioxidante de compuestos fenólicos de bebidas vegetales de hojas de encino fermentadas con hongo kombucha"***
en la categoría: *INVESTIGACIÓN EN BIOTECNOLOGÍA E INNOVACIÓN*
en el XV Concurso de Trabajos de Investigación en Salud
realizado en el marco I Jornada Nacional de Investigación en Salud Durango 2017

José Rosas Aispuro Torres
Gobernador del Estado de Durango

Dr. César Humberto Franco Mariscal
Secretario de Salud y Dir. Gral. de los Servicios de Salud

Victoria de Durango, Dgo. a Agosto de 2017

EL GOBIERNO ESTADO DE DURANGO

Y LA SECRETARÍA DE EDUCACIÓN DEL ESTADO

A TRAVÉS DEL

CONSEJO DE CIENCIA Y TECNOLOGÍA DEL ESTADO DE DURANGO

Otorgan el presente

RECONOCIMIENTO

A: Dra. Nuria Elizabeth Rocha Guzmán Dr. José Alberto Gallegos Infante
Dr. Rubén Francisco González Laredo Dra. Martha Rocío Moreno Jiménez
Dr. Luis Medina Torres

PREMIO ESTATAL DE CIENCIA, TECNOLOGÍA E INNOVACIÓN DURANGO 2015

EN EL ÁREA DE:

INGENIERÍAS, DESARROLLO INDUSTRIAL Y TECNOLÓGICO

CON EL TRABAJO DE INVESTIGACIÓN:

Desarrollo tecnológico para obtener nanopartículas bioactivas de poli-(DLLactida- Co-Glicolida) cargadas con lupeol de hojas de encino

Victoria de Durango, Dgo. Noviembre de 2015

ING. HECTOR E. VELA VALENZUELA
Secretario de Educación
del Estado de Durango

C.P. JORGE HERRERA CALDERA
Gobernador Constitucional del Estado de Durango

DR. ELISEO MEDINA ELIZONDO
Director General del Consejo de Ciencia
y Tecnología del Estado de Durango

EL GOBIERNO DEL ESTADO DE DURANGO Y LA SECRETARÍA DE EDUCACIÓN
A TRAVÉS DEL CONSEJO DE CIENCIA Y TECNOLOGÍA
DEL ESTADO DE DURANGO

DURANGO
GOBIERNO DEL ESTADO

Unidos crecemos en ciencia, tecnología e innovación

CONSEJO DE CIENCIA Y TECNOLOGÍA DEL ESTADO DE DURANGO
COCYTED 1996
CIENCIA Y TECNOLOGÍA

Otorgan el presente

RECONOCIMIENTO

A: *Dra. Martha Rosales Castro, Dra. Nuria Elizabeth Rocha Guzmán, Dr. Rubén Francisco González Laredo y Dr. José Alberto Gallegos Infante*

POR HABER SIDO MERECEDORES DEL PREMIO ESTATAL DE "CIENCIA, TECNOLOGÍA E INNOVACIÓN DURANGO 2012", EN EL ÁREA DE:

CIENCIAS EXACTAS E INGENIERÍA

COLABORANDO A LA VINCULACIÓN DE LA CIENCIA, TECNOLOGÍA E INNOVACIÓN EN PROYECTOS QUE HAN CONTRIBUIDO A ELEVAR EL DESARROLLO ACADÉMICO, CIENTÍFICO Y EMPRESARIAL EN NUESTRO ESTADO.

Victoria de Durango, Dgo. Octubre 2012

ING. HECTOR VELA VALENZUELA
Secretario de Educación
del Estado de Durango

C.P. JORGE HERRERA CALDERA
Gobernador Constitucional del Estado de Durango

DR. JOSÉ DIMAS LÓPEZ MARTÍNEZ
Director General del Consejo de Ciencia
y Tecnología del Estado de Durango

Oficio No. ANFEI SE -361-13
México, D.F. a 22 de abril de 2013

DR. RUBÉN FRANCISCO GONZÁLEZ LAREDO
ACADÉMICO DEL INSTITUTO TECNOLÓGICO
DE DURANGO

Me es grato a nombre de la ANFEI, expresarle nuestras más sinceras felicitaciones por haber sido seleccionado por el jurado calificador, como el merecedor del Reconocimiento al **Mérito Académico 2013, de la Región III**. Hemos leído su trayectoria, y nos ha parecido una decisión muy justa, sobre todo tratándose de un académico que ha dedicado su vida a la formación de ingenieros. Pero lo más importante no es eso, sino que esa actividad la ha llevado con verdadera excelencia, lo que lo distingue de muchos otros académicos.

Su labor académica es digna de ser imitada por sus colegas, por lo que de esta manera la ANFEI, como promotora de la calidad académica, busca **resaltar los valores** que se encuentran en cada uno de los institutos, escuelas y facultades que ofrecen programas de ingeniería.

En el marco de la XL Conferencia Nacional de Ingeniería **le rendiremos un homenaje** en la **ceremonia** que se llevará a cabo para ese efecto, por lo que nos veremos muy honrados de contar con su presencia. No omito manifestarle que usted **es uno de nuestros invitados de honor** en esta Conferencia, y le hemos pedido al Sr. Director de su Institución, le proporcione todas las facilidades posibles para que pueda asistir a este evento.

Para mayor información del evento, visite la página de la ANFEI **www.anfei.org.mx.**

Esperando poder felicitarle personalmente, aprovecho la oportunidad para manifestarle mi reconocimiento, admiración y respeto, así como la seguridad de todas mis atenciones.

A T E N T A M E N T E

ING. JUAN JOSÉ ECHEVARRÍA REYES
SECRETARIO EJECUTIVO

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Effect of different drying procedures on the bioactive polysaccharide acemannan from *Aloe vera* (*Aloe barbadensis* Miller)

Rafael Minjares-Fuentes[a], Víctor Manuel Rodríguez-González[b], Rubén Francisco González-Laredo[c], Valeria Eim[a], María Reyes González-Centeno[a], Antoni Femenia[a,*]

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ABSTRACT

The main effects of different drying procedures: spray-, industrial freeze-, refractance window- and radiant zone-drying, on acemannan, the main bioactive polysaccharide from *Aloe vera* gel, were investigated. All the drying procedures caused a considerable decrease in the acemannan yield (~40%). Degradation affected not only the backbone, as indicated by the important losses of (1 → 4)-linked mannose units, but also the side-chains formed by galactose. In addition, methylation analysis suggested the deacetylation of mannose units (>60%), which was confirmed by ^{1}H NMR analysis. Interestingly, all these changes were reflected in the functional properties which were severely affected. Thus, water retention capacity values from processed samples decreased ~50%, and a reduction greater than 80% was determined in swelling and fat adsorption capacity values. Therefore, these important modifications should be taken into consideration, since not only the functionality but also the physiological effects attributed to many *Aloe vera*-based products could also be affected.

1. Introduction

Acemannan, the major polysaccharide found in *Aloe vera* gel, is mainly composed of large amounts of partially acetylated mannose units (Man >60%), followed by glucose (Glc ~20%) and, to a minor extent, galactose (Gal <10%) (Choi & Chung, 2003; Chow, Williamson, Yates, & Goux, 2005; Femenia, Sánchez, Simal, & Rosselló, 1999; Talmadge et al., 2004). Structurally, the acemannan polysaccharide, with a molecular weight of around 40–50 kDa, could be represented by a single-chain of β-(1 → 4) mannose with β-(1 → 4) glucose inserted into the backbone; α-(1 → 6) galactose units may also be found as side-chains (Chokboribal et al., 2015; Chow et al., 2005; Femenia et al., 1999; Talmadge et al., 2004). The acetyl groups are the unique non-sugar functional groups present in acemannan and seem to play a key role not only in the physico-chemical properties but also in the biological activity of the *Aloe vera* (Campestrini, Silveira, Duarte, Koop, & Noseda, 2013; Chokboribal et al., 2015; Ni et al., 2004).

Acemannan is a storage polysaccharide located within the protoplast of the parenchymatous cells of the *Aloe vera* gel, and not a component of the cell walls (Femenia et al., 1999). Interestingly, this polymer has been reported as the main bioactive substance present in *Aloe vera* gel, being responsible for most of the beneficial properties attributed to *Aloe vera* (Hamman, 2008; McAnalley, 1993; Reynolds, 1985; Reynolds & Dweck, 1999; t'Hart, van den Berg, Kuis, van Dijk, & Labadie, 1989), such as the reduction in blood glucose, blood pressure and the improvement of lipid profile in diabetic patients, among many others (Choudhary, Kochhar, & Sangha, 2011; Pothuraju, Sharma, Onteru, Singh, & Hussain, 2016). These beneficial effects have been attributed to the high molecular weight fractions of acemannan which are degraded by the intestinal microbiota to form oligosaccharides that inhibit intestinal glucose absorption (Boban, Nambisan, & Sudhakaran, 2006; Jain, Gupta, & Jain, 2007; Yagi et al., 2001, 2009). Furthermore, several studies have demonstrated that the acetyl groups of acemannan are mainly responsible not only for the interaction of acemannan with other biomolecules but also for enabling the transport of other bioac-

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CHEMICAL ANALYSIS OF POLYPHENOLS WITH ANTIOXIDANT CAPACITY FROM *PINUS DURANGENSIS* BARK

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[4]Department of Wood Science and Engineering, Oregon State University, Corvallis, Oregon, USA

The most active phenolics in *Pinus durangensis* residual bark were identified and evaluated following a chromatographic fractionation. Bark powder was defatted with hexane, and a crude extract (CE) was obtained by extraction with aqueous acetone (67%). A liquid partition with ethyl acetate was performed to produce an organic extract (OE), which was subsequently purified by column chromatography (Toyopearl HW-40F, methanol), resulting in ten fractions (MF1 to MF10) and an oligomeric fraction eluted with acetone 67% (OLF). Subfraction MF6-1 was obtained by a second chromatographic purification of MF6. Extraction yields, total phenolics, flavonoids, and flavanols contents were determined in CE and OE. The antioxidant activity of bark extracts was measured by DPPH and ABTS assays at 100 μg/mL, expressed in percentage, median effective concentration (IC_{50}), and TEAC (mM). Also the low density lipoprotein inhibition was evaluated. Identification of major phenolics was carried out by HPLCESI–MS and HPLC–DAD instruments. Bioactive taxifolin (dihydroquercetin), dihydromyricetin, myricetin, quercetin, pinomyricetin (myricetin-methoxy), pinoquercetin (quercetin-methoxy), trimeric, and tetrameric procyanidins were detected and identified in *P. durangensis* bark extracts. Polyphenols found are similar to those contained in Pycnogenol and other *Pinus* species.

KEYWORDS. Antioxidant capacity, bark, flavonoids, *Pinus durangensis*

INTRODUCTION

The *Pinus* genus (Pinaceae), with over 100 commonly known species, is the widest extant genus of conifers and is distributed in the Northern Hemisphere.[1] This genus is cultivated in Mexico to produce timber, and at least 20 species are part of the forest resource in Durango, Mexico, where the main species are *P. durangensis, P. cooperi, P. arizónica, P. engelmannii, and P. teocote*, among others.[2] The wood is the main product in the forestry industry, while large amounts of bark are generated as a waste residue. However, the pine bark has been utilized for centuries as herbal remedies.[3] Indications of the therapeutic use of pine bark can be found from the 4th century B.C. when Hipocrates mentioned its use against inflammatory diseases.[4] Actually, bark is considered as a rich source of natural compounds, which have attracted attention from the nutrition, health, and medicine fields, due to its high concentration of polyphenols.

Bark compounds exhibit various physiological activities, including free radical scavenging,

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Alternative uses of sawmill industry waste

Usos alternativos de los desechos de la industria del aserrío

Jesús N. Fregoso-Madueño[1]; José R. Goche-Télles[2]; José G. Rutiaga-Quiñones[3]; Rubén F. González-Laredo[2,4*]; Melissa Bocanegra-Salazar[1]; Jorge A. Chávez-Simental[5]

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Abstract

In Mexico, approximately 8 million m^3 of wood is produced annually. Of this volume, 70 % goes to the sawmill industry, generating around 2.8 million m^3 of waste, mainly sawdust, woodchips and bark. The management of these wastes represents a problem today, as they are mainly used as a source of energy, negatively affecting the environment, generating dust in the air and contributing to the emission of carbon dioxide into the atmosphere. In addition, the waste is harmful to the health of sawmill workers and residents in nearby areas, by generating environmental problems such as fires and self-combustion. Consequently, it is necessary to find alternative uses for this waste. Most of this waste is rich in cellulose, hemicellulose, lignin and other low molecular weight substances, desirable characteristics in many industrial processes. The extractable substances could be used in these processes, thus reducing the environmental impact. This review provides sustainable alternatives for the development and use of forest industry resources, based on available information on the application and use of forest residues.

Keywords: Forest waste, sawdust, bark, *Pinus.*

Resumen

En México, la producción anual de madera es de aproximadamente 8 millones de m^3. De este volumen, 70 % se destina a la industria del aserrío, generando alrededor de 2.8 millones de m^3 de desechos, principalmente aserrín, virutas y cortezas. El manejo de estos residuos representa un problema en la actualidad, pues se emplean principalmente como fuente de energía, afectando negativamente el ambiente, generando polvo en el aire y contribuyendo a la emisión de dióxido de carbono a la atmósfera. Además, los desechos perjudican la salud de trabajadores y habitantes de las zonas cercanas a los aserraderos, al generar problemas ambientales como incendios y autocombustión. En consecuencia, es necesario encontrar alternativas de uso de los residuos. La mayoría de estos son ricos en celulosa, hemicelulosa, lignina y otras sustancias de bajo peso molecular, características deseables en muchos procesos industriales. Las sustancias extraíbles podrían emplearse en dichos procesos, disminuyendo así el impacto ambiental. Esta revisión proporciona alternativas sustentables para el desarrollo y aprovechamiento de los recursos de la industria forestal, con base en la información disponible sobre la aplicación y uso de los residuos forestales.

Palabras clave: Desechos forestales, aserrín, corteza, *Pinus.*

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In Silico Prediction of the Toxic Potential of Lupeol

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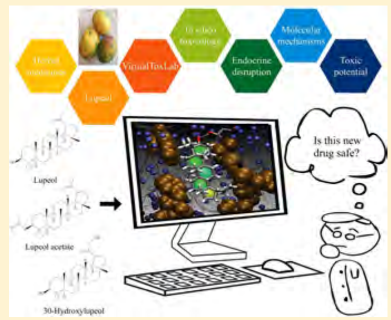
ABSTRACT: Lupeol is a natural triterpenoid found in many plant species such as mango. This compound is the principal active component of many traditional herbal medicines. In the past decade, a considerable number of publications dealt with lupeol and its analogues due to the interest in their pharmacological activities against cancer, inflammation, arthritis, diabetes, and heart disease. To identify further potential applications of lupeol and its analogues, it is necessary to investigate their mechanisms of action, particularly their interaction with off-target proteins that may trigger adverse effects or toxicity. In this study, we simulated and quantified the interaction of lupeol and 11 of its analogues toward a series of 16 proteins known or suspected to trigger adverse effects employing the *VirtualToxLab*. This software provides a thermodynamic estimate of the binding affinity, and the results were challenged by molecular-dynamics simulations, which allow probing the kinetic stability of the underlying protein−ligand complexes. Our results indicate that there is a moderate toxic potential for lupeol and some of its analogues, by targeting and binding to nuclear receptors involved in fertility, which could trigger undesired adverse effects.



■ INTRODUCTION

Lupeol and its analogues are triterpenes found in a diversity of vegetables and fruits. For instance, lupeol is found in mangoes, cabbage, green pepper, strawberry, olives, and grapes.[1,2] Interestingly, this group of compounds is the active component in many plants used in traditional medicine by native cultures in North America, Japan, China, Latin America, and Caribbean islands.[2−4] Importantly, it has been shown that lupeol and its analogues display therapeutic properties against cancer, inflammation, arthritis, diabetes, and heart disease. Therefore, these compounds have raised interest as drugs to treat such conditions.[5]

In some cases, it has been possible to determinate their action mechanism against these diseases. Lupeol is a multitarget agent that affects different protein receptors depending on the disease that is treated with this compound. In the case of inflammation, lupeol affects the molecular pathways of the nuclear factor kappa B(NF*κ*B), cFLIP, Fas, Kras, phosphatidylinositol-3-kinase PI3K/Akt, and Wnt/*β*-catenin in a variety of cells.[6] In cancer treatments, lupeol inhibits DNA topoisomerase II, protein kinases, and serine proteases, causing the death of cancer cells.[7,8] Lupeol has also been reported to inhibit growth in melanoma and leukemia cells and inhibit tumor promotion in mouse skin by modulating various signaling pathways.[9−11] The topical application of lupeol at 200 μg/animal has been reported to prevent DNA strand breaks in mice skin caused by 7,12-dimethylbenz[a]anthracene (DMBA).[12] Furthermore, in skin mouse models, lupeol has inhibited the genotoxicity effect of benzo[a]pyrene (B[a]P), which is a binding mutagen. Additionally, lupeol was able to significantly decrease B[a]P-induced clastogenicity by pretreating mice with lupeol [1 mg/animal] for 7 days prior to B[a]P administration.[13]

Many studies have focused on understanding the properties of lupeol and its analogues such as determination of phytochemical properties, synthesis and biological activity using mice, dogs, and cancer cell lines as test models to find promising applications to cure diseases. However, prior to their potential application in humans, it is necessary to establish if they might trigger undesired effects. Traditionally, initial bioassays are performed using mouse models, but these experiments are both laborious and expensive with the inconvenience that results may not simply be translated to humans.[14,15] Therefore, to better understand the toxicological effects of a new drug, it is necessary to develop new approaches to overcome these problems. Computational approaches for in silico toxicology determinations turn into an efficient alternative to predict drug−protein interactions without the aforementioned drawbacks.

One of these new tools is *VirtualToxLab* (cf. http://www.virtualtoxlab.org), which is an in silico concept for estimating the toxic potential: endocrine and metabolic disruption, aspects

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CHANGES IN PHYTOCHEMICAL AND ANTIOXIDANT POTENTIAL OF TEMPEH COMMON BEAN FLOUR FROM TWO SELECTED CULTIVARS INFLUENCED BY TEMPERATURE AND FERMENTATION TIME

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ABSTRACT

Processing option such as fungal fermentation (tempeh) improves legume nutraceutical properties. The aim of this work was to evaluate the physicochemical and antioxidant potential of common bean tempeh flour from two varieties: *Bayo victoria* (BV) and *Pinto durango* (PD) processed at two different temperature and fermentation times. Results showed differences between cultivars followed by changes in temperature and fermentation times, being more significant at 35C for 40 h. The phenolic content in both cultivars varied considerably after cooking, being higher in raw flour (0.4–3.0-fold for BV and 0.35–0.5-fold for PD). The highest phenolic content was for BV fermented at 35C and 40 h, whereas for PD was at 30C and 40 h. Antioxidant capacity was evaluated by 2,2-diphenyl-1-picrylhydrazyl, low-density lipoprotein oxidation and hydroxyl radical-scavenging assays. Results showed different antioxidant capacity for each test. The major differences in results were shown between cultivars than the processing variations of temperature and fermentation time.

PRACTICAL APPLICATIONS

Phaseolus vulgaris is one of the most important grain legumes for human consumption attributable to its nutritional properties, low cost and health promoter effects. However, the nutraceutical properties of this legume have changed due to process variables such as temperature and time of cooking. It has been demonstrated experimentally that fungal fermentation or tempeh production can be an efficient strategy to improve the phenolic content and antioxidant activity of common beans, becoming a favored alternative as an ingredient/supplement development for the prevention and control of degenerative diseases. However, little information is available on the effect of temperature, fermentation time and common bean cultivars in relation with their nutraceutical properties. The present investigation demonstrated that the major effects were between cultivars rather than processing variations of temperature and fermentation time. Therefore, considering cultivars and processing variables, common bean tempeh flour may be an efficient strategy to enhance the antioxidant activity of this seed.

INTRODUCTION

Common bean (*Phaseolus vulgaris* L.) is one of the most important grain legumes for human consumption. It comprises 50% of the grain legumes consumed worldwide. It is the primary source of dietary protein in developing countries (Mitchell *et al.* 2009).

Phaseolus vulgaris is grown in a variety of eco-agricultural regions and distributed in multiple forms, such as whole unprocessed seeds, as part of mixed, canned products, or as gluten-free wheat flour substitute (Câmara *et al.* 2013). Common beans have been studied due to their bioactive components, which include antioxidants, dietary fiber fractions, resistant starch and oligosaccharides present in the

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Structure preservation of Aloe vera (*barbadensis Miller*) mucilage in a spray drying process

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Aloe vera (*barbadensis Miller*) mucilage in powder form was obtained by spray-drying following by suspension in aqueous solution, to enable microstructure recovery. The rheological behavior of the reconstituted mucilage was evaluated as a function of mucilage concentration, temperature, pH and ionic-strength. Mucilage solutions exhibited shear-thinning non-Newtonian behavior. The viscosity was found dependent on ionic-strength. This dependence is more evident when divalent cations are used, although a strong rise in viscosity upon increasing pH is observed. Linear viscoelastic data show a predominant viscous behavior, but with a crossover point (storage module $G' =$ loss module G'') suggesting a change in molecular conformation to a random-coil arrangement of the mucilage microstructure. The spray-dried powders were compared with fresh mucilage, with regard to chemical composition and mechanical flow behavior. Results reveal a small structure modification during the spray-drying process, evidencing preservation of the mucilage microstructure when optimum spray-drying conditions are used, i.e., 1.5 L/h inlet flow, temperature of 150 °C and atomization rate of 27,500 rpm.

1. Introduction

Polysaccharides are used in the food industry for their ability to modify the functional properties of food systems (Medina-Torres, Brito-de La Fuente, Torrestiana-Sánchez, & Katthain, 2000). Since polysaccharides impart a functional property to a specific product, the economics and availability of polysaccharides are important in the final formulation (Whistler, 1993). A very popular plant in the Cactaceae family is Aloe vera (AV) (*barbadensis Miller*) which has been widely studied due to its healing properties. AV is a hetero-polysaccharide (it is formed by several polysaccharides) of high molecular weight.

Spray-drying (SD) is a process widely used to produce powders due to several advantages such as capacity to produce powders of a specific particle size and moisture content, continuous operation, short production times, cost effectiveness, and flexibility (Keshani, Daud, Nourozi, Namvar, & Ghasemi, 2015 and references therein). Examples of recent studies of SD food products are: Blackberry (Ferrari, Germer, & de Aguirre, 2012), coffee oil (Frascareli, Silva, Tonon, & Hubinger, 2012), Yoghurt (Sakin-Yilmazer, Koç, Balkir, & Kaymak-Ertekin, 2014), among others. However, the relative high temperatures used in the SD process can negatively affect the properties of the powders causing degradation and oxidation of the product. Thus, finding the best process conditions is of paramount importance to obtain powders with optimum properties. For example, it was found that the increase in inlet air-temperature

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Effect of different drying procedures on physicochemical properties and flow behavior of Aloe vera (*Aloe barbadensis* Miller) gel

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ABSTRACT

The main aim of this study was to evaluate the effect of different drying procedures, used at industrial scale, on physicochemical properties, such as water activity, solubility, hygroscopy and, also, on the flow behavior of Aloe vera (*Aloe barbadensis* Miller) gel. The drying methods applied were: spray-drying, industrial freeze-drying, refractance-window-drying and radiant-zone-drying. Further, the flow behavior of all dehydrated Aloe vera samples was investigated at different temperatures (10, 20, 30, 40, and 50 °C). In addition, fresh Aloe vera gel was lyophilized and used as a reference. All processed samples exhibited lower water activity (<0.4), higher solubility (>90%) and higher hygroscopy (>80%) than the reference sample. Moreover, a shear-thinning behavior, exhibited by the fresh Aloe vera gel, was modified to a Newtonian behavior in all the processed samples. Interestingly, the viscosity of all the processed samples exhibited a higher temperature dependence (E_a > 28 kJ/mol) than the reference sample (E_a = 21 kJ/mol). These important changes in the physico-chemical properties and, also, in the flow behavior of the dehydrated Aloe vera samples could be related to structural modifications observed for the acemannan polymer, the main bioactive polymer present in Aloe vera gel; and in particular, to the modification of its degree of acetylation.

1. Introduction

Aloe vera has enjoyed a long history of providing a myriad of health benefits, being one of the herbal remedies most frequently used throughout the world (Guo & Mei, 2016; Pothuraju, Sharma, Onteru, Singh, & Hussain, 2016). Currently, Aloe vera has become one of the most important raw materials in the food industry since it represents an emerging source of bioactive components. The potential use of Aloe vera gel in the food industry is mainly focused on the development of functional foods due to its beneficial properties in treating constipation, coughs, diabetes, headaches, arthritis and immune-system deficiencies (Eshun & He, 2004; Radha & Laxmipriya, 2015; Vogler & Ernst, 1999).

The Aloe vera gel contains more than 98 g moisture/100 g gel and the remaining portion is mainly composed of polysaccharides (more than 60 g polysaccharides/100 g gel solids). Other compounds such as phenolics, organic acids, enzymes, vitamins and minerals are also present in minor quantities (Femenia, Sánchez, Simal, & Rosselló, 1999). Acemannan, a partially acetylated polysaccharide found in the Aloe vera gel, is responsible for its biological activities (Choi & Chung, 2003; Chokboribal et al., 2015; Kumar & Tiku, 2016; Pothuraju et al., 2016; Talmadge et al., 2004). Nevertheless, fresh Aloe vera gel is highly perishable and needs to be processed using appropriate processing technologies in order to increase the shelf stability, retaining its functional properties (Swami Hulle, Patruni, & Rao, 2014).

The manufacturing of Aloe products often involves different operations such as pasteurization, concentration and/or drying (Ramachandra & Rao, 2008). In addition, the requirements of the International Aloe Science Council (IASC) in order to obtain the international certification for Aloe vera products for oral

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ORIGINAL PAPER

Theoretical insights into [NiFe]-hydrogenases oxidation resulting in a slowly reactivating inactive state

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Abstract [NiFe]-hydrogenases catalyse the relevant $H_2 \rightarrow 2H^+ + 2e^-$ reaction. Aerobic oxidation or anaerobic oxidation of this enzyme yields two inactive states called Ni-A and Ni-B. These states differ for the reactivation kinetics which are slower for Ni-A than Ni-B. While there is a general consensus on the structure of Ni-B, the nature of Ni-A is still controversial. Indeed, several crystallographic structures assigned to the Ni-A state have been proposed, which, however, differ for the nature of the bridging ligand and for the presence of modified cysteine residues. The spectroscopic characterization of Ni-A has been of little help due to small differences of calculated spectroscopic parameters, which does not allow to discriminate among the various forms proposed for Ni-A. Here, we report a DFT investigation on the nature of the Ni-A state, based on systematic explorations of conformational and configurational space relying on accurate energy calculations, and on comparisons of theoretical geometries with the X-ray structures currently available. The results presented in this work show that, among all plausible isomers featuring various protonation patterns and oxygenic ligands, the one corresponding to the crystallographic structure recently reported by Volbeda et al. (J Biol Inorg Chem 20:11–22, 19)—featuring a bridging hydroxide ligand and the sulphur atom of Cys64 oxidized to bridging sulfenate—is the most stable. However, isomers with cysteine residues oxidized to terminal sulfenate are very close in energy, and modifications in the network of H-bond with neighbouring residues may alter the stability order of such species.

Keywords [NiFe]-hydrogenase · Oxidative inactivation · Ni-A state · Protein S-*sulfenation* · Density functional theory

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Introduction

Hydrogenases are enzymes involved in the metabolism of dihydrogen, and are expressed by several eukaryotic and prokaryotic microorganisms. In particular, two hydrogenases classes—the [NiFe] and [FeFe]-hydrogenases—are able to catalyse the reversible oxidation of H_2, following the reaction [1–4]:

$$H_2 \rightarrow 2H^+ + 2e^-.$$

[NiFe]-hydrogenases represent the most widespread hydrogenase class in Nature; this fact, as well as the very interesting reactivity promoted by such enzymes, has led researchers to spend increasing efforts in the study of [NiFe]-hydrogenases. In particular, the development of green-chemistry approaches for the evolution of molecular hydrogen would enable to employ H_2 as a clean energy carrier.

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ANTIOXIDANT PHENOLIC COMPOUNDS OF ETHANOLIC AND AQUEOUS EXTRACTS FROM PINK CEDAR (*ACROCARPUS FRAXINIFOLIUS* WHIGHT & ARN.) BARK AT TWO TREE AGES

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In Central Mexico, commercial plantations of pink cedar (*Acrocarpus fraxinifolius* Whight & Arn.) from 7 to 15 years old are ready for harvesting to obtain wood products without current bark use. Therefore, the aim of this work was to study ethanolic and hot water extracts from *A. fraxinifolius* bark of 7-year-old (young) and 13-year-old (mature) trees. Yields, total phenolic, flavonoid, and proanthocyanidin contents, as well radical scavenging activity by 1,1-diphenyl-2-picrylhydrazyl (DPPH) and 2,2-azinobis-(3-ethylbenzothiazoline-6-sulfonate) (ABTS) radicals, as well by ferric-reducing antioxidant power (FRAP) and low-density lipoprotein inhibition assays were estimated. Extracts of young tree barks showed higher phenolic content and better scavenging activity than extracts from mature tree barks; ethanolic extracts were superior to the aqueous ones. Positive correlations between polyphenol content and scavenging activity were observed. Results suggest that *A. fraxinifolius* bark loses phenolic content and antiradical activity as it ages. Bioactive phenolics such as gallic acid, catechin, epicatechin, and catechin gallate were identified by HPLC-DAD.

KEYWORDS. *Acrocarpus fraxinifolius*, bark, extraction solvent, free radicals scavenging, phenols, pink cedar, tree age

INTRODUCTION

Bark provides protection to the tree, structural support, and leads nutrients from the leaves to the roots. Generally, it is smooth and thin on young trees, and thick and rough in older trees. It is composed of various cell types and their structure is complex compared to wood.[1] Outer bark layers are waxy and waterproof. As bark gradually hardens, it becomes a physical and chemical barrier against microorganisms and external agents, moderating temperature inside the trunk and reducing the water loss.

In woody species, bark represents about 10–15% of the tree total weight.[2,3] Its chemical composition is complex and varies by many factors, such as species, tree age, growing conditions, and geographical location, among others.[4] Chemically, bark has the same constituents of wood and the typical components of the cell wall: cellulose, hemicellulose, lignin

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Ultrasound assisted extraction modeling of fructans from agave (*Agave tequilana* Weber var. Azul) at different temperatures and ultrasound powers

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A B S T R A C T

The effect of ultrasound power and temperature on the extraction of carbohydrates from agave was evaluated. Extraction kinetics of fructans (F), total carbohydrates (TC) and reducing sugars (RS) were obtained at different ultrasound powers (28–49 mW/mL) and temperatures (20–40 °C). The mass transfer coefficients of F, TC and RS were calculated and a model using the production functions of Cobb–Douglas was developed. Microstructural analysis was performed to evaluate the effect of ultrasound and temperature on carbohydrates extraction. Ultrasound and temperature had impact on F, TC and RS extractions. After 5 min, no increases in carbohydrates content were observed, showing an asymptotic tendency. Results showed a strong sonication effect in carbohydrate extraction at any extraction temperature. The maximum F, TC and RS contents were 7.2, 7.79 and 0.54 g/100 g d.m., respectively, at 49 mW/mL and 40 °C. The fructans volumetric mass transfer coefficients ranged from $0.0585 \pm 4.2 \times 10^{-4}$ to $0.0834 \pm 12.51 \times 10^{-4}$ s^{-1} ($R^2 = 0.86$–0.92). An overall model was developed based on the Cobb–Douglas function, which was adjusted adequately to estimate the fructans extraction assisted with ultrasound ($R^2 = 0.954$). Tissue structural changes were present due to cell-wall modifications and breakdowns of sonicated agave samples, which have enhanced the carbohydrates extraction.

Abbreviations: F, fructans; TC, total carbohydrates; RS, reducing sugars; *UPC*, ultrasound power calculate (mW); *UP*, ultrasound power (mW/mL); $K_L a/V$, volumetric mass transfer coefficient (s^{-1}); *R*, correlation coefficient; *RMSE*, root mean square of error; χ^2, reduced chi-square; mW, milliwatts; d.m., dry matter.

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Review article:

PLANTS WITH POTENTIAL USE ON OBESITY AND ITS COMPLICATIONS

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ABSTRACT

Obesity is the most prevalent nutritional disease and a growing public health problem worldwide. This disease is a causal component of the metabolic syndrome related with abnormalities, including hyperglycemia, dyslipidemia, hypertension, inflammation, among others. There are anti-obesity drugs, affecting the fundamental processes of the weight regulation; however they have shown serious side effects, which outweigh their beneficial effects. Most recent studies on the treatment of obesity and its complications have focused on the potential role of different plants preparation that can exert a positive effect on the mechanisms involved in this pathology. For instance, anti-obesity effects of green tea and its isolated active principles have been reported in both *in vitro* (cell cultures) and *in vivo* (animal models) that possess healthy effects, decreasing adipose tissue through reduction of adipocytes differentiation and proliferation. A positive effect in lipid profile, and lipid and carbohydrates metabolisms were demonstrated as well. In addition, anti-inflammatory and antioxidant activities were studied. However, the consumption of green tea and its products is not that common in Western countries, where other plants with similar bioactivity predominate; nevertheless, the effect extension has not been analyzed in depth, despite of their potential as alternative treatment for obesity. In this review the anti-obesity potential and reported mechanisms of action of diverse plants such as: *Camellia sinensis, Hibiscus sabdariffa*, *Hypericum perforatum*, *Persea americana*, *Phaseolus vulgaris*, *Capsicum annuum*, *Rosmarinus officinalis*, *Ilex paraguariensis*, *Citrus paradisi*, *Citrus limon*, *Punica granatum*, *Aloe vera*, *Taraxacum officinale* and *Arachis hypogaea* is summarized. We consider the potential of these plants as natural alternative treatments of some metabolic alterations associated with obesity.

Keywords: Obesity, obesity complications, anti-obesity plants, phytochemicals, alternative treatments

INTRODUCTION

Obesity is now the most prevalent nutritional disease and a growing public health problem worldwide. The disease has acquired epidemic proportions projected to reach 2.3 billion of overweight adults and 700 million obese adults, respectively by 2015 (Malik et al., 2013).

Overweight is an established risk factor for type 2 diabetes and cardiovascular diseases, where the central and causal component is the metabolic syndrome (Montague and O'Rahilly, 2000). This is a series of metabolic abnormalities including hyperglycemia, dyslipidemia, hypertension, inflammation, oxidative stress, among others (Grundy et al., 2004).

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Wood preservation using natural products

Preservación de la madera usando productos naturales

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Abstract

It is a current concern in the wood preservation field to avoid the use of toxic chemicals and develop new technologies based on low environmental impact agents and sustainable principles. Under this expectation, an intended state-of-the-art is introduced on the application of natural products such as traditional tar and wood oils as well as tannins and plant extracts. A particular revision to heartwood chemical components is offered. The combined methods of using natural and chemical components are reviewed, considering as outstanding the mixtures of natural organic constituents with cooper and boron salts that seem to be under encouraging experimentation. Fungicides and anti-termite applications are commented as well the leaching problem of inorganic salts. Chemical modification of wood structure through the formation of adducts and the treatment with nanomaterials are promising tools that will change the actual view and performance of wood preservation techniques.

Keywords: bark, biocides, extract, fungicide, oil, phenolics, tannins, termites.

Resumen

Una de las prioridades actuales en el campo de la preservación de madera es evitar el uso de materiales tóxicos, desarrollando nuevas tecnologías fundamentadas en principios sustentables y empleando agentes de bajo impacto ambiental. Con esta expectativa se plantea una revisión del estado del arte sobre la aplicación de productos naturales, tales como taninos, alquitrán, aceites y extractos vegetales. Se presenta en particular una revisión sobre los componentes químicos contenidos en el duramen de maderas naturalmente resistentes. Se analizan los métodos combinados de ingredientes naturales y químicos, resaltando las mezclas de componentes naturales orgánicos con sales de cobre y boro que parecen representar una opción experimental confiable. Se comentan también las aplicaciones fungicidas y anti termitas, así como los problemas de lixiviación de sales inorgánicas. Opciones como la modificación química de la madera vía la formación de aductos y por tratamiento con nanomateriales son procesos promisorios que cambiaran eventualmente la manera de ver y aplicar la tecnología actual de preservación de maderas.

Palabras clave: corteza, biocidas, extracto, fungicidas, aceite, compuestos fenólicos, taninos, termitas.

Introduction

Wood as a natural renewable resource plays an important role in the world economy, particularly in the construction and furniture fields. The expectation for better options in preserving wood from biodegradation during storage, transportation, manufacturing, and in service is actual. Environmental issues from the conventional toxic chemical preservatives containing metals for wood treatment and their disposal problems have urged the search for more ecologically friendly technologies. The current progress and implementation of new technologies has been limited due to variability between the laboratory and the field performances of natural products alternatives, and legal problems derived from the lack of globally

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Mesquite leaves (*Prosopis laevigata*), a natural resource with antioxidant capacity and cardioprotection potential

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ABSTRACT

The antioxidant activity of acetone extracts and purified fractions from *Prosopis laevigata* leaves were evaluated as well its cardioprotection potential *in vitro*. Mezquite leaves were dewaxed with petroleum ether and extracted with aqueous acetone (70%); the polar extract was purified in Sep-Pak® Cartridges and their fractions evaluated. Significant differences among fractions and crude extracts were found in total phenolic content (Folin Ciocalteu), antioxidant capacity by scavenging hydroxyl and DPPH radical assays. Purified fractions showed antihypertensive effects inhibiting angiotensin converting enzyme and cardioprotection inhibiting low density lipoprotein oxidation. The HPLC profile displayed phenolic compounds such as gallic acid, catechin, gallocatechin, epicatechin gallate, rutin, and luteolin that may explain these antioxidant and biological properties. Mesquite leaves can be a source of bioactive phenolics as nutraceutical ingredients.

1. Introduction

Currently, there is a generalized interest for balanced diets rich in fruits and vegetables and their direct relationship with human health and well-being. The contribution of natural phytochemicals present in foods to reduce the risk of chronic diseases is being continuously reported (De La Rosa et al., 2010). Cell damage from unbalance of free radicals that endures as an oxidative stress disorder affects the cellular structure and its components. Then tissues and organs become disturbed as a result of the metabolic syndrome, which is often characterized by oxidative stress that eventually promotes the appearance of degenerative conditions such as cancer, diabetes and cardiovascular diseases (Roberts and Sindhu, 2009).

Plants, herbs and spices have been used as remedies in traditional medicine and attained a wide recognition as sources of bioactive phytochemicals with prophylactic benefits. A distinctive property of these active principles is their antioxidant capacity, which is common in many secondary metabolites from the plant kingdom (Yadav et al., 2012). The major natural antioxidants are polyphenols, although antioxidation is not a property limited only to them. Polyphenols protect macromolecules from the cell structure and its parts from being damaged by free radicals and reactive species, avoiding diseases such as atherosclerosis (Han et al., 2007). Plant phenols, as named in industry, are used as the active principles in many actual formulations (Quideau et al., 2011). Hence, there is interest in searching for bioactive plant antioxidant sources that might prevent from oxidative stress-induced degradation or fight its negative effects in biological systems.

Mesquite (*Prosopis* spp.) is an endemic tree that belongs to the Leguminosae family and Mimosaceae subfamily, and comprises 44 species distributed at arid and semiarid regions over one third of the earth surface (Burkart, 1976). In Mexico there are 11 *Prosopis* species: *P. odorata*, *P. glandulosa*, *P. velutina*, *P. articulata*, *P. tamaulipana*, *P. yaquiana*, *P. vidaliana*, *P. mezcalana*, *P. mayana*, *P. juliflora*, and *P. laevigata* (Cedillo and Mayoral, 1997). Mesquite is an ecologically important plant because it fixes nitrogen in soil, promoting the growing of associated shrub and bushes species, which diminishes soil erosion (Golubov et al., 2001). Its stem and branches are used for wood and charcoal production, and as firewood; from its pods a kind of honey and other edible products are obtained, and the pods along the leaves are also used as forage for cattle and small ruminants (Rodriguez-Franco and Maldonado-Aguirre, 1996). Heartwood from *Prosopis* species has shown resistance against fungal attack, mainly suggesting (−)-mesquitol as the bioactive flavanol compound (Pizzo et al., 2011). However, it cannot be considered as the unique and definite factor to explain the durability of this woody material.

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Research Article

Drying Parameters of Half-Cut and Ground Figs (*Ficus carica* L.) var. Mission and the Effect on Their Functional Properties

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Drying of ground and half-cut figs (*Ficus carica* L., var. Mission) was investigated at three temperatures (45, 55, and 65°C). Their effective moisture diffusivity (D_{eff}) was estimated by using the slope method. D_{eff} values for ground figs were 5.15×10^{-10}, 9.96×10^{-10}, $1.07 \times 10^{-9}\,\mathrm{m^2\,s^{-1}}$ and for half cut figs 5.88×10^{-10}, 1.66×10^{-9}, and $2.08 \times 10^{-9}\,\mathrm{m^2\,s^{-1}}$ at 45, 55, and 65°C, respectively. Dehydrating fig samples showed a similar behavior: higher D_{eff} values at higher temperatures and activation energy (E_a) values in the range of other foodstuffs. Half-cut figs needed about twice more energy and time than ground figs to carry out the dehydration; E_a values were 56.86 and 28.21 kJ mol^{-1}, respectively. The drying process increased the total phenolic content and degraded the anthocyanin content of figs; however, it enhanced the dried figs antioxidant activity. Dehydrating ground figs was faster and maintained its functional properties better than half-cut figs.

1. Introduction

Many studies have demonstrated that daily intake of fruit and vegetable is associated with the reduction of chronic-degenerative diseases [1, 2]. In other investigations, it has been observed that fruit- and vegetable- rich diets protect against different diseases, including cancer and cardiovascular diseases. Etiology for these diseases is pointing to the free radicals as promoters of protein, nucleic acids, and cellular lipids oxidations that damage biological systems; fruits and vegetables contain a great number of components with antioxidant activity, such as flavonoids, carotenoids, and vitamins C and E [3].

Nowadays, the study for different vegetables species is promoted in order to identify their diverse functional capacities; since the human organism cannot produce phytochemicals such as polyphenols, they have to be obtained from food [4]. The most viable alternative is to consume fresh fruit and vegetables, since it is well known that after harvesting, their components can change during processing and storage and relatively lose part of its biological activity. Although there are some factors that can limit its intake such as seasonal availability, market accessibility, cost, and shelf life, it is important to process them by freezing, canning, or drying, but these conservation methods can reduce the bioactive component contents [5].

Fig tree (*Ficus carica* L.) is widely found in tropical and subtropical countries, and its fruit has a high commercial value. Fig production is mainly located around the Mediterranean Sea or in places with similar weather such as California, Australia, or South America [6]. From the yearly world production of fruits of above 600 million tons, fig is over one million tons. The largest fig producer is Turkey with about 23.5% of the total world harvest. The

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Antioxidant activity of fractions from *Quercus sideroxyla* bark and identification of proanthocyanidins by HPLC-DAD and HPLC-MS

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Abstract

The most active phenolics in *Quercus sideroxyla* Humb. & Bonpl. residual bark were identified and evaluated following a chromatographic fractionation. Bark powder was defatted with hexane and crude extract (CE) was obtained by extraction with aqueous acetone (70%). A liquid partition with ethyl acetate was performed to produce an organic extract (OE), which was subsequently purified by column chromatography (Toyopearl HW-40F, methanol), and resulted in six methanolic fractions (MF1 to MF6) and an oligomeric fraction (OLF) eluted with acetone 67%. Extraction yields, total phenolic and flavanol contents were determined. The antioxidant activity of bark extracts was measured by 2,2-diphenyl-1-picrylhydrazyl (DPPH), Trolox (6-hydroxy-2,5,7,8-tetramethylchroman-2-carboxylic-acid)-equivalent antioxidant capacity (TEAC), and ferric ion reducing antioxidant power (FRAP) assays. Their median effective concentration (EC_{50}) data and rate constants for DPPH radical scavenging were also estimated. Identification of major phenolics was carried out by high performance liquid chromatography with diode array detection (HPLC-DAD) and high performance liquid chromatography with electrospray ionization coupled to mass spectrometry (HPLC-ESI-MS) instruments. Bioactive gallic acid, catechin, epicatechin, gallocatechin, catechin gallate, dimeric procyanidins, galloylated dimeric proanthocyanidins, trimeric procyanidins, and tetrameric proanthocyanidins were detected and identified in *Q. sideroxyla* bark extracts. MF2 was the most active fraction containing gallocatechin as its major compound; MF5 and OLF contain galloylated procyanidins, which may explain their higher antiradical activity. OLF besides galloylated procyanidins has gallocatechin, which presumably contributes to its higher antiradical activity. Consequently, *Q. sideroxyla* bark could be a good source of therapeutic health products or nutraceutical ingredients that may exert a potential prevention or treatment action against diseases in biological systems.

Keywords: antiradical activity; bark; HPLC; proanthocyanidins; *Quercus sideroxyla*.

Introduction

Proanthocyanidins are oligomers and polymers composed mainly of monomeric flavan-3-ol units; they are the distinctive polyphenolic group in condensed tannins. After lignin, proanthocyanidins are the second most abundant group of natural phenols in the plant kingdom and one of the most widespread polyphenolic biflavonoids in herbs and spices (Porter 1993). Proanthocyanidins (polyphenolics) in wood and bark of trees are in focus of research since the beginning of modern wood science. Recent publication demonstrates that their chelating and antioxidant properties are of increasing importance (Willför et al. 2004; Zulaica-Villagomez et al. 2005; Gao et al. 2006; Donoso-Fierro et al. 2009). Also in the context of the development of environmentally benign wood preservatives of extractives are the antioxidant properties and chelating characteristics of flavons and flavonoids in discussion (Binbuga et al. 2005, 2008). Polyphenolic compounds from barks are especially relevant with this regard and in terms of biorefinery (Makino et al. 2011; Telysheva et al. 2011). The availability of modern isolation and characterization methods contribute a lot for advances in this field of science. For example, Liimatainen et al. (2011) used high performance liquid chromatography with diode array detection (HPLC-DAD) and high performance liquid chromatography with electrospray ionization coupled to mass spectrometry (HPLC-ESI-MS) instruments for structural elucidation of phenolic compounds from the inner bark of *Betula pendula*. Yao et al. (2010) discovered new phenolic glucosides and flavonoids in the bark of *Eucommia ulmoides*. Reaction of polyphenols with 2,2-diphenyl-1-picrylhydrazyl (DPPH) frequently plays an important role for characterization of their biotic activities (Smeds et al. 2011).

Proanthocyanidins are divided into different classes depending on the substitution pattern of the flavan unit (Figure 1). The most common are the procyanidins, which