LGAC-Alimentos Funcionales y Nutracéuticos (AFyN)

La línea de investigación de Alimentos Funcionales y Nutracéuticos tiene como objetivo el identificar y purificar principios activos en productos naturales, desarrollando con la aplicación de nuevas tecnologías, nutracéuticos, alimentos y bebidas funcionales de relevancia para la salud, demostrando su eficacia con estudios de biología celular, biología molecular y estudios preclínicos para facilitar el tránsito hacia la evaluación clínica.

La línea de investigación en su origen fue constituida por los profesores investigadores: Dr. José Alberto Gallegos Infante, Dra. Nuria Elizabeth Rocha Guzmán y el Dr. Rubén Francisco González Laredo. En años recientes se ha sumado al grupo, fortaleciéndolo, la Dra. Martha Rocío Moreno Jiménez. El perfil académico, especialidad y experiencia de los integrantes es diverso pero complementario, ya que va de la Fisicoquímica de Alimentos, hasta la Biología Molecular y Celular, pasando por la Química de Productos Naturales. Por lo anterior la integración de los mencionados se ha dado de manera natural, su sinergia de trabajo ha sido virtuosa, siendo un ejemplo de trabajo en equipo a nivel local y nacional, además de promover múltiples colaboraciones a nivel nacional e internacional.

En el caso de publicaciones científicas en colaboración con estudiantes, del año 2013 a la fecha se han publicado un total de 35 artículos de investigación, de los cuales 25 son con estudiantes de Doctorado.

PRODUCCIÓN ASOCIADA A LOS PTC-ESTUDIANTES DE LA LGAC ALIMENTOS FUNCIONALES Y NUTRACÉUTICOS.

ALIMENTOS FUNCIONALES Y NUTRACÉUTICOS

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Recent Research in Science and Technology 2018, 10: 16-22
doi: 10.25081/rrst.2018.10.3399
http://updatepublishing.com/journal/index.php/rrst/

ISSN: 2076-5061

REGULAR ARTICLE

POLYPHENOLIC PROFILE, SUGAR CONSUMPTION AND ORGANIC ACIDS GENERATION ALONG FERMENTATION OF INFUSIONS FROM GUAVA (*PISIDIUM GUAJAVA*) BY THE KOMBUCHA CONSORTIUM

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ABSTRACT

The kombucha beverage is usually prepared from black tea, with sucrose, inoculated with previously fermented liquid broth and/or tea fungus pellicle, and incubated. Alternative sources have been used for kombucha beverages. Guava leaves have been used for long time as traditional medicine. It is found in many commercially available botanical supplements in form of decoction, milled and used as comprises. They are rich in polyphenolic compounds. Several changes are produced during fermentation of the beverages. The main objective of the present work is to characterize fermentation process of guava leaves infusions by kombucha and studying possible chemical changes in their polyphenolic profile. Infusions from guava leaves were prepared and fermented by the kombucha consortium. The pH, titrable acidity, polyphenolic compounds, sugar consumption, organic acid along the fermentation was made by UPLC-ESI-MS. Kombucha from *Camellia sinensis* (CS) was made as a control. Higher rate of sucrose consumption was observed for Kombucha made with CS, also, higher production of organic acids (acetic and succinic acid) was observed too. Both behaviors were related to the content of glucose. The flavan-3-ols were diminishing along the fermentation time, with the exception of epigallocatechin in *Camellia sinensis*, Flavan-3-ol content in Guava leaves was low. Higher content of dicaffeoyl quinnic acid was observed for both systems in special for CS, falling after a maximum peak; minor constituents of hydroxycinnamic acids were stable along the fermentation for both systems.

Keywords: Fermentation, Guava leaves, Kombucha, Polyphenols

INTRODUCTION

Guava (*Psidium guajava*) is a fruit that grows in tropical countries. The variety of fruit dictates its shape (i.e. round, oval, or pear-shaped), diameter (approximately 1–4 in), and color (i.e. pink, white, yellow, salmon, or deep red color) [1]. *Psidium guajava* L. (guava) leaves have been used for a long time as traditional medicine in form of decoction, milled and used as comprises, etc., currently they are still employed [2]. Guava leaves after drying is suitable as a botanical supplement. Several biological activity studies showed that guava leaves have important beneficial healthy effects as anti-inflammatory, hypoglycemic, antibacterial, antidiarrheal and antioxidant properties [3-5] indicated that in India, guava leaves were used to treat skin wounds and alleviate toothaches.

The leaves contain antimicrobial components effective against *Staphylococcus aureus* that may ward off infection, and its tannin content may promote healing. Indigenous people from Southeast Asian countries consumed the fruit to reduce or prevent hypertension and to fight influenza infection. In Malaysia, guava leaves are used in an astringent solution to treat diarrhea and stomach ache. Researchers have also reported the use of guava leaves to expel the placenta during child birth [5]. Other health conditions related to guava use were reviewed by [6] who suggested that different plant constituents, usually the leaves, may exhibit antidiabetic, antimicrobial, antidiarrheal, and anti-cough properties.

Similarly, some *in vivo* studies have proved the anti-inflammatory action of extracts, essential oils, or steam distilled components of guava leaf [7, 8]. About studies on its phytochemical profile, several authors report presence of flavonoids, in special, quercetin [9, 10] in guava leaves. In contrast, the guava leaves fermentation process showed

Received 26 December 2017; Accepted 28 February 2018

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Chemico-Biological Interactions 272 (2017) 1–9

Contents lists available at ScienceDirect

Chemico-Biological Interactions

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

Oak kombucha protects against oxidative stress and inflammatory processes

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ARTICLE INFO

Article history:
Received 20 March 2017
Received in revised form
27 April 2017
Accepted 1 May 2017
Available online 3 May 2017

Keywords:
Antioxidant
Kombucha
Quercus
Anti-inflammatory
Fermented beverages

ABSTRACT

Black tea infusion is the common substrate for preparing kombucha; however other sources such as oak leaves infusions can be used for the same purpose. Almost any white oak species have been used for medicinal applications by some ethnic groups in Mexico and could be also suitable for preparing kombucha analogues from oak (KAO). The objective of this research was to investigate the antioxidant activity and anti-inflammatory effects of KAO by examining its modulation ability on macrophage-derived TNF-alpha and IL-6. Herbal infusions from oak and black tea were fermented by kombucha consortium during seven days at 28 °C. Chemical composition was determined by LC-ESI-MS/MS. The antioxidant activity of samples against oxidative damage caused by H_2O_2 in monocytes activated (macrophages) was explored. Additionally, it was determined the anti-inflammatory activity using lipopolysaccharide (LPS) - stimulated macrophages; in particular, the nitric oxide (NO), TNF-alpha, and IL-6 production was assessed. Levels of pro-inflammatory cytokines IL-6 and TNF-alpha were significantly reduced by the sample treatment. Likewise, NO production was lower in treatment with kombucha and KAO compared with LPS-stimulated macrophages. Fermented beverages of oak effectively down-regulated the production of NO, while pro-inflammatory cytokines (TNF-alpha and IL-6) in macrophages were stimulated with LPS. Additionally, phytochemical compounds present in KAO decrease oxidative stress.

1. Introduction

Some fermented foods have transcended their sources to become everyday products in more than one continent; fermentations involved in these foods are of enormous complexity, and their study has provided us a wealth of biotechnology knowledge. An attractive bioprocess consists on the degradation of glucose and fructose through the fermentation action of a bacterial and yeast consortium called Kombucha [6]. This Kombucha is a fermented beverage that has been traditionally consumed in China for over 2200 years. This ancient beverage is composed of two portions: a floating biofilm of cellulose and the sour liquid broth [4]. Several positive effects have been reported, including gastro protective effect of the culture broth and probiotic potential of the Kombucha microbiome [1,13]. In particular, in the culture broth the main metabolites identified are gluconic and glucuronic acids, glycerol, phenolic acids and caffeine; some are associated with beneficial effects on health. The two main classes of involved polyphenols are flavonoids and phenolic acids. Their chemical and structural modifications are due to biotransformation and metabolism by the kombucha consortium action, and have not been taken into account in previous studies of kombucha analogues obtained from other sources. The biotransformation of flavonoids has been a topic of research due to the interest in explaining the correlation between the beneficial properties of flavonoids and the structures of the active compounds. In Kombucha obtained from black tea, the

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http://dx.doi.org/10.1016/j.cbi.2017.05.001
0009-2797/

Chemical Research in Toxicology®

Article

IN SILICO PREDICTION OF THE TOXIC POTENTIAL OF LUPEOL

Manuel Antonio Ruiz-Rodríguez, Angelo Vedani, Ana Lidia Flores-Mireles, Manuel Humberto Chairez-Ramirez, Jose Alberto Gallegos-Infante, and Ruben F. Gonzalez-Laredo

Chem. Res. Toxicol., **Just Accepted Manuscript** • DOI: 10.1021/acs.chemrestox.7b00070 • Publication Date (Web): 27 Jun 2017

Just Accepted

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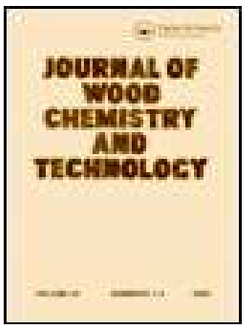
Chemical Research in Toxicology is published by the American Chemical Society. 1155 Sixteenth Street N.W., Washington, DC 20036



Journal of Wood Chemistry and Technology

ISSN: 0277-3813 (Print) 1532-2319 (Online) Journal homepage: http://www.tandfonline.com/loi/lwct20

Chemical analysis of polyphenols with antioxidant capacity from pinus durangensis bark

Martha Rosales-Castro, Rubén F. González-Laredo, María José Rivas-Arreola & Joseph Karchesy

To cite this article: Martha Rosales-Castro, Rubén F. González-Laredo, María José Rivas-Arreola & Joseph Karchesy (2017): Chemical analysis of polyphenols with antioxidant capacity from pinus durangensis bark, Journal of Wood Chemistry and Technology, DOI: 10.1080/02773813.2017.1310898

To link to this article: http://dx.doi.org/10.1080/02773813.2017.1310898

Published online: 22 May 2017.

Food Research International 102 (2017) 690–699

Contents lists available at ScienceDirect

Food Research International

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

In vitro and *in vivo* assessment of anti-hyperglycemic and antioxidant effects of Oak leaves (*Quercus convallata* and *Quercus arizonica*) infusions and fermented beverages

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ARTICLE INFO

Keywords:
Fermented beverages
Kombucha
Anti-hyperglycemic activity
Antioxidant activity
Oak leaves

ABSTRACT

The aim of this study was to evaluate the anti-hyperglycemic and antioxidant effects of oak leaves infusions and fermented beverages from *Quercus convallata* and *Q. arizonica in vitro* and *in vivo*. Female C57BL/6 mice fed with high saturated fat and fructose diet-induced obesity were treated with oak leaves beverages (200 μL/per day equivalent to 15 mg of lyophilized sample/Kg of body weight for infusions and 31 mg of lyophilized sample/Kg of body weight for fermented beverages) for 3 months and an oral glucose tolerance test (OGTT) was performed. Blood plasma was obtained for determination of glucose, lipid profile, and oxidative stress markers (ABTS, nitric oxide, and ORAC assays). Insulin resistance was estimated using the product of triglycerides and glucose (TyG). Oak leaves infusions and fermented beverages exhibited exerted inhibition of α-amylase (8–15% and 5–9%, respectively) and α-glucosidase (98% and 99%, respectively) enzymes. After OGTT, the groups treated with either oak leaves infusions or fermented beverages showed lower glucose levels compared with the obesity control group (18%) and a similar glucose tolerance to healthy control group. On long-term evaluation, intervention groups showed a significant reduction in fasting glucose concentrations (41–50% for oak leaves infusions and 52–66% for fermented beverages) and TyG index (4.2–4.6% for oak leaves infusions and 5.9–7.5% for fermented beverages) compared with the obese control group. Oak leaves infusions and fermented beverages had antioxidant potential *in vitro* and scavenging activity for radicals such as peroxyl and peroxynitrite anions. Our results suggest anti-hyperglycemic and antioxidant effects of beverages prepared with leaves of *Quercus* species *in vitro* and *in vivo*.

1. Introduction

Obesity is a highly prevalent metabolic disorder characterized by an excess of visceral adiposity. Furthermore, it has been associated with dyslipidemia, hyperglycemia, insulin resistance, and oxidative stress through several mechanisms, leading to metabolic syndrome (Alberti et al., 2009). Regard, oxidative stress is an imbalance of reactive oxygen species (ROS) and antioxidant defenses. The cells are protected against the excess of ROS by antioxidant enzymes (*e.g.* catalase, glutathione peroxidase (GPX), superoxide dismutase (SOD), and other antioxidants). However, when ROS overwhelms antioxidant capacity, the cell functions are affected by this imbalance (Matsuda & Shimomura, 2013).

On over-nutrition condition, a large amount of glucose is oxidized during the tricarboxylic cycle, leading to an increased production of electron donors in the mitochondrial electron transport chain. Thus, the process of electron donation to molecular oxygen promotes the production of superoxide ions (Brownlee, 2005). In addition, an excess of free fatty acids increases the oxidation level in the mitochondria. Both, β-oxidation of fatty acids and oxidation of free fatty acids-derived acetyl CoA by the tricarboxylic cycle, produce the same electron donors (NADH and FADH2) as in glucose oxidation; thus, an increased free fatty acid oxidation results in mitochondrial overproduction of ROS (Brownlee, 2005).

Several studies have reported a correlation between ROS and glucose metabolism disturbances, such as hyperglycemia and insulin

Abbreviations: QC_i, *Quercus convallata* infusion; QC_k, *Quercus convallata* fermented beverage; QA_i, *Quercus arizonica* infusion; QA_k, *Quercus arizonica* fermented beverage

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http://dx.doi.org/10.1016/j.foodres.2017.09.040
Received 6 June 2017; Received in revised form 14 September 2017; Accepted 17 September 2017
Available online 23 September 2017
0963-9969/

J Biol Inorg Chem
DOI 10.1007/s00775-016-1416-1

ORIGINAL PAPER

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

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Received: 29 July 2016 / Accepted: 9 November 2016

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

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.

Electronic supplementary material The online version of this article (doi:10.1007/s00775-016-1416-1) contains supplementary material, which is available to authorized users.

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Published online: 21 November 2016

EXCLI Journal 2016;15:758-771 – ISSN 1611-2156
Received: September 14, 2016, accepted: October 30, 2016, published: November 30, 2016

Review article:

LUPANE-TYPE TRITERPENES AND THEIR ANTI-CANCER ACTIVITIES AGAINST MOST COMMON MALIGNANT TUMORS: A REVIEW

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http://dx.doi.org/10.17179/excli2016-642

ABSTRACT

In recent times, a great deal of interest has been motivated on plant derived compounds known as nutraceuticals. These compounds exert important beneficial activities that improve people's health status when are consumed regularly, and now they appear as a viable option to explore their possible therapeutic effects against diseases like cancer. Particularly, lupane-type triterpenes have shown great ability to modulate multiple cancer-related signaling pathways and processes, including NF-κB, Wnt/β-catenin, PI3K/Akt, apoptosis, and many other routes related to proliferation or cell death, which are uncontrolled in malignant tumors. These investigations have promoted *in vitro* and *in vivo* studies, searching their mechanisms of action; although more research is still needed to prove its potential in human clinical trials. This review focuses on the ability of betulin, betulinic acid and lupeol to show benefits against the most common types of malignant tumors, which are considered a major global threat for public health.

Keywords: lupeol, betulin, betulinic acid, cancer, signaling pathway

INTRODUCTION

In present times, non-communicable chronic diseases are responsible for about 63 % of deaths worldwide. This group includes diabetes mellitus (DM), cardiovascular diseases (CVD), chronic respiratory diseases (CRD) and cancer, being responsible for approximately 38 million of deaths per year; 75 % of these deaths (28 million) occur commonly in third world countries.

Cancer is a generic term that comprises a large number of diseases that affect distinct parts of the human body. It is characterised by uncontrolled cell growth, and is capable to disseminate to different tissues from where it was originated (metastasis), leading to people´s death. Cancer is responsible for

Journal of Chemical Biology & Therapeutics

Díaz Rivas et al., J Chem Biol Ther 2016, 1:2

Review Article Open Access

Gastroprotective Activities of *Buddleja scordioides*-Role of Polyphenols against Inflammation

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Received date: Jun 13, 2016; **Accepted date:** Aug 25, 2016; **Published date:** Aug 29, 2016

Abstract

Medicinal plants show great interest today because of its multiple physiological effects. They contain a diversity of chemical compounds, phytochemicals, with demonstrated important biological activities. *Buddleja scordioides* Kunth is a plant that shows a wealth of important phytochemicals, which could contribute towards the prevention of various health problems such as gastrointestinal disorders. The main causes of gastrointestinal pathology are mediated by inflammatory processes caused by several factors. *B. scordioides* HBK (KUNTH) is commonly used for the treatment of diarrhea and stomach pain (colic). Several studies shown presence of flavonoids such as rutin, quercetin and quercetrin and kaempferol (also found in *Buddleja* genus). Other isolated compounds include some hidroxicinnamic and hidroxibenzoic acids, verbascosides, siringin, some iridoids, sesquiterpenes and fenilpropanoids. All of them related with anti-inflammatory activity. The present review is an opinion of the state of art anti-inflammatory activity of *B. scordioides* and gastrointestinal disorders.

Keywords: Anti-Inflammation *Buddleja scordioides*; Gastroprotection; Phytochemicals

Introduction

Medicinal plants show great interest today because of its multiple physiological effects The contain a diversity of chemical compounds, phytochemicals, with demonstrated important biological activities. Thes compounds are produced by the secondary metabolism of plants, which have evolved from differen biotic or abiotic factors, and used by the plant for defense or survival. However, multiple studies on these compounds have proven beneficia to human health [1].

Phytochemicals have multiple properties such as antioxidant and anti-inflammatory which can be used as a preventive means to protect against the development of health problems. The may interact with molecules that can inhibit the genesis of this type of pathologies or conversely, interact with biomarkers that enhance the protective capabilities of the organism.

Medicinal properties of many plants are mainly attributed to the presence of flavonoids but these effect may also be promoted by other organic and inorganic compounds such as coumarins, alkaloids, terpenes, tannins, antioxidant phenolic acids and micronutrients, for example, Cu, Mn and Zn. *Buddleja scordioides* Kunth is a plant that shows a wealth of important phytochemicals, which could contribute towards the prevention of various health problems such as gastrointestinal disorders. Nowadays these diseases have been considered a health problem around the world due to its high incidence.

Gastrointestinal disease and inflammatory response

Gastrointestinal diseases are one of the most common health problems that affec people of all ages and social condition, although the most vulnerable groups are children and the elders.

In Mexico in 2008, the incidence of ulcers, gastritis and duodenitis were larger than the states of Nayarit, Tabasco and Durango (3396.11, 3212.11 and 2193.78 cases per 100,000 population, respectively) [2]. In general, these problems are associated with inflammator processes, which are part of a non-specifi response of tissues that occurs in reaction to any type of injury, which is an immune response to pathogens, damaged, irritating cells, etc. [3].

Th main symptoms of inflammator processes are: Redness, heat, pain and tumor and also these symptoms can cause high cellular metabolism, vasodilatation, and high blood flo [4]. In some diseases the inflammatio process under normal conditions is restrictive; it becomes chronic dysfunctions that develop subsequently. In inflammator processes, it can be distinguished two steps of inflammation 1) Acute inflammatio that is the immediate response to vascular changes, where widespread effect of inflammatio mediators cause pain, heat and swelling; these symptoms are usually short-lived. 2) Chronic inflammatio is self-prolonged that and can last for weeks, months and even years, and can be developed as a result of recurrent or progressive acute inflammatio [5].

Th main causes of gastrointestinal pathology are mediated by inflammator processes caused by invading microorganisms ingested in the diet, use of medications that hurt the mucosa such as non-steroidal anti-inflammator drugs (NSAIDs), milk and dairy fats, alcohol, stress and nervousness are responsible for many digestive disorders [6]. Thei presence of symptoms is varied, may include stomach or abdominal pain accompanied by cramps, diarrhoea, dehydration, abdominal bloating, increased intestinal gas, lawn blood, fever, tires, loss of appetite and weight loss, weakness and constipation, among others [7].

Once developed an inflammator process focused on the gastrointestinal tract, the mucosa in charge of maintenance and integrity causing activation of immune cells, which begin to produce differen proteins (cytokines) by expressing differen molecules in

ISSN 1330-9862
doi: 10.17113/ftb.54.03.16.4622

preliminary communication

Antioxidant and Angiotensin-Converting Enzyme Inhibitory Activity of *Eucalyptus camaldulensis* and *Litsea glaucescens* Infusions Fermented with Kombucha Consortium

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Received: January 26, 2016
Accepted: May 11, 2016

Summary

Physicochemical properties, consumer acceptance, antioxidant and angiotensin-converting enzyme (ACE) inhibitory activities of infusions and fermented beverages of *Eucalyptus camaldulensis* and *Litsea glaucescens* were compared. Among physicochemical parameters, only the pH of fermented beverages decreased compared with the unfermented infusions. No relevant changes were reported in consumer preference between infusions and fermented beverages. Phenolic profile measured by UPLC MS/MS analysis demonstrated significant concentration changes of these compounds in plant infusions and fermented beverages. Fermentation induced a decrease in the concentration required to stabilize 50 % of DPPH radical (*i.e.* lower IC_{50}). Additionally, it enhanced the antioxidant activity measured by the nitric oxide scavenging assay (14 % of *E. camaldulensis* and 49 % of *L. glaucescens*); whereas relevant improvements in the fermented beverage were not observed in the lipid oxidation assay compared with unfermented infusions. The same behaviour was observed in the inhibitory activity of ACE; however, both infusions and fermented beverages had lower IC_{50} than positive control (captopril). The present study demonstrated that fermentation has an influence on the concentration of phenolics and their potential bioactivity. *E. camaldulensis* and *L. glaucescens* can be considered as natural sources of biocompounds with antihypertensive potential used either as infusions or fermented beverages.

Key words: herbal infusions, fermented beverages, kombucha, antioxidant activity, polyphenols

Introduction

In recent years, the consumption of herbal infusions around the world has increased due to their beneficial health effects. These beverages are prepared by placing a small amount of the selected plant material in freshly boiled water, allowing the preparation to steep for a short period of time (*1*). Although herbal infusions do not have any particular nutritional value, they represent an important source of bioactive compounds such as polyphenols. It has been shown that these compounds can act by diverse mechanisms providing significant protection against chronic diseases (*2*). For example, the consumption of some herbal polyphenols with antioxidant activity may regulate hypertension through inhibition of the angiotensin-converting enzyme (ACE), a key component in the renin-angiotensin aldosterone system which regulates blood pressure (*3*).

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Innovative Food Science and Emerging Technologies 34 (2016) 171–179

Contents lists available at ScienceDirect

Innovative Food Science and Emerging Technologies

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

Effect of pulsed electric field (PEF)-treated kombucha analogues from *Quercus obtusata* infusions on bioactives and microorganisms

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ARTICLE INFO

Article history:
Received 4 November 2015
Received in revised form 12 January 2016
Accepted 25 January 2016
Available online 12 February 2016

Keywords:
Flavonoids
Topic:
Kombucha
Oak leaves
Pulse electric fields
Functional beverages
Phenolic

ABSTRACT

Pulsed electric field (PEF) is a promising non-thermal food preservation technology. The objective was to study inactivation of yeasts in PEF-treated kombucha analogues prepared from *Quercus obtusata* infusions. Fermentation conditions of infusions from *Q. obtusata* were time (7 days), sugar (10%), starting culture (10%), and inoculum (2.5%, at 25 °C). The PEF treatment considered using square waves, an electric field strength (37.3–53.4 kV/cm), PEF processing time (445.3–1979.2 μs), an output temperature (18.31 ± 0.98 °C), an input energy (21.2 - 136.5 KJ/L), and two feed flow rates (51.42 and 102.85 L/h). pH, °Brix, color determinations, microbiological testing, total phenolic, flavonoid content, DPPH test, and UPLC/ESI/MS/MS analysis were done. No changes at different PEF conditions were observed for pH and °Brix. Higher color changes were observed at higher specific energies. Acid-acetic bacteria were more sensitive to PEF than yeasts. Lower specific energies render products with higher polyphenolic content and antioxidant capacity.

Industrial relevance: Pulse electric field is an interesting alternative to preserve kombucha analogues from oak leave infusions with minimal changes in physicochemical characteristics, antioxidant activity and bioactive compounds. The present work describes the effect of feed flow and specific energy on the several characteristics of fermented beverages, determining conditions for best processing.

1. Introduction

Thermal treatments are effective on enzyme inactivation and microbiological control. However, they imply an important loss of nutrients and phytochemicals such as phenolic compounds (Manzocco, Mastrocola, & Nicoli, 1998), although several reports have claimed opposite results (Manzocco, Anese, & Nicoli, 1998; Nicoli, Anese, Parpinel, Franceschi, & Lerici, 1997).

The conventional way to determine the efficiency of a thermal process is based on the assumption that survival curves of microbial cells and bacterial spores are governed by a first-order kinetic law (Mafart, Couvert, Gaillard, & Leguerinel, 2002). As a complement to or replacement of traditional thermal pasteurization, pulsed electric field (PEF) is a promising non-thermal food preservation technology (Toepfl, Heinz, & Knorr, 2007). Several investigations have been performed in various fruit juices to evaluate microbial resistance to PEF treatments (Raso, Calderón, Góngora, Barbosa-Cánovas, & Swanson, 1998a, 1998b; Timmermans et al., 2013). Wouters, Alvarez, & Raso (2001) indicate that the main process parameters that affect microbial inactivation by PEF are electric field strength, pulse length, pulse shape, number of pulses, and start temperature (MacGregor, Farish, Fouracre, Rowan, & Anderson, 2000). Also, type of microorganism, species, strains, size and shape are related with the efficiency of PEF to inactivate microorganisms (Wouters et al., 2001).

Electric field strength and treatment time are the most studied parameters related with microbial inactivation by PEF. The main process parameters that affect microbial inactivation by PEF are electric field strength, pulse length, pulse shape, number of pulses, and starting temperature (Barbosa-Canovas, Pothakamury, Gongora-Nieto, & Swanson, 1999; Saldaña, Álvarez, Condón, & Raso, 2014; Siemer, Toepfl, & Heinz, 2014). In general, increasing the intensity of these factors enhances microbial inactivation; however, their relationship with the survival fraction is unclear (Wouters et al., 2001). Not only process parameters are important, but also product parameters are significant too.

PEF treatment has been applied to a range of different products as fruit juices, milk, liquid eggs, and dry herbs (Barba et al., 2015). Also the influence of pH and conductivity has been studied by several groups. Wouters et al. (2001) found that a change in the medium conductivity affected the pulse energy; Vega-Mercado, Pothakamury, Chang, Barbosa-Cánovas, & Swanson (1996), concluded that it is better to

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http://dx.doi.org/10.1016/j.ifset.2016.01.018
1466-8564/

ARTÍCULO DE INVESTIGACIÓN

Evaluación química y capacidad antioxidante de extractos polifenólicos de cortezas de *Pinus cooperi, P. engelmannii, P. leiophylla* y *P. teocote*

Chemical evaluation and antioxidant capacity of polypehenolic extracts from bark of *Pinus cooperi, P. engelmannii, P. leiophylla* and *P. teocote*

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RESUMEN

Se evaluó la concentración de fenoles totales, flavonoides y proantocianidinas en extractos de acetona acuosa 70% (extracto crudo) y extractos semipurificados por partición líquido-líquido con acetato de etilo (extracto orgánico), de cortezas de *Pinus cooperi, Pinus engelmannii, Pinus leiophylla* y *Pinus teocote*, asimismo se determinó la actividad antioxidante de los extractos por las técnicas de radical ácido 2,2´-azinobis-3-etilbenzotiazolin-6-sulfónico (ABTS•+), desoxi-d-ribosa (atrapamiento de radical hidroxilo), y por la inhibición de la oxidación de lipoproteínas de baja densidad (LDL). Se realizó una comparación cromatográfica de los extractos por Cromatografía Líquida de Alta Resolución (HPLC). La concentración de fenoles fue de 491 mg g^{-1} a 604 mg g^{-1}, los extractos orgánicos presentaron mayor concentración de flavonoides (292 mg g^{-1} a 385 mg g^{-1}) que los extractos crudos (259 mg g^{-1} a 314 mg g^{-1}), mientras que la concentración de proantocianidinas fue mayor en el extracto crudo (186 mg g^{-1}a 286 mg g^{-1}) que en el orgánico (70 mg g^{-1}a 151 mg g^{-1}). La capacidad de captura del radical ABTS fue de 49,48% a 57,44%, similares al que presentó el estándar catequina (57,92%). La capacidad de captura del radical hidroxilo varió de 25,85% a 48,46% y fue mayor en el extracto orgánico en todas las especies. La inhibición de oxidación de LDL fue de 64,41% a 89,39%, con valores más altos en el extracto orgánico. Los cromatogramas de HPLC muestran semejanza de los compuestos químicos en las cuatro especies. Se identificó el flavanol catequina a baja concentración en todas las especies. El compuesto principal en *P. cooperi, P. engelmannii,* y *P. teocote*, es similar en las tres especies y por espectro de UV corresponde a una flavanona.

PALABRAS CLAVE:
ABTS, corteza, Lipoproteínas de Baja Densidad (LDL), *Pinus*, polifenoles.

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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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Received for Publication July 28, 2015
Accepted for Publication September 14, 2015

doi:10.1111/jfpp.12604

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

LWT - Food Science and Technology 66 (2016) 93–100

Contents lists available at ScienceDirect

LWT - Food Science and Technology

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

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

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ARTICLE INFO

Article history:
Received 9 April 2015
Received in revised form
5 October 2015
Accepted 6 October 2015
Available online xxx

Keywords:
Rheology
Molecular-weight
Viscoelastic properties
Viscosity
Polysaccharides

ABSTRACT

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 heteropolysaccharide (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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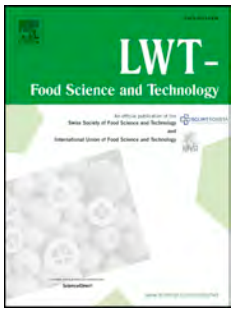
http://dx.doi.org/10.1016/j.lwt.2015.10.023
0023-6438/

Accepted Manuscript



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

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PII: S0023-6438(16)30471-6

DOI: 10.1016/j.lwt.2016.07.060

Reference: YFSTL 5634

To appear in: *LWT - Food Science and Technology*

Received Date: 28 March 2016

Revised Date: 26 July 2016

Accepted Date: 27 July 2016

Please cite this article as: Minjares-Fuentes, R., Femenia, A., Comas-Serra, F., Rosselló, C., Rodríguez-González, V.M., González-Laredo, R.F., Gallegos-Infante, J.A., Medina-Torres, L., Effect of different drying procedures on physicochemical properties and flow behavior of Aloe vera (*Aloe Barbadensis* Miller) gel, *LWT - Food Science and Technology* (2016), doi: 10.1016/j.lwt.2016.07.060.

Industrial Crops and Products 90 (2016) 1–8

Contents lists available at ScienceDirect

Industrial Crops and Products

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

Microencapsulation by spray drying of laurel infusions (Litsea glaucescens) with maltodextrin

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ARTICLE INFO

Article history:
Received 17 February 2016
Received in revised form 18 May 2016
Accepted 6 June 2016

Keywords:
Microencapsulation
Laurel infusions (*Litsea glauscecens*)
Spray-drying
Rheological properties and release profile

ABSTRACT

The effect of maltodextrin as an encapsulating agent on spray dried (SD) laurel infusions was studied (inlet temperatures: 140, 160 and 180 °C, and feed rate: 8 and 10 mL/min at fixed flow atomization). In the SD samples, the phenolic content (TPC), antioxidant capacity (DPPH*), morphology (SEM), chemical structure (FTIR), rheology properties and release profiles were studied. The results show that laurel infusion had 42.10 (±0.23) mg gallic acid equivalent/g of laurel and EC_{50} of 0.40 (±0.10) mg laurel/mL of DPPH*, the SD microparticles showed defined morphologies. Encapsulation of laurel infusion was achieved with an efficiency of ~70%. The reconstituted SD powders solutions showed a shear-thinning rheological behavior ($n < 1$). The results evidenced that the best conditions for laurel encapsulation by SD were 160 °C inlet temperature and 8 mL/min feed rate.

1. Introduction

Laurel (*Litsea* spp.) is one of the most used spices in the world. These spices are commonly used as food additives, provide flavors, scents, colors and even help in food preservation. It is commonly known as "bay laurel" and it has been reported to impart antimicrobial and antioxidant properties to food. Laurel has been reported to be used as an aid in gastrointestinal disorders, inflammation problems and atherosclerosis (Shan et al., 2007; Cherrat et al., 2014). The laurel spice has been used since ancient times in traditional Chinese medicine (Xie and Yu, 1996). All these benefits are related to the phytochemicals that compose laurel which include polyphenols such as phenolic acids and flavonoids (Kong et al., 2015; Tsai and Lee, 2011). The phenolic compounds (polyphenols) in Laurel spice provide natural antioxidant capacities to trap free radicals and inhibit oxidative processes in the body (Shan et al., 2005). However, polyphenols are extremely labile at ambient conditions (Ultraviolet, radiation, temperature, oxygen, stomach digestion, etc.) which affects their stability and reduce the antioxidant benefits, so that their protection with encapsulation vectors becomes crucial for the preparation of functional food (D'Archivio et al., 2010; Ersus and Yurdagel, 2007; Jafari et al., 2008). The most common microencapsulation process is spray drying (SD), which has proven to be an effective technology in protecting polyphenolic compounds. SD consists in converting water suspensions into powdered microparticles, which are composed of a wall material (shell) and a core (encapsulated material) (Reineccius, 1988). Carbohydrates, such as maltodextrins are one of the main wall materials used as encapsulating materials to protect polyphenolic compounds (Desai and Park, 2005; Ersus and Yurdagel, 2007; Jafari et al., 2008). Maltodextrins are hydrolyzed starch, they have a low cost and possess high water solubility (>75%) and low viscosity in aqueous solutions. Maltodextrins form a coating film minimizing oxygen contact of the encapsulated material (Pourashouri et al., 2014). Microparticles obtained from SD are able to last for longer periods of time and they have been reported to release the encapsulated materials under simulated conditions of the digestive tract (Medina-Torres et al., 2013) SD is the ideal process to achieve mechanical stability of encapsulated polyphenols particles and preserve their bioactivity (Mahdavi et al., 2014; Khazaei et al., 2014). There have been

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http://dx.doi.org/10.1016/j.indcrop.2016.06.009
0926-6690/

LWT - Food Science and Technology 64 (2015) 571–577

Contents lists available at ScienceDirect

LWT - Food Science and Technology

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

Spray drying-microencapsulation of cinnamon infusions (*Cinnamomum zeylanicum*) with maltodextrin

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ARTICLE INFO

Article history:
Received 4 March 2015
Received in revised form
3 June 2015
Accepted 6 June 2015
Available online 18 June 2015

Keywords:
Microencapsulation
Cinnamon infusions (*Cinnamomum zeylanicum*)
Spray-drying
Rheological properties and release profile

ABSTRACT

The effect of temperature and feed rate on spray dried cinnamon infusions (SDCInf) using maltodextrin as an encapsulating agent was studied (inlet temperature: 140, 160, and 180 °C; feed rate: 8 and 10 mL/min). Total phenolic content (TPC), antioxidant capacity (DPPH*), morphology (SEM), chemical (FTIR) and rheological properties, and releasing profiles were assessed in SDCInf. Cinnamon infusions (CInf) resulted in 29.32 (±0.70) mg of GAE/g of cinnamon. As for DPPH* inhibition, EC_{50} was 0.291 (±0.09) mg of cinnamon/mL. Microparticles showed a deflated-balloon like shape, encapsulating up to ~85% of the cinnamon infusion, and a simple shear-thinning behavior ($n < 1$). Results show that powdered SDCInf obtained at 160 and 180 °C and 10 mL/min yielded the best protection for cinnamon infusions.

1. Introduction

Spices are commonly used food additives. They provide flavor, aroma, color, and food preservative capabilities. Cinnamon is the second most important spice (just behind black pepper) in the USA and Europe (Jayaprakasha, Negi, Jena, & Rao, 2007). Its consumption is related to health benefits, such as: antimicrobial activity, inhibition of cancer cells proliferation, protection against common flu, and glucose control in diabetes (Anderson et al., 2004). Among the compounds related to these effects are polyphenols. Polyphenols possess characteristic properties, such as free-radical scavenging and inhibition of oxidizing processes in the body. Phenolic compounds are important because they provide cinnamon with natural antioxidant capacity (*i.e.* scavenging of free radicals). However, they are extremely sensitive to environmental conditions (e.g. UV radiation, temperature, oxygen, digestion, etc.). Microencapsulation processes, such as spray drying, have proved to be an effective technology for protecting this sort of compounds. This technology turns suspensions into powdered microparticles, comprised of a wall material and a core. Carbohydrates, such as maltodextrins, are among major wall materials; they are used as encapsulating materials that protect the core (Desai & Park, 2005; Jafari, Assadpoor, He, & Bhandari, 2008). Maltodextrins are obtained from starch hydrolysis. They are cheap, highly water soluble (>75%), and aqueous solutions containing them have commonly low viscosity. This material has the ability to form a cover for the core, encapsulating aromas and flavors, minimizing exposure to oxygen (Pourashouri et al., 2014). Microparticles obtained by spray drying are able to protect cores for long periods and release them under digestive conditions. Therefore, this process is suitable for increasing polyphenols stability during long-term storage while preserving their biological activity (Khazaei, Jafari, Ghorbani, & Kakhki, 2014; Mahdavi, Jafari, Ghorbani, & Assadpoor, 2014). Thus, these microparticles are studied in relation to their total phenolic content, chemical configuration (FTIR-analysis), morphology (Scanning Electron Microscopy), particle size homogeneity (Particle Size Distribution, PSD), rheological properties, and release profile. There are several studies on the non-polar fraction of cinnamon, yet only a few for the aqueous fraction. The aim of this study was to assess the effect of temperature and feed rate on the properties of SDCInf encapsulated with maltodextrin in order to find the best spray drying conditions to achieve the highest total

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http://dx.doi.org/10.1016/j.lwt.2015.06.020
0023-6438/

Review article doi: 10.5154/r.rchscfa.2015.04.014

Mexican oaks as a potential non-timber resource for Kombucha beverages

Encinos mexicanos, un recurso no maderable con potencial para elaborar bebidas tipo Kombucha

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Abstract

Oaks (*Quercus* spp.) are some of the world's most important and abundant trees in nearly all temperate forests of the northern hemisphere. There are two diversity centers for this genus: one is in Southeast Asia, and the other is in Mexico. Studies on the use of oak have mainly highlighted its timber applications. However, its non-timber value is still unappreciated. Ethnobotanical tradition shows infusions from *Quercus* leaves, alone or in combination with other plants, which have anticarcinogenic effects in gastric cancer patients. Sensorial studies on oak herbal infusions have shown that a higher phenolic content decreases their acceptability. Therefore, a significant alternative for encouraging use of herbal teas is fermentation with the Kombucha culture (black tea fungus). Kombucha drink is reported as a potential health promoter. It is a slightly acidic beverage from fermentation of sweetened black tea with Kombucha consortium, which consists mainly of acetic acid bacteria and yeasts. The phenolic composition and content gradually changes over fermentation time, producing a beverage rich in antioxidants. Metabolic conversion of polyphenols may be due to glucuronidation of original flavonoid compounds. This process enhances the bioavailability of phytochemicals, which include a wide range of bioactive ellagitannins and flavonoids, in oaks.

Keywords: Nutraceutical, herbal infusion, functional drinks, polyphenols, *Quercus.*

Resumen

Los encinos (*Quercus* spp.) son algunos de los árboles más importantes y abundantes en casi todos los bosques templados del hemisferio norte. El sudeste asiático y México destacan como centros de diversidad del género. La investigación sobre el encino se ha enfocado principalmente en sus aplicaciones maderables, siendo poco reconocido su valor como recurso no maderable. La tradición etnobotánica muestra que las infusiones de hojas de encino, solas o combinadas con otras plantas, presentan efectos contra el cáncer gástrico; sin embargo, el análisis sensorial de las infusiones ha mostrado relación inversa entre su aceptabilidad y su contenido fenólico. Por lo anterior, el hongo del té (Kombucha) es una alternativa para fermentar infusiones de encino, mejorando su aceptabilidad y carácter profiláctico. La bebida Kombucha es ligeramente ácida debido a que se prepara a partir de té negro endulzado que es fermentado por el consorcio microbiano Kombucha. El consorcio se forma por bacterias ácido acéticas y levaduras que cambian gradualmente la composición fenólica del sustrato, produciendo una bebida rica en antioxidantes. La conversión metabólica de los polifenoles puede deberse a su glucuronidación, que es un proceso que libera y realza la biodisponibilidad de los fitoquímicos presentes en el encino, incluyendo elagitaninos y flavonoides bioactivos.

Palabras clave: Bebidas nutracéuticas, bebidas funcionales, infusión herbal, polifenoles, *Quercus.*

Please cite this article as follows (APA 6): Vázquez-Cabral, B. D., Moreno-Jiménez, M. R., Rocha-Guzmán, N. E., Gallegos-Infante, J. A., González-Herrera, S. M., Gamboa-Gómez, C. I., & González-Laredo, R. F. (2016). Mexican oaks as a potential non-timber resource for kombucha beverages. *Revista Chapingo Serie Ciencias Forestales y del Ambiente, 22*(1), 73-86. doi: 10.5154/r.rchscfa.2015.04.014

Received: April 14, 2015 / Accepted: December 01, 2015.

RCHSCFA

www.chapingo.mx/revistas/forestales

Food and Chemical Toxicology xxx (2015) 1–8

Contents lists available at ScienceDirect

Food and Chemical Toxicology

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

Morphological and release characterization of nanoparticles formulated with poly (DL-lactide-co-glycolide) (PLGA) and lupeol: *In vitro* permeability and modulator effect on NF-κB in Caco-2 cell system stimulated with TNF-α

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ARTICLE INFO

Article history:
Received 29 May 2015
Received in revised form
23 July 2015
Accepted 2 August 2015
Available online xxx

Keywords:
Anti-inflammation
Lupeol
Nanoparticles
NF-kB
Transport

ABSTRACT

Lupeol exhibits anti-inflammatory effects; unfortunately it shows low water solubility. An alternative to overcome this is the development of nanomaterials. Several methods for nanomaterial production are available. One of them is emulsification/solvent-evaporation. The objective of the present work was to evaluate physical properties, transport and *in vitro* modulator effects on NF-κB of poly (lactide-co-glycolide) (PLGA) nanoparticles loaded with lupeol. Nanonutraceuticals were prepared with 16% (w/v) of lupeol. Size distribution and morphology were measured by particle size analyzer and TEM. In vitro release of lupeol was studied by three different models: Higuchi, Siepmann & Peppas, and Power law. Transport of nanonutraceutical was studied in a Caco-2 cell model and by GC–MS. Modulator effect on NK-κB was studied by western blot analysis. Nanonutraceuticals were 10% larger than the nanoparticles without lupeol (372 vs 337 nm) and presented a broader size distribution (0.28 vs 0.22). TEM results displayed spherical structures with a broader size distribution. Entrapment efficiency of lupeol was 64.54% and it *in vitro* release data fitted well to the Power law and Higuchi equation ($R > 0.84–0.84$). Strong regulation of NF-κB of nanonutraceutical was observed. It was not observed any transport across the Caco-2 cell model at the different experimental conditions.

1. Introduction

Several natural compounds show biological effects, as the pentacyclic triterpenes. They are based on a 30-carbon skeleton comprising 5 six-membered rings (ursanes and lanostanes) or 4 six-membered rings and 1 five-membered ring (lupanes and hopanes) (Wal et al., 2011). They can be found in the balsam, and plant resins (Muffler et al., 2011); and usually in the diet, where a consumption of 250 mg per day is estimated for this compound (Saleem, 2009). One of them is lupeol, a lupane-type pentacyclic triterpene present in diverse plants such as Japanese pear, aloe leaf, mango pulp extract, ginseng oil, etc. (Siddique and Saleem, 2011).

Regarding to its anti-inflammatory effect, lupeol has shown inhibitory activities on pro-inflammatory cytokines such as IL-2, IFN-γ and TNF-α (Bani et al., 2006; Ahmad et al., 2010), IL-4, IL-5, eosinophils reduction (Vasconcelos et al., 2008) and effect against pro-inflammatory enzymes like iNOS and COX-2 (Saleem et al., 2004; Sánchez-Burgos et al., 2013).

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http://dx.doi.org/10.1016/j.fct.2015.08.003
0278-6915/

Industrial Crops and Products 77 (2015) 827–832

Contents lists available at ScienceDirect

Industrial Crops and Products

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

Isolation of lupeol from white oak leaves and its anti-inflammatory activity

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ARTICLE INFO

Article history:
Received 21 July 2015
Received in revised form
20 September 2015
Accepted 22 September 2015

Keywords:
Lupeol
Anti-cyclooxygenase activity
Purification
Chromatography

ABSTRACT

Lupeol [lup-20(29)-en-2-ol] is found mainly on the surface of plant barks, stems, leaves and fruits waxes. This research explored oaks leaves of several species (*Quercus resinosa*, *Q. grisea*, *Q. laeta* and *Q. obtusata*) as potential source of lupeol. It was extracted from *Quercus* leaves by maceration with $CHCl_3$ at 35 °C, followed by a purification in silica column (normal phase), and using as mobile phase hexane (100%), hexane:ethyl acetate (90:10) and hexane:ethyl acetate (80:20). Lupeol in oak leaves was identified by ^{13}C NMR and quantified by GC–MS. *Quercus obtusata* leaves were an abundant source of lupeol (173.59 μg/g of sample). Anti-cyclooxygenase activity has been used for determining bioactivity of lupeol in this research.

1. Introduction

Nutraceuticals are recognized as biologically active substances present in natural products and foods that when consumed in concentrated form have demonstrated beneficial effects on the health. Plants are the most commonly sources of natural bioactive compounds, which may specifically be helpful in the treatment of certain diseases. *Quercus* species commonly known as oaks have an important distribution in Mexico. Particularly the state of Durango, Mexico, possesses large forest areas with 41 *Quercus* species, from which 22 are whites and 19 are reds (Rosales-Castro et al., 2011). As reported, *Quercus* spp. leaves contain tannins, alkaloids, saponins, cardiac glycosides and steroids (Sánchez-Burgos et al., 2013), and have shown antioxidant, antimicrobial, antitopoisomerase and gastroprotective effects. Infusions of *Quercus* species has been used in folk medicine as treatment for several inflammatory diseases (Maxia et al., 2005).

Inflammatory diseases are one of the major problems in many pathophysiologies such as gastrointestinal disorders. There are many alternatives to treat inflammatory processes, some of which involve the use of nonsteroidal anti-inflammatory drugs (NSAIDs). However, the low enzymatic selectivity of these drugs and the abuse in their consumption cause health problems. This is due to the non-selective inhibition of NSAIDs on cyclooxygenase cytoquines. Therefore, it is justified to explore natural alternatives, which involve the use of bioactive nutraceuticals without side effects as the associated with the prolonged use of NSAIDs (Kumari and Kakkar, 2012).

Among the nutraceutical recognized with major biological potential as anti-inflammatory activity are triterpenes. Lupeol is a pentacyclic triterpene found in many medicinal plants and some fruits (Deyrup et al., 2014; Hernández-Vázquez et al., 2010). This chemical constituent has shown diverse biological effects such as: antioxidant, anti-topoisomerase, antitumor, anti-inflammatory, among other activities (Santiago and Mayor, 2014; Zhang et al., 2015; Kumari and Kakkar, 2012).

Lupeol is distributed along the plant kingdom, and is found in olive fruit, mango fruit, Aloe leaves, Elm Plant, Japanese pear, Ginseng oil (Saleem, 2009) and fig (Santiago and Mayor, 2014) among others, in concentrations between 3 and 880 μg/g of sample. Considering the health benefits that this triterpene provides, the main objective of the present work was to explore new natural sources to obtain lupeol from several white oak species. In addition, a second

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http://dx.doi.org/10.1016/j.indcrop.2015.09.056
0926-6690/

cogent food & agriculture

FOOD SCIENCE & TECHNOLOGY | RESEARCH ARTICLE

Phenolic composition of selected herbal infusions and their anti-inflammatory effect on a colonic model *in vitro* in HT-29 cells

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Received: 05 February 2015
Accepted: 02 June 2015
Published: 13 July 2015

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Reviewing editor:
Fatih Yildiz, Middle East Technical University, Turkey

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Abstract: Some herbal infusions used in folk medicine in Mexico to treat gastrointestinal disorders were evaluated. Antioxidant activity and phenolic compounds were analyzed on the lyophilized aqueous crude extracts (LACE) of arnica (*Aster gymnocephalus*), chamomile (*Chamaemelum nobile*), cumin (*Cominum cyminum*), desert resurrection plant (DRP) (*Selaginella lepidophylla*), laurel (*Listea glaucescens*), marjoram (*Origanum majorana*), mint (*Mentha spicata*), salvilla (*Buddleia scordioides*) and yerbaniz (*Tagetes lucida*). Total phenolic content ranged from 8.0 to 70.7 µg GAE/mg for DRP and laurel respectively. Major phenolic compounds were identified by gas chromatography–mass spectrometry and high-performance liquid chromatography. The IC_{50} determined by the degradation of the deoxy-D-ribose ranged from 2,452.53 to 5,097.11 µg/mL. The cytoprotective effect of the LACE alone and on indomethacin-induced oxidative stress in HT-29 cells was tested. The tetrazolium dye MTT assay was performed in concentrations of 0.125–10 mg/mL allowing choosing the lowest concentration for this experimentation. Inflammation markers were measured by

Elda Herrera-Carrera

ABOUT THE AUTHORS

The authors are part of the "Functional Foods and Nutraceuticals Academic Group", a research team at the Technological Institute of Durango (TNM-ITD). Their endeavor is to educate specialists as graduate students and to perform research on the subject. Their search focuses on scientific and technological options to use and convert local natural resources into bioactive and functional products, which may contribute to health and diet solutions for the general population. Among their current investigation topics are local plants with known biological activity such as Quercus and guava leaves, which also are tested as kombucha analog products. They also pursue the utilization of natural polymers from mucilages of "nopal" (*Opuntia* spp.) and Aloe vera plants. Another matter of interest is the development of nanomaterials and organogels to encapsulate natural principles and nutraceuticals.

PUBLIC INTEREST STATEMENT

Stomach pain and gastrointestinal inflammation are common conditions in people with bad diets or eating disorders. Another cause is the unsupervised consumption of non-steroidal anti-inflammatory drugs (NSAIDs). Traditionally, herbal teas, infusions, and decoctions of many plants have been used to treat such complications with no exact knowledge on what phytochemicals and metabolic mechanisms are involved. Arnica, chamomile, cumin, desert resurrection plant, laurel, marjoram, mint, salvilla, and yerbaniz are typical examples of herb infusions consumed in Mexico to alleviate these ailments. In this paper, the herbal infusions were freeze dried and analyzed for polyphenols as bioactive antioxidant compounds present in plants that might be responsible for the protective role of these beverages. Extracts were also tested in a colonic cell model and inflammation markers determined, comparing against a positive control from a NSAID like indomethacin. It follows that salvilla, chamomile, and laurel have shown promising and explainable anti-inflammatory effects.

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Food and Chemical Toxicology ■■ (2015) ■■–■■

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Food and Chemical Toxicology

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Antioxidant, anti-inflammatory and anticarcinogenic activities of edible red oak (*Quercus* spp.) infusions in rat colon carcinogenesis induced by 1,2-dimethylhydrazine

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ARTICLE INFO

Article history:
Received 25 September 2014
Accepted 12 March 2015
Available online

Keywords:
Quercus sideroxyla
Anticarcinogenic activity
Anti-inflammatory
Colon cancer
Herbal infusions
Polyphenols

ABSTRACT

Red oak (*Quercus* spp.) leaves are traditionally used as food in Mexico, and some of their infusions have potential anticarcinogenic and anti-inflammatory effects; however, these properties have not yet been scientifically tested. The aim of this work was to explore the anti-inflammatory activity in HT-29 cells and anticarcinogenic effect in 1,2-dimethylhydrazine (DMH)-induced colon carcinogenesis of red oak infusions. *Quercus* infusions were prepared and administered as the sole source of drink to male Sprague-Dawley rats (1% w/v) for the entire 26-week experimental period. On week 4, rats received 8 subcutaneous injections of DMH (21 mg/kg body weight) once a week. The results showed that mean tumor (0.9 ± 0.2 vs. 2.6 ± 0.3) and multiplicity (1.2 ± 0.1 vs. 2.0 ± 0.23), and β-catenin protein level (2.2-fold) in adenocarcinomas were significantly lower in *Quercus sideroxyla*-treated group compared with DMH group. By contrast, *Quercus durifolia* and *Quercus eduardii* infusions had no protective effect. Additionally, the experiments in HT-29 cells confirmed that *Q. sideroxyla* infusion effectively decreased the levels of the inflammatory markers COX-2 and IL-8 by modulating the expression of NF-κB. These results highlight some of the molecular mechanisms related to the chemopreventive effect of *Q. sideroxyla* infusion and its potential value as a source of bioactive compounds.

1. Introduction

Colorectal cancer (CRC) is the third most common malignant neoplasm worldwide (Altobelli et al., 2014; Matsuda and Machii, 2013). In Mexico, according to the 1998–2002 cancer registry data, CRC represents 3.8% of new cancer cases, a 36% increase during this period; furthermore, CRC mortality has also increased over the same period (Verastegui and Mohar, 2010). CRC is the end result of a stepwise process involving transition of preneoplastic lesions (polyps) to more advanced stages (adenocarcinomas) (Tanaka, 2009). Colonic malignant transformation involves activating mutations in proto-oncogenes, such as K-*ras* and *CTNNB1*, the gene coding for β-catenin, and genetic alterations in tumor suppressor genes, including the *APC* gene, a suppressor of β-catenin signaling (Bos et al., 1987; Morin et al., 1997). Mutations in the K-*ras* gene and in *CTNNB1* can also be detected in colonic tumors of rats induced with the colonic procarcinogen 1,2-dimethylhydrazine (DMH), or its proximate metabolite, azoxymethane (AOM) (Perše and Cerar, 2011; Takahashi and Wakabayashi, 2004).

Inflammation-related processes have also been shown to be involved in the development of both human and DMH/AOM-induced colon carcinogenesis (Rogler, 2014; Takahashi and Wakabayashi, 2004). Nuclear factor kappa B (NF-κB) is a transcription factor that plays a crucial role in regulation of pro-inflammatory cytokines, such as tumor necrosis factor α (TNF-α), chemokines, anti-apoptotic proteins and growth factors (Shen and Tergaoankar, 2009); therefore, NF-kB modulation by dietary constituents is of major importance in cancer chemoprevention.

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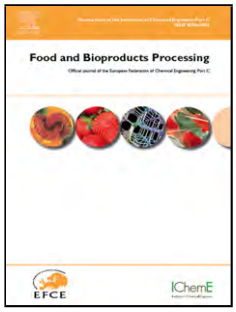
http://dx.doi.org/10.1016/j.fct.2015.03.011
0278-6915/

Accepted Manuscript



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

Author: Martín Narváez-Flores Miguel Á. Sánchez-Madrigal Armando Quintero-Ramos Marco A. Paredes-Lizárraga Rubén F. González-Laredo Martha G. Ruiz-Gutiérrez Hilda A. Piñón-Castillo Carmen O. Meléndez-Pizarro

PII: S0960-3085(15)00109-1
DOI: http://dx.doi.org/doi:10.1016/j.fbp.2015.08.007
Reference: FBP 641

To appear in: *Food and Bioproducts Processing*

Received date: 2-4-2015
Revised date: 3-8-2015
Accepted date: 30-8-2015

Please cite this article as: Narváez-Flores, M., Sánchez-Madrigal, M.Á., Quintero-Ramos, A., Paredes-Lizárraga, M.A., González-Laredo, R.F., Ruiz-Gutiérrez, M.G., Piñón-Castillo, H.A., Meléndez-Pizarro, C.O.,Ultrasound assisted extraction modeling of fructans from agave (*Agave tequilana* Weber var. Azul) at different temperatures and ultrasound powers, *Food and Bioproducts Processing* (2015), http://dx.doi.org/10.1016/j.fbp.2015.08.007

EXCLI Journal 2015;14:809-831 – ISSN 1611-2156
Received: February 11, 2015, accepted: June 16, 2015, published: July 09, 2015

Review article:

PLANTS WITH POTENTIAL USE ON OBESITY AND ITS COMPLICATIONS

Claudia I. Gamboa-Gómez, Nuria E. Rocha-Guzmán, J. Alberto Gallegos-Infante, Martha R. Moreno-Jiménez, Blanca D. Vázquez-Cabral, Rubén F. González-Laredo*

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http://dx.doi.org/10.17179/excli2015-186

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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Gastroprotective potential of *Buddleja scordioides* Kunth Scrophulariaceae infusions; effects into the modulation of antioxidant enzymes and inflammation markers in an *in vivo* model

J.O. Díaz-Rivas, E. Herrera-Carrera, J.A. Gallegos-Infante, N.E. Rocha-Guzmán, R.F. González-Laredo, M.R. Moreno-Jiménez, M. Ramos-Gómez, R. Reynoso-Camacho, M. Larrosa-Pérez, M.A. Gallegos-Corona

PII: S0378-8741(15)00290-1
DOI: http://dx.doi.org/10.1016/j.jep.2015.04.024
Reference: JEP9467

To appear in: *Journal of Ethnopharmacology*

Received date: 27 September 2014
Revised date: 16 April 2015
Accepted date: 16 April 2015

Cite this article as: J.O. Díaz-Rivas, E. Herrera-Carrera, J.A. Gallegos-Infante, N. E. Rocha-Guzmán, R.F. González-Laredo, M.R. Moreno-Jiménez, M. Ramos-Gómez, R. Reynoso-Camacho, M. Larrosa-Pérez, M.A. Gallegos-Corona, Gastroprotective potential of *Buddleja scordioides* Kunth Scrophulariaceae infusions; effects into the modulation of antioxidant enzymes and inflammation markers in an *in vivo* model, *Journal of Ethnopharmacology,* http://dx.doi.org/10.1016/j.jep.2015.04.024

EXCLI Journal 2015;14:204-212 – ISSN 1611-2156
Received: October 23, 2014, accepted: December 12, 2014, published: February 04, 2015

Original article:

CHEMICAL COMPOSITION OF BIOMASS GENERATED IN THE GUAVA TREE PRUNING

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http://dx.doi.org/10.17179/excli2014-647

ABSTRACT

Psidium guajava L. (*Myrtaceae*) is a native plant of Central America and is now widely cultivated in many tropical regions of the world for the fruit production. In Mexico, in the guava orchards common practices to control fruit production are: water stress, defoliation and pruning. In this study, we report the chemical composition of the biomass (branches and leaves) generated in the pruning practices. The results ranged as follows: pH (4.98-5.88), soda solubility (39.01-70.49 %), ash (1.87-8.20 %); potassium and calcium were the major inorganic elements in ash. No heavy metals were detected in the studied samples; total solubility (15.21-46.60 %), Runkel lignin (17.77-35.26 %), holocellulose (26.56 -69.49 %), α-cellulose (15.53-35.36 %), hemicelluloses (11.02-34.12 %), tannins in aqueous extracts (3.81-9.06 %), and tannins in ethanolic extracts (3.42-15.24 %).

Keywords: *Psidium guajava*, pH, ash, extractives, polysaccharide, tannins

INTRODUCTION

Psidium guajava L. belongs to the *Myrtaceae* family. It is a native of Central America but is now widely cultivated, distributed and the fruits enrich the diets of millions of people in the world tropics (Rathish and Sumitra, 2007; El-Mahmood, 2009). In Mexico, the States with the largest fruit production are Michoacan (42 %), Aguascalientes (35 %) and Zacatecas (15 %), the rest (8 %) belongs to other states (González Gaona et al., 2002). In Michoacan, the maximum fruit production falls into three municipalities located in the eastern area of the state: Jungapeo (2,500 hectares), Benito Juárez (1,500 hectares) and Zitácuaro (1,000 hectares) (Mendoza Lopez et al., 2005). In these guava orchards common practices to control fruit production are: water stress, defoliation and pruning; pruning is the most used activity.

P. guajava is a well known traditional medicinal plant used in some indigenous systems throughout the world. All parts of this tree, including roots, bark, leaves, seeds, and the fruits have been used for treatment gastrointestinal problems. Leaves, pulp and seeds are used as an antispasdomic, anti-inflammatory, and anti-diarrheic, to treat

Phenolic composition changes of processed common beans: Their antioxidant and anti-inflammatory effects in intestinal cancer cells

Martha R. Moreno-Jiménez, Verónica Cervantes-Cardoza, José A. Gallegos-Infante, Rubén F. González-Laredo, Isabel Estrella, Teresa de J. García-Gasca, Elda Herrera-Carrera, Jesús O. Díaz-Rivas, Nuria E. Rocha-Guzmán

PII: S0963-9969(14)00773-X
DOI: doi: 10.1016/j.foodres.2014.12.003
Reference: FRIN 5605

To appear in: *Food Research International*

Received date: 25 September 2014
Revised date: 2 December 2014
Accepted date: 6 December 2014

Please cite this article as: Moreno-Jiménez, M.R., Cervantes-Cardoza, V., Gallegos-Infante, J.A., González-Laredo, R.F., Estrella, I., García-Gasca, T.J., Herrera-Carrera, E., Díaz-Rivas, J.O. & Rocha-Guzmán, N.E., Phenolic composition changes of processed common beans: Their antioxidant and anti-inflammatory effects in intestinal cancer cells, *Food Research International* (2014), doi: 10.1016/j.foodres.2014.12.003

Madera y **Bosques** vol. **21**, núm. **especial: 63-76** **2015**

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

Nutra*foods* (2014) 13:169-178
DOI 10.1007/s13749-014-0035-0

Chemical and sensory evaluation of a functional beverage obtained from infusions of oak leaves (*Quercus resinosa*) inoculated with the kombucha consortium under different processing conditions

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Keywords:
kombucha
Quercus resinosa
functional beverage
fermentation
herbal infusion

Received: 17 January 2014 / Accepted: 20 June 2014

Abstract

The potential use of non-timber products as alternative sources of functional beverages such as kombucha analogues was evaluated. The fermentation of sweetened oak herbal infusions (*Quercus resinosa*) with the kombucha consortium was explored. The following conditions of the fermentation process induced by the action of the kombucha consortium were assessed: sensory acceptability and pH, colour and chemical changes (phenolic composition). The chemical analysis showed the presence of hydroxybenzoic and hydroxycinnamic acid derivatives, flavonoids, flavonols and flavanones, which are related to the antioxidant capacity of the product obtained. The metabolic consumption of flavan-3-ols and hydroxybenzoic acid derivatives as well as the production of organic acids (succinic acid) has decreased the astringency and bitterness, improving the product's quality and acceptability. Fermentation with the kombucha consortium significantly increased the product's acceptability (up to 5 units) and decreased its pH (2 units).

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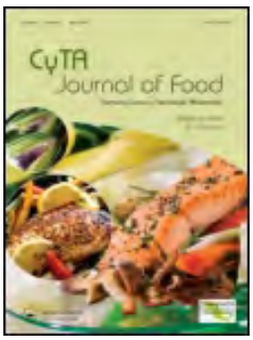
Introduction

Kombucha is a popular beverage that originated in Northeast China or Manchuria and then spread to Russia, Germany and the rest of the world [1]. Kombucha tea is an effervescent and sour drink that is a product of the biotransformation of sweetened black tea (*Camellia sinensis*) by means of the symbiotic action of a consortium formed by acetic acid bacteria (*Bacterium xylinum*, *B. xylinoides*, *B. gluconicum*, among others) and yeasts (*Saccharomyces ludwigii*, *S. apiculatus varieties*, *Schizosaccharomyces pombe*, among others) [2]. The symbiosis of the kombucha consortium may vary depending on geographic and climatic conditions as well as on the local species of wild yeasts and bacteria [3].

The fermentation process involves the activity of yeasts that ferment glucose and fructose to ethanol, which is then oxidised to acetic acid by acetic acid bacteria. The main source of carbon in this process is sucrose. The sugar is hydrolysed by the enzyme invertase from yeast present in the kombucha consortium, producing ethanol via the metabolic pathway of glycolysis, with a preference for fructose as the substrate. Subsequently, acetic bacteria convert



CyTA - Journal of Food

ISSN: 1947-6337 (Print) 1947-6345 (Online) Journal homepage: http://www.tandfonline.com/loi/tcyt20

Effect of infrared heating on the physicochemical properties of common bean (Phaseolus vulgaris L.) flour

Estrella Edith Arce-Arce, José Alberto Gallegos-Infante, Nuria Elizabeth Rocha-Guzmán, Rubén Francisco González-Laredo, Rocío Moreno-Jiménez, Juan de Dios Figueroa-Cárdenas & Argelia Nazdira Montelongo-Montelongo

To cite this article: Estrella Edith Arce-Arce, José Alberto Gallegos-Infante, Nuria Elizabeth Rocha-Guzmán, Rubén Francisco González-Laredo, Rocío Moreno-Jiménez, Juan de Dios Figueroa-Cárdenas & Argelia Nazdira Montelongo-Montelongo (2014) Effect of infrared heating on the physicochemical properties of common bean (Phaseolus vulgaris L.) flour, CyTA - Journal of Food, 12:3, 242-248, DOI: 10.1080/19476337.2013.834978

To link to this article: http://dx.doi.org/10.1080/19476337.2013.834978

LWT - Food Science and Technology 55 (2014) 426–435

Contents lists available at ScienceDirect

LWT - Food Science and Technology

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

Study of spray drying of the *Aloe vera* mucilage (*Aloe vera barbadensis* Miller) as a function of its rheological properties

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ARTICLE INFO

Article history:
Received 8 July 2013
Received in revised form
4 September 2013
Accepted 27 September 2013

Keywords:
Rheological properties
Viscoelasticity
Mucilage
Aloe vera
Spray drying

ABSTRACT

Spray Drying (SD) was used to obtain *Aloe vera* powder from fresh plants. The powder was reconstituted in an aqueous medium and its rheological properties, particle size distribution (PSD), thermal properties (differential scanning calorimetry, DSC), and morphology (scanning electron microscopy, SEM) were evaluated in order to find an alternative to natural gum to be used in the food industry. Rheological measurements were conducted at 25 °C in aqueous concentrations of 3 g/100 mL and 6 g/100 mL. A 2^3 factorial design was used with three central points to evaluate yield, efficiency and the rheological properties of reconstituted powders, results were compared with a liophilized (FD) sample of *A. vera* mucilage. Experimental results showed that the shear viscosity decreased with the increase of the inlet air temperature and the speed of atomization, and it increased with increasing feed flow in SD. Additionally, most powders obtained in all treatments have an average particle diameter of ~10 μm with a modal distribution (PSD). The best conditions of SD in order to obtain a good thickening agent were: 150 °C inlet temperature, 1.5 L/h feed rate and atomization speed of 275,000 rpm, and with rheological properties very close to those of the FD sample.

1. Introduction

Due to the concern and current interest of people in their health and quality of life, there has been an increasing demand for natural products, which has impelled pharmaceutical and natural products industries to focus their research on products with functional properties. A raw material that currently has potential in this field is *A. vera*, a kind of cactus from which cosmetics, pharmaceuticals and chemistry products can be obtained. *A. vera* is considered to be a potential source of gums and/or hydrocolloids (Sánchez González, Vargas, González-Martínez, Cháfer, & Chiralt, 2008). The selection of new sources of biopolymers requires a thorough understanding of the rheological properties and physicochemical characteristics of natural chemistries (García-Cruz, Rodríguez-Ramírez, Méndez-Lagunas, & Medina-Torres, 2013). These properties of the gum are sensitive to separation methods and they can be significantly altered with the drying process (Wang, Wang, Li, Xue, & Mao, 2009). It has been shown that this plant can provide nutritional components as feedstock for the production of functional products, considered the chemistry of the future (Vega, Ampuero, Díaz, & Lemus, 2005). *A. Vera* is a plant that has great range for adaptation to the environment due to its high rate of water retention, allowing it to form a dense layer of gel, which contains 99.4 g/100 g water and 0.6 g/100 g of solids, there are at least four different partially acetalized sugars in its composition that differ in the radius of the glucose and mannose (Vega, Uribe, Lemus, & Miranda, 2007). This plant has a composition of equal proportions of D-glucose and D-mannose (76 g/100 g), with 24 g/100 g of uronic acid, the juice contains 55.2 mg of polysaccharides per 100 mL of juice. The approximate total mass of polysaccharides is 788 mg/L (Rodríguez-González, Femenia, Minjares-Fuentes, & González-Laredo, 2010). Femenia, Sánchez, Simal, and Rosselló (1999) and Femenia, García-Pascual, Simal and Rosselló (2003) reported that the polysaccharides contained in the parenchyma of the *Aloe* are of

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http://dx.doi.org/10.1016/j.lwt.2013.09.026

LWT - Food Science and Technology 55 (2014) 426–435

Contents lists available at ScienceDirect

LWT - Food Science and Technology

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

Study of spray drying of the *Aloe vera* mucilage (*Aloe vera barbadensis* Miller) as a function of its rheological properties

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ARTICLE INFO

Article history:
Received 8 July 2013
Received in revised form
4 September 2013
Accepted 27 September 2013

Keywords:
Rheological properties
Viscoelasticity
Mucilage
Aloe vera
Spray drying

ABSTRACT

Spray Drying (SD) was used to obtain *Aloe vera* powder from fresh plants. The powder was reconstituted in an aqueous medium and its rheological properties, particle size distribution (PSD), thermal properties (differential scanning calorimetry, DSC), and morphology (scanning electron microscopy, SEM) were evaluated in order to find an alternative to natural gum to be used in the food industry. Rheological measurements were conducted at 25 °C in aqueous concentrations of 3 g/100 mL and 6 g/100 mL. A 2^3 factorial design was used with three central points to evaluate yield, efficiency and the rheological properties of reconstituted powders, results were compared with a liophilized (FD) sample of *A. vera* mucilage. Experimental results showed that the shear viscosity decreased with the increase of the inlet air temperature and the speed of atomization, and it increased with increasing feed flow in SD. Additionally, most powders obtained in all treatments have an average particle diameter of ~10 μm with a modal distribution (PSD). The best conditions of SD in order to obtain a good thickening agent were: 150 °C inlet temperature, 1.5 L/h feed rate and atomization speed of 275,000 rpm, and with rheological properties very close to those of the FD sample.

1. Introduction

Due to the concern and current interest of people in their health and quality of life, there has been an increasing demand for natural products, which has impelled pharmaceutical and natural products industries to focus their research on products with functional properties. A raw material that currently has potential in this field is *A. vera*, a kind of cactus from which cosmetics, pharmaceuticals and chemistry products can be obtained. *A. vera* is considered to be a potential source of gums and/or hydrocolloids (Sánchez González, Vargas, González-Martínez, Cháfer, & Chiralt, 2008). The selection of new sources of biopolymers requires a thorough understanding of the rheological properties and physicochemical characteristics of natural chemistries (García-Cruz, Rodríguez-Ramírez, Méndez-Lagunas, & Medina-Torres, 2013). These properties of the gum are sensitive to separation methods and they can be significantly altered with the drying process (Wang, Wang, Li, Xue, & Mao, 2009). It has been shown that this plant can provide nutritional components as feedstock for the production of functional products, considered the chemistry of the future (Vega, Ampuero, Díaz, & Lemus, 2005). *A. Vera* is a plant that has great range for adaptation to the environment due to its high rate of water retention, allowing it to form a dense layer of gel, which contains 99.4 g/100 g water and 0.6 g/100 g of solids, there are at least four different partially acetalized sugars in its composition that differ in the radius of the glucose and mannose (Vega, Uribe, Lemus, & Miranda, 2007). This plant has a composition of equal proportions of D-glucose and D-mannose (76 g/100 g), with 24 g/100 g of uronic acid, the juice contains 55.2 mg of polysaccharides per 100 mL of juice. The approximate total mass of polysaccharides is 788 mg/L (Rodríguez-González, Femenia, Minjares-Fuentes, & González-Laredo, 2010). Femenia, Sánchez, Simal, and Rosselló (1999) and Femenia, García-Pascual, Simal and Rosselló (2003) reported that the polysaccharides contained in the parenchyma of the *Aloe* are of

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http://dx.doi.org/10.1016/j.lwt.2013.09.026

Hindawi Publishing Corporation
International Journal of Food Science
Volume 2014, Article ID 513641, 8 pages
http://dx.doi.org/10.1155/2014/513641

Research Article

Influence of Commercial Saturated Monoglyceride, Mono-/Diglycerides Mixtures, Vegetable Oil, Stirring Speed, and Temperature on the Physical Properties of Organogels

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Received 11 May 2014; Revised 25 July 2014; Accepted 16 August 2014; Published 21 September 2014

Academic Editor: Jose M. Prieto

Th objective of this study was to evaluate the influence of gelator, vegetable oil, stirring speed, and temperature on the physical properties of obtained organogels. They were prepared under varying independent conditions and applying a fractional experimental design. From there a rheological characterization was developed. The physical characterization also included polarized light microscopy and calorimetric analysis. Once these data were obtained, X-Ray diffraction was applied to selected samples and a microstructure lattice was confi med. Commonly, the only conditions that affect crystallization have been analyzed (temperature, solvent, gelator, and cooling rate). We found that stirring speed is the most important parameter in the organogel preparation.

1. Introduction

Gels have been described as materials that are "easier to recognize than defin " [1]. Most of the times this problem comes from industry, which develops products with a gel name, just to be attractive to consumers [2]. However, gels have been accepted as semisolid materials comprising low concentrations (<15%) of gelator molecules to form a network self-assembly that entraps the solvent (in organogels both nonpolar components), preventing fl w due to surface tension [3].

Gels can be defi ed both from a rheological behavior and from a structural feature. In a rheological point of view, a gel is a system that does not flow and has the presence of a plateau region of storage modulus and a low tanδ (<0.1) at an angular frequency from 10^{-3} to 10^{2} rad/s. The structural defin tion is based on the connectivity of the system. Gel is a system consisting of molecules, particles, and chains, which are partially connected to each other in a fluid medium by crosslinks to the macroscopic dimensions. The the loss of fluidity is the result of connectivity. Both are operational definitions and may have the possibility of exclusions [2].

Organogels have been attracting much attention in biomedical and pharmaceutical fields, where the erosion of gels in stomach and intestines is important for drug delivery [4, 5]; therefore gels erosion has been applied for this purpose [6]. As oils are safe materials and are suitable for lipophilic components [7], they are considered a good option for organogels elaboration. That is why food industry is very interested in this type of systems as a replacement of hydrogenated fats [8]. Thus, understanding organogels, defin tion is closely related to their characteristics and their crucial potential to develop new applications.

Industrial Crops and Products 42 (2013) 57–62

Contents lists available at SciVerse ScienceDirect

Industrial Crops and Products

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

Antioxidant, antimicrobial, antitopoisomerase and gastroprotective effect of herbal infusions from four *Quercus* species

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ARTICLE INFO

Article history:
Received 18 April 2012
Received in revised form 9 May 2012
Accepted 14 May 2012

Keywords:
Quercus
DPPH
Deoxyribose
Anti-topoisomerase activities

ABSTRACT

Leaves from four species of white oaks (*Quercus resinosa*, *Quercus laeta*, *Quercus grisea*, and *Quercus obtusata*) were investigated for the evaluation and comparison of their antioxidant, antimicrobial, anti-topoisomerase, and anti-proliferative activities. DPPH and hydroxyl radical scavenging capacities were tested *in vitro*. Results indicated that aqueous extracts from leaves of *Quercus laeta* and *Q. grisea* displayed higher radical scavenging activity, while extracts from *Q. grisea* and *Q. obtusata* were more efficient in inhibiting the degradation of deoxyribose, preventing the formation of hydroxyl radicals. Polar extracts showed different degrees of antimicrobial activity, presenting *Q. resinosa* leaves a broader spectrum. In the anti-topoisomerase assay only *Q. resinosa* leaves infusions showed activity. The investigation indicates that the biological activity of aqueous extracts from oak leaves promises a more rational and effective application of this resource in the near future.

1. Introduction

Quercus trees, commonly known as oaks, belong to the family Fagaceae. They comprise 450 species worldwide, with an important distribution in Mexico, where are present 135–150 species, 86 of them are considered endemic (Luna-José et al., 2003). The state of Durango, Mexico, possesses extent woodland resources covered by template species mainly represented by mixed pine and oaks forests (Corral and Navar Chaidez, 2005). In Durango, Mexico forests inhabit 41 *Quercus* species, from which 22 are white and 19 are red (Rosales-Castro et al., 2011).

Research on natural products with potential therapeutic benefits represents an area of great interest in which herbal products had been the most important source. Phytochemical compounds allow us to understand plant physiology and biochemical pathways and propose a sustainable handling for each particular product. This potential source for non-timber products, including nutraceutical ingredients, has not been explored.

In Mexican traditional medicine the use of plants on the form of infusion or plasters is a common practice. Chemoprevention with dietary substances is an important area of research and entails using non-toxic substances to interfere with carcinogenesis (Johnson et al., 2010). There are worldwide efforts to discover anticancer agents from plants (Demain and Vaishnav, 2011). Some phytochemicals as ellagitanins (type of polyphenols) have shown antioxidant, gastroprotective (Beserra et al., 2011) and anticancer properties (Umesalma and Sudhandiran, 2011).

Several methods have been proposed to link biochemical mechanism to carcinogenesis (Shureiqi et al., 2000). An example is topoisomerase inhibitors which constitute a class of agents that inhibit carcinogenesis *via* their antiproliferative or cell-differentiating action and are considered an attractive targeting strategy in chemotherapy and chemoprevention (Cho et al., 2000).

The aim of this work was to investigate the *in vitro* antioxidant, antitopoisomerase, antimicrobial, anticiclooxigenase and antiproliferative activities of herbal infusions (teas) from the leaves of *Quercus resinosa*, *Quercus grisea*, *Quercus laeta* and *Quercus obtusata*.

2. Material and methods

2.1. Biological material

Saccharomyces cerevisiae mutant cells JN362a, JN394, JN394 t_{-1}, JN394t_{2-4} and JN394t_{2-5} were kindly provided by Dr. John Nitiss of St. Jude Children's Research Hospital, Memphis, TN, USA. Standard

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http://dx.doi.org/10.1016/j.indcrop.2012.05.017

Industrial Crops and Products 44 (2013) 336–342

Contents lists available at SciVerse ScienceDirect

Industrial Crops and Products

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

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

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ARTICLE INFO

Article history:
Received 14 September 2012
Received in revised form 9 November 2012
Accepted 19 November 2012

Keywords:
Antioxidant
Cardioprotection
Mesquite
Polyphenols
Prosopis

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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http://dx.doi.org/10.1016/j.indcrop.2012.11.030

academicJournals

Vol. 7(35), pp. 2564-2573, 17 September, 2013
DOI: 10.5897/JMPR12.997
ISSN 1996-0875 ©2012 Academic Journals
http://www.academicjournals.org/JMPR

Journal of Medicinal Plants Research

Full Length Research Paper

Polyphenolic content and antioxidant activity of leaf extracts from *Quercus durifolia, Quercus eduardii, Quercus sideroxyla* and *Quercus resinosa*

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Accepted 8 September, 2013

The phenolic content and antioxidant activities of extracts from *Quercus durifolia, Quercus resinosa, Quercus eduardii* and *Quercus sideroxyla* leaves were studied. Extracts were obtained by successive extraction with aqueous acetone (70%) followed by methanol (50%). Antioxidant activities were determined using a single electron transfer (SET) and hydrogen atom transfer (HAT) based assays. For SET-based the assays performed were, 2,2-diphenyl-1-picryl hydrazine (DPPH) inhibition expressed as IC_{50}, redox potential, as mV, inhibition of the low density lipoprotein (LDL) oxidation, as % of inhibition. For HAT-based assay, crocin bleaching technique was applied; a kinetics approach was used for the evaluation of total antioxidant capacity and the results presented in terms of equivalence by weight of a reference antioxidant. Acetone extracts (PFQA) from leaves of all *Quercus* species showed the best antioxidant capacity. *Q. resinosa* (PFQr) exhibited the best antioxidant capacity among the *Quercus* species analyzed either in acetone or methanol extracts (PFQM). Distinctive results are: DPPH IC_{50}, PFQrA = 78.3 µg/g, PFQrM = 250.7 µg/g; In Redox potential, PFQrA = 147.0 mV, PFQrM = 201.6 mV; In LDL oxidation inhibition: 98.2% and in inhibition of crocin bleaching, PFQrA = 1.08 g, PFQrM = 0.98 g. In conclusion, *Quercus* leaves might be used as potential source of polyphenolic antioxidants.

Key words: *Quercus sp.*, SET-based assay, HAT-based assay, phenolic compounds, antioxidant activity.

INTRODUCTION

On recent times the use of plants, vegetables, herbs and spices used in folk and traditional medicine have gained a wide acceptance as an important source for new chemicals discovery (Afolayan et al., 2008). Currently, there is an increased interest for new sources of compounds with evidenced biological activity, among which are natural antioxidants. These compounds can prevent the damage to macromolecules and cells by interfering with free radicals, usually implicated in the etiology of several diseases such as atherosclerosis,

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International Food Research Journal 20(3): 1087-1093 (2013)
Journal homepage: *http://www.ifrj.upm.edu.my*

Evaluation of culinary quality and antioxidant capacity for Mexican common beans (*Phaseolus vulgaris* L.) canned in pilot plant

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Article history

Received: 24 August 2012
Received in revised form: 12 December 2012
Accepted:13 December 2012

Keywords

Canning
common beans
polyphenols
quality
radical scavenging activity

Abstract

Common beans are rich in bioactive phytochemicals such as polyphenolic compounds. Unfortunately, they need to be thermally processed to be consumed. The health benefits related to common beans comsumption depends mainly on their thermal processing. The objective of this work was to evaluate the effect of thermal processes on the antioxidant capacity and industrial quality of four Mexican common beans cultivars (Black bean 8025, Pinto Saltillo, Pinto Durango, and Bayo Victoria). The common beans were thermally processed by two methods: sterilization (canning), and open pan cooking. Optimal cooking time and Fo parameter (Defined as being equivalent, in sterilizing capacity, to the cumulative lethal effect of all time/temperature combinations experienced at the slowest heating point) were obtained for each cultivar. Grain size, water absorption capacity (WAC), oil absorption capacity, integrity and color were the physical parameter evaluated. Chemical parameters analyzed were total phenolic content (TPC), and DPPH radical scavenging activity. Bayo beans showed biggest size, Pinto beans, medium size, and Black beans, the smallest size. Lowest optimal cooking time (open pan) was observed in Pinto Saltillo cultivar. Lowest Fo parameter of the container during the thermal process was observed for Bayo Victoria cultivar. Higher WAC values were observed in Bayo Victoria and Black bean cultivar (open and canned). Higher value of integrity was found for Bayo Victoria beans. After any thermal processing L^* value was lower in all cultivars. Higher values of TPC in cooked common beans cultivars were observed in Black beans and Bayo Victoria cultivars. Lower IC_{50} value in DPPH test was observed in canned Black beans and Bayo Victoria cultivars.

Introduction

Common edible beans (*Phaseolus vulgaris* L.) are one of the basic foods in Africa, India, and Latin America. Pinto beans are preferred in the North of Mexico and the Southwestern of United States, while Central and South of Mexico, Central America and South America eat mostly colored beans (including black beans). Common bean is a legume considered a functional food because it contains bioactive phytochemicals, such as polyphenols and tannins, which show antioxidant capacity (Dueñas *et al*., 2005; Oomah *et al*., 2005).

In vitro antioxidant activities and phenolic compounds in raw (unprocessed) pinto and black beans, yellow and black soybeans have been reported in several studies (Madhujith *et al*., 2004; Oomah *et al*., 2005; Xu and Chang, 2007). They indicate that common beans may serve as an excellent dietary source of natural antioxidants for disease prevention and health promotion. However, the health-promoting capacities of common beans could depend on their

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Efecto del procesamiento térmico sobre la capacidad antioxidante de pinole a base de vainas de mezquite (Prosopis laevigata)

Article *in* CyTA - Journal of Food · January 2012

DOI: 10.1080/19476337.2012.712057

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LWT - Food Science and Technology 50 (2013) 642–650

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Microencapsulation by spray drying of gallic acid with nopal mucilage (*Opuntia ficus indica*)

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ARTICLE INFO

Article history:
Received 7 March 2012
Received in revised form
17 July 2012
Accepted 24 July 2012

Keywords:
Nopal mucilage
Rheological behavior
Bioactive compounds
Gallic acid
Spray drying

ABSTRACT

The spray-drying process has been previously used to encapsulate food ingredients such as antioxidants. Thus the objective of this work was to produce microcapsules of gallic acid, a phenolic compound that acts as antioxidant, by spray drying with an aqueous extract of nopal mucilage (*Ofi*), which acted as an encapsulating agent. The rheological response and the particle size distribution of the final solutions containing gallic acid at concentrations of 6 g/100 mL were characterized along with the control sample, no gallic acid added, to elucidate the degree of encapsulation. The drying parameters to prepare the microcapsules with extract of nopal mucilage were: inlet air temperature (130 and 170 °C) and speed atomization (14,000 and 20,000 rpm). The rehydrated biopolymer showed a non-Newtonian pseudoplastic behavior. The Cross Model was used to model the rheological data. Values for "m" varied between 0.55 and 0.85, and for "time characteristic, λ", the range was between 0.0071 and 0.021 s. The mechanical spectra showed that the sample with gallic acid was stable long term (>2 days) and presented a bimodal particle size distribution. This study demonstrated the effectiveness of nopal mucilage when utilized as wall biomaterial in microencapsulation of gallic acid by the spray-drying process.

1. Introduction

Polyphenols are chemical compounds or phytochemicals with diverse biological activities due to their antioxidant capacity. Ingestion of polyphenol-rich foods should be beneficial to human health as factors associated with cardiac mortality in developed countries with particular reference to the consumption of wine (St. Leger, Cochrane, & Moore, 1979). Wine has antimicrobial and antifungal activity and may play a role in the etiology of migraine. Red wine may even protect against the common cold. Wine contains polyphenols from the flavonoid type, mostly as grape tannins (about 35 g/100 g) and anthocyanin pigments (about 20 g/100 g), not only present mostly in red rather than in white grapes (Takkouche et al., 2002), but also non-flavonoid phenolics such as stilbenes and gallic acid. Gallic acid (acid 3,4,5-tri-hydroxy-benzoic) and its derivatives are considered natural antioxidants and their effects and uses have been widely reported (Cho, Kim, Ahn, & Je, 2011; Pasanphan & Chirachanchai, 2008; Negi et al., 2005). Stabilization and application of polyphenols in foods and nutraceutical formulations can be improved by microencapsulation technologies (Sáenz, Tapia, Chávez, & Robert, 2009). Microencapsulation allows protection of bioactive compounds; *i.e.*, an active material (nucleus) is embedded in a polymer matrix (encapsulating agent or wall material) to act as a protective barrier against external or environmental factors (Ahmed, Akter, Lee, & Eun, 2010; Borgogna, Bellich, Zorzin, Lapasin, & Cesàro, 2010; Sáenz et al., 2009).

Spray drying is a common technique for producing encapsulated food materials (Sáenz et al., 2009). Good microencapsulation efficiency during spray drying is achieved when the maximum amount of core material is encapsulated inside the powder particles, succeeding in microcapsule stability, volatile losses prevention, and product shelf-life extension (Seid, Elham, Bhesh, & Yinghe, 2008). In spray drying, the operating conditions and the dryer design used depend on the characteristics of the material to be dried and the desired powder specifications (León Martínez, Méndez, & Rodríguez, 2010). Studying the effect of operating parameters

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0023-6438/$ – see front matter © 2012 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.lwt.2012.07.038