Productividad Académica de la LGAC de Biotecnología Microbiana

Las publicaciones de los PTC de la LGAC de Biotecnología Microbiana, en comparación con el periodo anterior, se incrementaron en este periodo de evaluación y se publicaron en revistas de mejor impacto, mientras se han enfocado en tres temáticas básicas: *i*) fermentación alcohólica de agave y aprovechamiento de las levaduras asociadas, *ii*) valorización de subproductos e insumos de bajo valor comercial y, *iii*) biorremediación de suelos. Así mismo, se ha colaborado con grupos de investigación de otras instituciones, en investigaciones relacionadas con las temáticas ya mencionadas.

La labor científica de la LGAC se complementa con la colaboración con grupos de investigación de otras instituciones, tanto nacionales como extranjeras, en donde se han generado un total de 13 artículos de investigación en colaboración con estudiantes en el periodo, de los cuales 12, son con estudiantes de doctorado

PRODUCCIÓN ASOCIADA A LOS ESTUDIANTES-PTC MIEMBROS DE LA LGAC BIOTECNOLOGIA MICROBIANA.

	BIOTECNOLOGIA MICROBIANA
1	Vazquez-Ortega, P. G., Alcaraz-Fructuoso, M. T., Rojas-Contreras, J. A., López-Miranda, J., & Fernandez-Lafuente, R. (2018). Stabilization of dimeric β-glucosidase from Aspergillus niger via glutaraldehyde immobilization under different conditions. Enzyme and microbial technology 110, 38-45.
2	Sánchez-Castañeda, A. K., Athès, V., Moussa, M., López-Miranda, J., Páez-Lerma, J. B., Soto-Cruz, N. Ó., & Trelea, I. C. (2018). Modeling of isoamyl acetate production by fermentation with Pichia fermentans in an aerated system coupled to in situ extraction. Process Biochemistry.65, 11-20
3	Bailón-Salas, A. M., Ordaz-Díaz, L. A., Valle-Cervantes, S., Lopez-Miranda, J., Urtiz-Estrada, N., Páez-Lerma, J. B., ... & Rojas-Contreras, J. A. (2017). Bacterial Diversity in Two Aerated Lagoons of a Pulp and Paper Effluent and their Interaction with a Commercial Inoculum using PCR-DGGE. *BioResources*, *12*(3), 5487-5501.
4	Cisneros de la Cueva S., Hernández Rodríguez C., Soto Cruz, N.O., Rojas-Contreras, J.A., López- Miranda, J. (2016) **Changes in Bacterial Populations During Bioremediation of Soil Contaminated with Petroleum Hydrocarbons** Water, Air, & Soil Pollution, Vol.227, Pag.1-12.
5	Cisneros-de la Cueva, S., Martínez-Prado M.A., López-Miranda, J., Rojas-Contreras, J.A. and H. Medrano-Roldán H. (2016) **Aerobic degradation of diesel by a pure culture of Aspergillus terreus kp862582**, Revista Mexicana de Ingeniería Química, Vol.15, Pag.347-360.
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8	Alma D. Orozco-Cortés, Gerardo Álvarez-Manilla, Gerardo Gutierrez-Sánchez, Olga M. RutiagaQuiñones, Javier López-Miranda and Nicolás O. Soto-Cruz. (2015) Characterization of fructans from *Agave duranguensis*. African Journal of plant Science. 9(9), pp. 360-367
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10	Ordaz-Díaz L.A., Rojas-Contreras J.A., Rutiaga-Quiñones O.M., Moreno-Jiménez M.R., Alatriste-Mondragón F. and Valle-Cervantes S. (2014). **Microorganism degradation efficiency in bod analysis formulating a specific microbial consortium in a pulp and paper mill effluent**. Bioresources. 9. 7189-7197.
11	Hernández-Carbajal, G.R., Rutiaga-Quiñones, O.M., Pérez-Silva, A, Saucedo-Castañeda, G., Medeiros, A.B.P., Soccol, C.R, and Soto-Cruz, N.O. (2013). **Screening of native yeast from *Agave duranguensis* spontaneous alcoholic fermentation with potential for production of Isoamyl acetate.** (Brazilian Archives of Biology and Technology. Vol.56, Pag.357-363.
12	Páez-Lerma, J. B. Arias-García, A., Rutiaga-Quiñones, O. M., Barrio, E. and Soto-Cruz, N. O. (2013). **Yeasts isolated from the alcoholic fermentation of *Agave duranguensis* during mezcal production,** Food Biotechnology, Vol.27. 342-356.
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Stabilization of dimeric β-glucosidase from *Aspergillus niger* via glutaraldehyde immobilization under different conditions

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ARTICLE INFO

Keywords:
Stabilization of multimeric enzymes
Glutaraldehyde versatility
Enzyme immobilization
Improved enzyme activity upon immobilization
Amino-agarose beads
Glucosidase

ABSTRACT

The dimeric enzyme β-glucosidase from *Aspergillus niger* has been immobilized on different amino-agarose beads at pH 5 and 7, exploiting the versatility of glutaraldehyde. The stability of the free enzyme depended on enzyme concentration. Immobilization via ion exchange improved enzyme stability/activity, depending on the immobilization pH. However, the enzyme was desorbed in 75 mM NaCl at pH 7 and some stability/enzyme concentration dependence still existed.

Treatment: of these biocatalysts with glutaraldehyde increased enzyme stability (e.g. at pH 5, after incubation under conditions where the enzyme just ionically exchanged was fully inactivated, the activity of the glutaraldehyde treated enzyme remained unaltered). Immobilization on glutaraldehyde pre-activated supports yielded a higher increase in enzyme activity, but the stabilization was lower. While when measuring the enzyme activity at pH 4 there were no changes after immobilization, all immobilized enzymes were more active than the free enzyme at pH 6 and 7 (2–3 times). The Ki/Km ratio did not significantly decrease in any immobilized biocatalysts, and in some cases it worsened in a significant way (by a 9 fold factor using preactivated supports). The new biocatalysts are significantly more stable and avoid enzyme subunit desorption, being the immobilization pH a key point in their design.

1. Introduction

The demand for renewable energy sources has moved from biodiesel to bioethanol produced from lignocellulosic materials, the most abundant polymers in nature [1–4]. Lignocellulosic biomass is one of most promising renewable feedstocks for ethanol production, which is a suitable fuel, due to its high octane number, vaporization heat, and compatibility with motor vehicles [5]. The first step in the production of bioethanol is the hydrolysis of cellulose to get glucose. In this regard, the use of enzymes presents some advantages, like the prevention of side-reactions produced using acid catalysis that can hinder the fermentation process [1–4,6].

The enzymatic hydrolysis of cellulose is accomplished from the synergistic action of endoglucanases, exoglucanases I and II and β-glucosidases These enzymes are found commonly in fungal species (*Penicillium verruculosum, Trichoderma reesei, Aspergillus niger, Sporotrichum thermophile*) [7]. The first enzymatic hydrolytic steps are performed by endoglucanase and exoglucanase activities, and they produce elevated concentrations of cellobiose (a reducing sugar that is formed by two β glucose molecules linked by a β (1 → 4) bond), which is the substrate of β-glucosidase [8,9]. β-glucosidases may be applied in other processes such as fine chemicals and medicines production [10]. Thus, they are also used to produce the release of some glycosylated substances (like flavors or terpenes in wine and other products [11–18]) or the production of some glycosylic bonds [19–21]. The importance of β-glucosidases in industrial and environmental processes has been summarized in different reviews and investigations [22–24].

Thus, biocatalysis is a good option to transform cellulose into glucose, but some problems, such as the price and moderate enzyme stability under operational conditions are hindering their industrial implementation [25,26]. One solution to both problems may be enzyme immobilization. If the immobilized enzyme is stable enough, it may be reused, and that will decrease the final price of the biocatalyst [27–30]. A proper immobilization may improve enzyme stability via multipoint

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Modeling of isoamyl acetate production by fermentation with *Pichia fermentans* in an aerated system coupled to *in situ* extraction

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ARTICLE INFO

Chemical compounds studied in this article:
Isoamyl acetate (PubChem CID: 31276)
Decane (PubChem CID: 15600)
L-leucine (PubChem CID: 6106)

Keywords:
Aroma production
Fermentation kinetics
Partition coefficient
Simulation
Natural flavoring substance

ABSTRACT

This study deals with the production of isoamyl acetate (IAA) by fermentation of sugar cane molasses with the strain *Pichia fermentans* ITD00165, using L-leucine as precursor. A mathematical model that describes the experimental data from fermentation was developed for its use as a tool for further process optimization. The fermentation system was constantly aerated and coupled to liquid–liquid *in situ* extraction with decane as the recovery solvent. Thus, the model integrates the biological production of IAA, its partition coefficient in the two liquid phase system and the stripping effect of aeration. A productivity of 26 mg L^{-1} h^{-1} was obtained with addition of 4 g L^{-1} of L-leucine at 12 h of fermentation. The use of the model for process optimization was explored. According to it, the maximum theoretical productivity that can be obtained is 63 mg L^{-1} h^{-1}. The model was used to determine that 1.6 g L^{-1} is the minimum concentration of L-leucine that can be added without significantly reducing IAA production. Also, it makes possible to propose an adequate decane/culture medium ratio, to have a desired final concentration and amount of recovered IAA. This value can be adjusted based on the needs of further purification steps and is useful to define a global economic optimum of the process.

1. Introduction

Esters of short-chain fatty acids are important flavor and fragrance compounds widely used in the food and beverage industries. Isoamyl acetate (IAA) is characterized by its strong smell of banana which gives it a very important place in food, pharmaceutical and perfumery industries with a demand of 75 tons per year in USA alone in 2010 [1–3], increasing over the years. This substance is obtained by chemical synthesis, extraction from natural sources, or fermentation [4].

In recent years, the interest towards the production of flavor compounds through white biotechnology processes over traditional methods has increased. Principal reasons are that chemical synthesis often consists in an environmentally unfriendly production process, with important drawbacks such as poor reactions selectivity resulting in racemic mixtures, low yields, and high downstream costs [5,6]. Also, consumers have developed an apprehensive attitude towards these synthetic compounds, especially if the products are related to food or domestic usage. Moreover, the extraction of flavoring compounds from natural sources gives very low yields and has potential difficulties with obtaining the raw material [3,4,7]. Contrary to chemical synthesis, flavors obtained by fermentation can have the “natural flavoring substance” classification by the European (EC No 1334/2008) and U.S. (21CFR101.22) regulations, which allows using them safely as an additive in food and beverages. This has been the main reason for developing biochemical processes over the years, but presently, after years of research, the inherent advantages of white biotechnology processes are the driving force for its application: operation under mild and more environmentally friendly conditions, as well as chemical and stereo specificity of the obtained compounds, are the most important ones [8].

There are several published studies focused on IAA biological production. They include enzymatic synthesis using lipases and esterases [1,3,9–15] and fermentation process by microorganisms, especially yeasts strains [6,16–20]. Whole cell fermentation can be a more economical method than enzymatic systems and easier to scale up to industrial level. There are some encouraging studies with interesting IAA productivities in the literature; for example, Yilmaztekin et al. [6] used a *Williopsis saturnus* strain in a medium composed of beet molasses and

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Bacterial Diversity in Two Aerated Lagoons of a Pulp and Paper Effluent and their Interaction with a Commercial Inoculum using PCR-DGGE

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Aerated lagoons are a main unit operation for wastewater treatment in the paper industry. Many such operations involve inoculation with bacterial formulations in which *in situ* effectiveness has not been proven; this can be translated into low efficiency in treatment and unnecessary investments. Lack of knowledge of bacterial biodiversity present in a lagoon limits the capacity to exploit the maximum degradation. To overcome such problems, various methods to identify and study these microorganisms have been developed. In this study, a PCR-DGGE analysis was performed to estimate the bacterial diversity and to verify the presence of bacteria present in a commercial inoculum in two aerated lagoons of a pulp and paper effluent. Phylogenetic affiliation of predominant member's correspondent to γ- and β-proteobacteria and Firmicutes were found. The dominant bacteria present in lagoon 2 belonged to the following genus *Microbacterium* sp. *Rhodocyclaceae* sp., *Eubacterium* sp. and *B. subtilis*. In lagoon 1 the dominant genus included *Microbacterium* sp., *Rhodocyclaceae* sp. *Tepidimonas* sp., *Acetanaerobacterium* sp., and *Flavobacteria* sp. The two characterized lagoons were not similar to the commercial inoculum. In addition, non-dominant bacteria (less relative intensity) were composed mostly of bacteria of the commercial inoculum.

Keywords: Pulp and paper effluent; Bacterial diversity; PCR-DGGE; 16S rDNA; Commercial inoculum

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INTRODUCTION

Wastewaters of pulp-and-paper mills can be potentially polluting and very dangerous, so they should be treated before being discharged (Ashrafi *et al.* 2015). The most common aerobic biological methods used in the treatment of pulp mill effluents are aerated lagoons (Bajpai 2012). Of the microorganisms involved in the depuration process, bacteria stand out; they are able to convert organic matter to carbon dioxide, water, and biomass, which can be removed by physical methods (Welander *et al.* 1997; Forster *et al.* 2003). The stability and permanence of bacteria in the system ensures an efficient process. However, lagoons are subjected to various perturbations such as variations in pH, high organic loads, presence of toxic compounds, and seasonal changes (Mueller *et al.* 1977). To counteract these effects, a biomass support material (Welander *et al.* 1997) or lagoons that are inoculated with commercial inoculum are introduced.

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Changes in Bacteria! Popula tions During Bioremediation of Soil Contan1inated ,vith Petrolcun1 Hydrocarbons

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Revista Mexicaria de IngenieríaQuí1nica

AEROBIC DEGRAOATION OF DIESEL RY A PURE CULTURE OF *Aspergi/lus rerreus* KP862582

DEGRADACIÓN AERÓBICA DE D,IÍ S EL POR UN CULTl VO PURO DE *Aspergil/us terreus* KP862582

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Abstract

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Es1e c!Stttthose n:-;th 76 ro n unat. pa11.ingica. ai lad:.i de unsudominero., oniom1nadocon hid1vcarburm, tN::iles de peuóleo (l l"rt>). e 1den111cfüi ..;\1111,0 b µc, 11/m*1,•r,y1u* KPM.62 82 mediante la l 'lÜc.:á de reacción c 11 caden3 de: In pohmerasa El poicnc1QI de b1odcg ruda ción dé e.Me c ult1\>0 pum f<C c,,.,Juó ,md l;tbor.1101 ,1 co ncc.mr:ic1on de I0.000 ü 50.000 mg. de d'.1C.sef/kg d._. sm.•Jo (pp m J, us;u1do mk rOC(S:100 -. cu n :,,uclo ,c,;fCOI dur: m1c t.,() «-ha0,,. La \:.a¡,ac1dnd de b1odttmdac1ón acrób1c.1 Jcl *.4.spcr gi({m· !c-rre11.1* KP862:Sjt2, luc ,;;1gm1icahvameme mayo1(p < 0.05, parn 10.000, 20.00ú y 30.000 ppll\. eón consrunle!i de vcloo1d;.td e.le b iodc rnd:.ic ión dd diC:;t;I de (J025, 0.023} 0.012 I/J1a. re pccuv.imcnh.:. La via ilidJd c:cluk11Jcl *t\.Vli' illw Urrt'u.*Kf'862 5$2 en e;,ta.s:¡,:on1.·ciut.lc i om :-. mo:.1r(1 un mcn:mcmo 1gniíicati'"°d urante los1>nmuos 30 J1;,i . a parhr di, t: h : 1icP\po 1 cllc:ii:oc:rn.<.le n: moc1-ón) b v1:1ihilfad cd ulJr Ji miuuyemn rn nsitlcruhlcnlCntc Ps11! rn m por1nm1cmo e nhM"rvl'>:-. medida que 1:1umi:n1ó la t.'(\ll<.:en1r ióndeldi-é.el. re-Uh.and o c.n un.1menor1a.,a de deg1;.ldación pa,ra IO,(>OI) p¡)m(0 .00:i 1/di':,> y50.(l<)O rrm(0.1I02 1(dir1JC.oo h-i,.1-t:en lo" re uhi.ulo,;se conclu)ıı que la ccp.,de *A.Jpctrgdlt,., terreus* KP862.S82 puede M"r u :uJ.:1en la bJon emcd 1i1d0 11de u e Jo.,;_con13rn1n:td,)"con HTf'. .-on C(1n1:cmr.ic1tl ncs *de* 10.000 y 20.000 r pm. y c ump lit cond L\.tPcs.tablec1do por l,1 regulac1.J11 Mexu::ma *faJabrM d u ve:* 'LJnétiéa. degrndtt<.16n ,1eróbka.. industria mine ra, $U los cont:un11Ht<b:i eo11 HTP.

1 lntroduction

Diesel o11 spill havc 111crc.:u.\Cd cons1dcrnhly and thc:y :tri! onc t.hc mam problcms of .:mironmcnlal pollution. Thc main cau$C'l of lhcsc ,;pilli:; in .soil ,rnd gro undwa tcr are due to 1he ii massivc pmd ucuon as fuc ls for 1rrobp0n;1tion, ;tccadc nlal sp,lls whilc trnnspo1tcd. and by lcakagc ol pipeluw and undcrground s1oragc 1..1nks (UST) tLcc *e, o!..* 2006. 7..ansmli *t'I ul ..* 20101. Diesel mi *ls* a m dioin

* *Corresponding author. E-mail:* adriana.martinez@orst.edu

Comencs Jists.i.v1ilable.11

Food Microbiology

Journ.il homep gc: '1. 111

Performance of 1nixtures of Saccharomyces and non-Sacd1aro1nyces native yeasts during alcoholic fermentation of Agave duranguensis Jll!Ce

Marrha Eugenia Nunez-Guerrero, Jesús llern,1rdo Páez-Len11a,
Oiga Miriam Rutiaga-Quinones. Silvia Marina Gonzále 7.- Her re ra. Nicolás Osear Soto-Cruz

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article nro

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Ncohi:;!14 (ete nl.tillQf'I
SCMtl')I ,1n.tl i.\

abs11 act

Agave jmce is fermemN1.ind dlsllllt"d iwice m ord('r io ob1.1ln Olf'l(.)I, ,l tf dlltonol sp1nt bevcragc.Tite go.11oí 1his .nudy wos tu selcct. yeast or}'C mtX(llr<'5 ,h.,>r co uld be ukd m mdu1trial producüon of lug!H.¡uality mc.1.cal Yc,uts 1sol.\t{'d dllllOg fc:mlf.'11l.Jt1on ul Agaw dura ucnsis wer<' tes-ted w ;dennfy 1hc be·st urains wnh resp«c co1he <:hcm;c.11 ,;.nd 01ganolep,ic ch.>r.t(t,msucs or tht ptoduced mczc.11 l' hree 1n(ll\11du.\l ye.ist 1ram were "it'!('cted ílli' íunhet swdy ro,ul.tsp<,rd ddbrut:ckiillram rrrHl-00Ma, 5.1(.ch.uomyttScerl'Vi;iat' stro1in rm,ootss. and Klu 'Vcromycr:.marxianus <Stnln ITO OOM?. An,dyso uf lhc responsesurf.1c 1>e1miucd idtent1ñcahon of thrce mocui.tnt'\.; one mi,m,re (7S'.rS.cc1t"V1s1ac. nu OOJS5 ,ln:d .tsi L <klbruedal fTI).OOfll,13'1 ;ind two ¡,ute SlídUb (100; K m.1rx.1anus ITO-OOM? ,ln <I lOCYX S. t (f cvi -s1oé ITD-00!8S ME>1.c.1l m de, by üü ng lhe inoculam con.srirmed by 1$% S.Ct'fev1:.H1:-nu. 001 5 :md 251 T. dclbrUC'd:1i rro 00014.1, (n, m,t:d mezcal 75Sc/2.STd) was ch t,.:•51 in tel111! uJ y1cld. ndmcss o! vol,aule cetmpnuorh. .¡mi acccptabdity 111 srnso,y t(>$1S. Wt propo::.C' usmg this mixture or yc-Jsts to dt'lielop .) prrxSuCI that c,m be used ;is "" inoculam In 1ndu tri.tl production of m{1'.c.1l.,n (I 01ht""í', s 11lrt1S from dif1creni ave,"J){>Llt>'\

lntrodut 11on

Fcm1t·nl.1t1on proce<'ds sponldncbu ly dnring productJd11 of mci c:.11by artisan melhods {). le lS dunr chts s1:i3c th.11 soluble-sug.1rs .1.1·.e transformed imo elhanol anc-1 o t h er compounds. Th fin,t day) of Jlcoholic fermcnta11on an_. domlnat'edby mtn S.,crharomyceiyeél!.tsfromthegeneraCandi.da. Kluyvc:romvces.lb ruJas pora,.and Pidua..tmong others(1 1 1) _ 'fhcse ye.JSts have low fetmenl,,ti\'e capac1ty but gcneratt• various fl,wor compounds, 1nrl1.1dmg cerpeno1ds, C:-.).1t:rs. higher alcohol.s, glycerol. ace ta.ldehyd c.', accmc lCid. and succuuc .lcid(1). Af<cr Lhí'.sc fir.).1 d.aysof rermentatlon. non -S1ccharomyccsyei:U)t:,. Jr-<' re plJred by stt.ain:; of S:.n:haromy<.'6 ccrevista', wlurh comp!Ni Rt1111{·nt.m un (1 •, 1 .).SJ)(,nuneous fennént.iticm cluring anisat1 pro-ducllon of mc.-ical h,1s two undes-ir.1hlc ch.Jr.1crer1sncs: lh E'

íN ni en ta uon timecanva!)' from3 to 9 days, ,rnd thc conc-ent ra üon QÍ re-s1dual sug.cu h. v.lriablc.". A)larter cu11re (inoc\Jlant) can b<' used to Mand.11thie the (ermeruanon process.mdloac.:lm:v('Ibetter l111hz.1uon of d)c ti:ro1c:nla bte i , ig.:irs

In re-cent ycars, some stud1es h.1ve uscd rnomotultures or co. cultures of S. t:f"f<-'ViS!ác and non-S.1cchJron ces yeas1 Lo ¡>rodt.K!! MM(1), mal\go winl! (}. and ol ugarc,,ne und pmeapptc beverage (,). Non-S3cch.1romycf.'S y aSt$ conrribuce co 1hc incrcased production of potysaC'Charides and can 11)mh1la1 the final concem1i1HI01s of a,e.11eac1d omd vol.l.-tlle-compouods (1). Morcovc1,11 hJs been sug-g<."sU.·dlhat S.1cch.uo1esand non-$.lcch.,1rofTlY(esyeasts mayacl synerg1sncally (1}. ror t-x.:unr,te, mixt>d cu lrures of cfocted ye,1.St'S h.1vc.- been devcloped as starter mocu1,mt:; to l"nh<mce lhe (lucJllty uf win(1 11 11 ,,), Selection of the .app1'opnate strJms is generally bi1$cd on cn1rri,1 such ,b fermenta!iv<' power. roJeraocc to cthanul. e,h,mol y1('1d. toller phcnoty¡)E", ;tnd low acetic acid i:>md u<tio n (1').

úwn \pclti(li;ttJ.<Mh01'
E rl\lJI.iddress: " " (N.O.!M'itO Crut.

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l l\1PROVIN G *Agave d11rang11ensis* .MUST FOR E:'l'.ll ANCEr> FERl\,IEN TATION. C/N RAT I O F:FFECTS ON l\1EZCAL COMPOS IT IO N AND SEXSORY PROP ERT lr:S

iYf E .JORA !VrJNT O OEL IVIOST O DE *A a,·e durmtfiuensis* PAR/\ LA FER JEN TACJO' N IV\E .JOR AOA. EFEG: o s u¡; LA RAZÓ N C/N SOBRE LA COl\IJ OSTCLÚN DE MEZCAL Y LAS PROPIE DADES SENSO RI ALES

G.C. De lo Ric-.-Dcras[1]. O.M. Ruu:ig_a,Quhbnc ' .
J. l.ópc1-M1Hnda. J.B. Púc1,.(.cnnu[1], .vi t.6p('I.) N.O. Soto-Cnu 1•
1 *Dc pa rumwm o dc ln¡:emt'rrfJs Qufmu:a ,\ Bioqttlima,. h1s1i1uu, Tet'noMgteu ile Duron,,tJ. Jffr d, Ft!lipc Pescador IS.JO01,·• C,,t Nta'l't1 \t;:"' 'Yª. J4080. Oum n¡:o, l)ga 1Un,dad1. Bi hfn ·nolngftJ r· lnxeni,•rftJ Geuhu·rJ ,fe /um, Ct'ntru dt'lnn 1 lig" cilt 11 \' E 1mliur 1h"1n:iiáus Jtd IJ'N. A¡mrrudt1 l,'u t(,l/6 :?9. lru1 m aru. Gtu J65UO, /11'.•t.:ico.*

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h l!\h '()rd.r C"/N ratio. mczc.af t ompomion, vof:nile mctahohtc. . ens.ro y cvaltuumn

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1.:n czc,ll c.an a bchi, il rln dk ,m:iJ destilad: q1,.u:.'>c ob1knc por ícrmc.n1.i ión de:lo, a.t.üc.arcs de :'1f:J\.'C En cMdn b ¡b se dc (l ml11aron 10>e-(cc10'>de l: 1rclaL:itín CJN)' fa c-onceHrac10 n 1111d:)!dé ;.vite.ues.t:11d mostodi:tgm 'l' clurm ¡g cc.1fi:i o l>t\ fo mi C li i;:a J<.:rmcmac 1ón,l ..iW lllf)<$fi.:1ón)' la t:\ lu1u1ó1 11so,¡¡Idd ma ca) pí'OOcs Jo. l ji f ..:me n t ac1 <\n del mo tu tic *A d"rrmgut>,t i" fue* m<'Jm-ad.ip, dia nle l,1, 1Jic i1.n de un 0",i di.! n1lrc t·uo,1 <4-pN l:<' ial c-n ten hln or, nal, C'Onl(\ '>u1fo ., de il111on10:• un <'0c n t rac dn nu ci:d de 11.1.1kar de 150 8/l. l:.,uh CC1ndic,onc:,l nk il,é i; <:n cJ nio:-10de ícnncnut<"ión pcrmn, mn el umcnto <leb rr Lx,l11.:c1un Jede et:mol compue., tm , ol,i1ile . tille¡como! ct Luu de e.ulo,2 hu l oo ly n propa nu,l a4-ic:u11 l,l<bnun ucónde I¡¡c111 1d.-dde:1c:1d> uc.:tico, dura111 kl f,;,rmh·nu,;iln l .ul rcp ,:b l1d ad dd prt.lducm tin:sll rimbi l:n e 111cnm c n 1ó.La pt hcJ..:i1nl<:omc rcial dé L'<!a:....:omlicionc$1mu:..1,k en l:t 1l1 t póic iú 11ckl mc,.-.1pu <:d..! mc j ."tf.tr d pr fü é.'$0 dl"1n ducc 1óndi: m t.col, yn 'IU! pue,lt :11n"1Cr.1;lhel 1,pmw,:h:.nt 1U1 dt')a;<mmtn1.1p runa de,:uxk'l menos uzúc-ar rcsl<tu..11)' mejorar lti accp1.ibll!d:,JJd produ,:10

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African Journal of Plant Science

Ful/ Length Research Paper

Characterization of fructans from *Agave durangensis*

Alma D. Orozco-Cortés[1], Gerardo Alvarez-Manilla[2], Gerardo Gutiérrez-Sánchez[2], Oiga M. Rutiaga-Quiñones' , Javier López-Miranda[1] and Nicolás O. Soto-Cruz'•

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Rec,:f}lVOd 23 J:mu:ary 2013; AocephKl12 Ai9 1,,JSI, 2015

Agave plants are members of the *Agavaceae* family and utllize crassulacean acidmetabollsm (CAM) for CO, fi xation. Fructans *are* the main photosynthetic products produced by *Agave* plants, and are th e lr principal source of storage carbohydrates. The aim of this work was to determine the chemical and **molecular characterization of fructans from *Agave durangensls.* Fructans were extractad from 10 year** old *A. durangensls* plants. Trlmethylsilyl derlvatization was employed to determine !he monomer composition. The linkage lypcs in these carbohydrates wero determrned by mothylation followod by rcduction and 0 -acetylation, and fínally analysis by gas chromatography-mass spectrometry (GC-MS). S amp les were shown to contain t-Jl·D-Fru f, t-a-D-Glup , i-a-D-6,Glup and 1,6-dl·ll·D-Fruf linkages. The analysis of the degree of polymerlzation (DP) was confirmed by MALDl·TOF-MS, showlng a Wide DP ranging from 2 to 29 unit s. The analyses pertormed revealed that fructans from *A. durangens/s* are formed of 97.11% fructose and 2.89% glucose, and are a complex mixture of fructoollgosacch ar i des of the neo-fructan type containing princlpally 13(2·1) and 1!(2-6) li nk ages , wlth branchmoieties.

Key words: Degree of polymerizatlon(DP,) GC-MS MALDI-TOF-MS,

INTRODUCTION

Mexico has been con,s dered lhe cenler of orig,n and biodiversity of lhe *Agave* genus, due to the taxonom,c diversity found within its borders. Of lhe 310 species reported, about 272 can be found in this counlry, Members of the Agavaceae ram,ly are dls1tibuted throughou t Mexico, and are well adapled ,tobоU, arid and so,m arid regions (Garcia -Men doza and Ga lván, 1995). They h ave under gone both morphologlcal and

·c onespondtng autor. E-mail: nsoto@ltdurango.edu.mx. Tel: (+52) 618-8186936.Fax: (+52) 618-818481 .

Abbrevlatlons: OMSO, Oime1hyl sulfoxide: **TFA,** rrinuoroacetlc acid, EtOH, elhanol; HMOS, hexamethyldisilazane: NaOH, sod lum hydroxt de; **CH,1, iodomethane NaBD, sodlum borodeuteride; NH,OH, ammomum hydroxide: N . nitrogen C0 ,** carbon dioxid e; H,O, w ater: CAM, crassulacean aéid metabollsm; PAAMs, part,ally melhylaec sldtol acelates; WSC, water sol b le carbohydrales, OP, degree oí polymerization; GC-MS, gas Chromatography-mass spectrometry; MALOI-TOF-MS, matt-ix assis ted laser desorpton time-of-flighl mass spectometry

<,)·1:1 ,foomul 11/ l-nml. 21114
\'ol l . o l. 1 8. lmp:·'d;\'. J0, o,g,'IU.!0$() J<C H 7 20n nf)t,37

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ldcnli ficali cln de u,rn ce¡,a de lc,·ad ura con potencial de reinicinr fermentaciones ,·ínicas es1unc.ndns; una caracterización cinélica

l..Rodrigue;,-Sifocntcs . J.D. Pic.r-Lcrma' O.'.\i. Ru11a,ga•Qu1ili'ln(:•\ J.A Ro1as.-Cl)n1rer:is , F Ru11.-Baca .
(i Gul1Crrc1 S:inchc;,, í:. Banio ttnd Soto-Crut"

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!Rc«.mic:d i) Di:rcmrn:r N1J:: _rwuf rt'nmed 5 hd,rimry :tUJ)

Rc\!•r;cr)'C3tt.Wun.: ;1w 1r9.XI h.1..oru.urnc r,·,1du11I asui;11r ln1::11nly lni, ·) 11, q1.,d,: wuw \•rm.•n1111;,m,1 1l i,·il "t'I. '>I1,u1,11M 1\..: ,., ll: 1lc l,1 1 l •l¢ !ly S l1u " 11'!).YllO !l .;,J10..._.:\I :h ·h1 h,·1,1-....ih.1,..,t,•t th•• mn).,1tnt.1'l it\1\lotb ru·c, \ 11l r1..4-,, ;,,, o.1111,1,m1piio-1 , . ti: ,11.,'lJ nu unwn cUi11MI pr,tJUl.U<ln r,,1: 11)14),O 26:-: • rA.O.Z;1" t.:>?'" \.:h) ·lli,tft'ÍoJro:,11 i.:l,: -icd !O! fo1 1l "t Jtld lu:t'llc 11..tll.l) . S ltn.r ;inalu;. i<J.:ntifkd lb:!- iw Jlit· lb .•i.u-cJr.irr;,m,c,"J.1· (,:'1'!11.:,r !-tr,1.ill m }-00(1bll, l.'.t'OSl.iltl 1 00 % ;:.I\J)(•"" ;,(1t1,• Í HIOl::<Ji:t r!'l!i 't'.11(.ti 201' AlfllJV"t'.t.:i.pc"t:U\t:Jyt whto cu!l 1:dln incd..wn will 12 ./vi\•t cthJiOOl 'l l!é iruc1Qt1c (<'füWllf!ti<ln Nk v. i,tc J(;b)- q 7· " 11t3tl"(' '"111:n cth.1mrol ":h 11111i.t.ly p1i..;c 1 1l n t!W.-mnlu.S , ,,,v,1fom• l'l Ú·UIIO'>ll w.i<.i<.'lo!\-;; ,11,:ud, Íi:'tltl-"t1iutm·11;:111fü 111l,-;and •,l,•u:. ablc!\t \-11'1 l.1 ,: 1u 11m: n h 1 1-l h 1., a \'.'UmnlCt\'i11I11!.J \011.t. d.:.m11.'IJl1 11'li haJ.) H'l'°l'JJ1m• JIO,tJOD6ltl\ a p.:t<.ll.'Ul.I 'Wll 1lh IN 1 k 1111 ¡1 n:,siartcr- in \\inc im;d. ícrmcn,:n,vn nl z/'>•('

Keywords: fructose consumption; alcoholic fermentation of agave; mezcal

l;l,o;pt6 J,:ku1di= l'l:llllCl.l&fít Lhh;,:.np,..111COht t..rur k, \ll'Íle,,r.:.. n:-<r.h1a! n"nJ')ollm'91t..:fl\1(f•J..;l!,:,,ícrm.:'l\l!l,.lunJe\-m,r."t c<t11n ,1(1:i,; l .:1: ,:l,:'Q 1-i-:1 e ¡MJt m'l··iu • nmu J4• lj ... ¡u, J: ICVd\lUm J.a .:.crn ITl}.<)l:l'IN m1 n.11l \':t'11r -s ltla,I alm,,: de l u,;¡u n1li\lln1,; di: ,nx-nn,cr.!<•• ..-on l,JtTIO &.- fü1.:1t1:,a)' rr(ldu,c. ·;fln ik c-1.l llill •0.113. ú,2(,lo, a d 0.231 li '. l':'{l\'.:t1vnn\cnk). J'vr 111 t noi,.,, fü ,· ,ekccu'lr:.iln r,.ir:1 l,\!. f"* , 1i,'r.· nmil i is nofocl1\-ir,;1)' c10 1cM l.M VI'1 ,:il<.'\'(1on:11.h la <'<'pi! JU\• h.i.:n1l•1.-nrla pl'lr m.:ti111 Rfl ¡)1!1v, S:1;rlum11t1l/\'... (U\"1v1iu..- l.:i«l¡):I n0 -0 1ll)(,.¡ C>.!1)$,11,0)(,\IÜI>""r)(, . tk IJ tit.1.:lc)\.t pr,.·,i.'l'lh'(ll l)"(:...l ℓ, h.!J.N'aiv3tllcnt l<:wtlllk) "" cu)uvó ; W enc,ho (•lU una ooc1C'i1rln,,::·l"iutul<'i11.l ,k IZ" (\·,) J.: ."1am1I b1 1,,,a c.l..\:O1h1.1,k fruct1.1 ,;e !\"Ú.l)Q (11\IlJ')7% 10"T ·\1.1m,lo..:J w11>l .;sh1l pw 1'1llt:c.lc..J.: .:! uno;,,:u.;; m.:d10 d\.'u 1lb\l'. .) l'R"\'i1 ,· fTl).{lij(lfll(..: i:n ,1,,1 01,<tlllthi--iunc. <f0 i.1m "-l. 1 1l ,· lám::;;cl,a Vfü,:C.ll,11/ J.: c1.1mplr<11r t. <cmx:n!-'l:i,:,n en I M h 1·n ,·11,,,1i1,i..:..,,,,¡¡11,-in\ '!U!:J..·"""""tm1.jU.:-.,; ,.,.,\ ITO-(k){)(,:u l l•l ca11,hd11,1 po«cnt:"ial pum $ IHl.• <.<Jt1\u,,., rl,!'111C1l;tll ·et !u.f.:ffik':'l(lb.!V1\.:,1,m,:.ii.!11,.:!()"C r-.111.bfasd :1•f-l: cnu uu (Id.:fnR t•..:a, (cr.nc1,t.:.t·1lli1 J.!c<•h&h,.. Je a a,,• 1-r. r.;;;J

J111r od u c tio n

Wmc ¡ tuJ uct.I>n 1s -omp c prnc :;, wh.:re yeas:.,¡ (pn n(ll , {¡((,.'t',b r.m1·c.\·c. ,, ,·,.,·iael m:nsform .sugars prc,; ,u in grnpe u tc,; mto 1N11u,I, C'O, .:ind c1h.::r 1111pon:m1 n\1}.100 htcs a;,0 . ..:rn1,:d w 11h Oft:in,1kph1: qual111 " (l'cre1.•C01.'II,. iln o11c,;,.Pi=,1/,. Ubl..tl h1.ltv.o , & M n in-Al.,mcz,l'i' .J) Onc ol 1hi: mo:-1cum monproblcms a,) f'ICiJ ll"d ,.,ith WÍJ\'I! produ..:tion r l.rck Fl!nni..-1,.

1:11i1>n 1h:u rcsuhs whl•n wa.1-t >:ll,p rrn.1.th<ltu:·aclJ\11cis and "uiani prcu, i111,:r.1pc 1u1,;1; ;m: oot .:.ompl.:tt;ly fcmu.•.1u1..,J(B1sltl,n, 1+;<, i) lintr..:1lMfüx:dsUf.IU'li- rc uh in lowc, c1b.mol yidJ:. am! conta1110:tu uf thc tin.d p1odu.:1 wuh n,,1,; \·e1mcro,11.;.m1sm:. In :iddi1ion, .swtt< il;wor 1s undcsirablc en dry wm s IBm hcJi;, ('rnJcm-Oicr,\, 8.1U<.·r, 'r hc..,•1 m. & Prcwl'iU

Scvc 1:ll foctors u1<:Jud1.ng nulnen1 cl fiCCncte :0. .1nd 1he pre-saneeof 10.x1c oomp)1nd lhwc1:'1(!11 i.k mdicd .1>,auS(.-:;. IC';l<ftn 1n \u.:kfcnn nu1ionol nd n1..1r ac-1.syncbrnnoulym ye<1s1cclls (r'\ l<J"1.flnd rc- & Ch:irpcnucr, 1 ,. : Uis"Mm, •,•,·• J)on b k &

h11:,.'f11m. ln>].!"aCU & Auultc. ,,,,l; M:\uocfo. (iu1J(), & Orl..:g;), 1'1, r,unputtrn & f,0ur,;,1ro•D'.u.s,, "•O; Salmo,n 1 •) l:lhanol hl\h:Cly 1s un,: of ch.: most ttt1f)<.rn .1m 1 .:aus,.::: t)r 1lm prohfom ('\l.:"and."C & (' h:itp;Ol'C'r, 1'19:,,; H.1sson ll, "l 1\s to:ml>l 1:11io n pr.:, -c(!;;.cdianol cc,n,:cnm11uns m(:r 1sc :11'hl me yc.i,.1lrams rr.ay b.: lmubl t>Jsimw undcr tbcsc1..,mJ1(.vns 1\1 1h ss mc 1ím.:. t:1tunol r u11, iu dcc-rca..'-cd sug:ar consumptton

í;\ f1SJ1.u;y(.;ak-o1c.Ulomhn. Ol-t¡Uill. & Sabla)•r11llc:1. _;c1111 t Ounog mnc r.:nn r.l.i.l ton, WUh! yca..;1s oo-fcrm,1•l(g l u o1:1 /ic :mJ fru.:tu : 1:.tvg;,r,; pn.:stnl 1n g1 pc JUi cl Yc.í:,;L-. tLu.11)' ,,rdt.'.1 t,:hu,,,:-1.• 1nst1:ad of f:uctosc i8 rnJ1ds . Cordc ro-Otcl\>. Uaucr. l'…h,nu,;., & Thc-w. ll'w-, '''': fü::1bcls c1 al., _:11,4; 'f nmchvm. Clamcro.Amlyo-Lo¡,.:t.Oarno.,1;¡;Qucrut, _IMI'•I,anJ11ccumu-l.1ting fn.n:ti•:>c <:l)fü"'l1trm11.mi,.ti::>'Ullm the developmcnt u!'stuek fl.'nncnl.don •fli .,¡>n ,i,:. Oul/.-<c-. 'lf!!) h ii,;. .kno,q¡ 1ba1 m n•n·1•l.n11e glucn,.é .md fructosc .11-..: lrurt.!>-l)On d l1m) 1hc ccll hv 1hc x\1n r r tC'tlb (Rt'1tc-nh1.'1g < Fre tdc-1, & Ciri;ity. I·"''';

*Corresponding author. Email: rsoto@itdurango.edu.mx

Microorganism Degradation Efficiency in BOD Analysis Formulating a Specific Microbial Consortium in a Pulp and Paper Mill Effluent

Luis A. Ordaz-Díaz.•[3]·ti Juan A Roj1s.-Comrcras.[11] Oiga "1 Rutiaga-Quifionl!Si
Marrha R. Morcno,-J mcnc,_• Felipe Alal!'istc-.MondrJgón.'and Sergio Yallc-Ccrv,u1tcs'

Pvlp and paper milis are a major source -0f p ollu tion, generatmg tiuge amounts of intensely colored ctfluont that goes to the recerv!ng end of a wastewater treatm ent ptanL The b1ochemlcal oxygen demand test {BO D;) rel •es heavtty·on th& m;croorganism metabohc capabiJity addedto thetesl as seed;ng mateuat The seeding matenal in the teslmg is obtained from sewage samplmg ar from commerc@l sources. Spec1fic organ ic p ollut ants that are prnsent in paper and pulp mili off!ucnt can only be *degiaded* by spec1fic m1crobes. 1herefore, common sewage or synthet e seedmay fead ,o err-oneous 80 0 ;;, estlmabons In this study, spec1fic m1crobaa! spec,es were se!ected to evaluate their deg,adatton eff,clency both 1ndividuayll and in combinaion The m1croo, gan1srns selected in tho formulated seed exh1l1t BODs in a reproducible and synergishc maoner The formul ation of this speci6c mlcrcbtal consortium can be used to devetop b1oremediation strme.g,es

Keywords: Paper and pulp, BODs, COD; Degradation; Formulation

('w11uct mfomwrrou: a:t' ,lumfrul ,u«I lliudm,urn/ H11grm!en,1g Dr ¡1<1rtm 1111.1 JJmvngo lnstrtrm! c,f T('(11m;/vJ!._\ (11l)).JJlnl.hd, J>,,rc<1do,· JRJO Ote.<c>J. \'11em f·:zcoyu, J,/0,0. /)uro.11:U, Dgu.• ,\h<.m:o: lr:Hm·tr011meu10J/:i,J,!illt'c>rilJ 1lfd malo J<>•,·l m1-e,:(idad J>ol,r<•w,cv ,fe /)r,rrms:n, t'mret ,n Ds;_o .,\J.::t1(·0,

km 9 J, ('()/ /)afo, J !l rr falxo , n1mmgo. l);w. \ /é.rt,,:: e Pow:mm /1nri11m· 11(ScU'111tJit:1.111d T dmoln¡.:icul Rest•a,· •J,,Cam iltop /a p1't!Ju Sam Jq.,J.]()5.), , 'o/ l ilmu,",/ l.l'<rOl,,(' P 78116, Sm, /,1,i.v l'c,toJi. SLP • (·11,·1v:.f'(md1,i¡:autlmr:\·mlm,,7'r, luumaflcon,

INTRODUCTION

· n,c pulpand papcr mdustry comnbu rcs hca\'1ly to \\atcr pollution."h ich gcncralli ariscs from úw industrial use of libcr, ccllulosc. and lignin: 1hcsc componcnts can ,mpart hip,h COD (chcmical o ,gcn dcmm,d). color. and BOi) to 1hc cftlucm (S,ng,h , , *al*. 200X) · ,11c HOD; tcslmg is 1101 spcciñc 10 tUl) pollu1an1. bu1 c.'Ul be uscd a., an aggnogálcd 1,aacr quality paramctcr ind,ca ting ú1e an1ou111 o f b1odcgmdabk orgomc m:llcrials in tcrms of O)gen consumpu,m (Pcppcrc1*al*. 1996)

Most o f,u c industrial cfllucnts ha,·c thc ncccssaf) nucroorganisms 10 rcalizc thc BODs tcst withoul adcling a microbial sccd 10 incrca. c its cffic1cucy Toe, ox, gcn uscd b)' lhc microorganism to degrade thc orgaruc mattcr is mrosurcd by tbc BOD, and ch:mgcs 1111htime and conccn1r.1t1on Usmg microorgamsms obtaincd dircc1ly from thc proccss *vio* ,solation and acchma1ion impro,es ,e 1reatmcn1(Kumar <'I<*1/* 20 1O).

l'rabu :md Ud,ay t oonnn (2005) reponed that 11h11c rol fungus d1a1was 1solatcd fm m so1l smnplcs . cnnchcd by continuous pulp and pnpcr m,11 c ffiucnl irrigat,o n. and idcntificd as *l'. chr}wo.1por111111.* "as capablc of 79o/o CO D rcduct1011. De Olivcr-J *e, oí.* (2009) cvalua1cd thc ability of *Baci/111.,r111mih, 1*CUMA!00081<1produce alkahnccaz)mcs

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Scrccning of Nativc Ycast from *Agave duranguensis* Fermentation for lsoamyJ Acetatc Production

Geranio Jlcrnándcz-Carbajal[1]• Oiga Miri:im Rutiaga-Quiñoncs[1], Araceli 'r'c'rc;,;...", va•[2]

Gcrardo Sauccdo-Castañcd al, Adrianc iVll'd ciros.i. Carlos Ricardo Soccol.... and Nicolás Óscar Soto-Cr uz ''

' Jnsltt Jd() TeC'nologitt> tfe Dum ngo , J-'t,/Jµe r .sacadQr /l;UIOh'. .i4IJXIJ; /Jurpt1JfO México ''tn.wtuto Ternfllógil'O
t,• Tu .t lep,:, :; Vfclor Bruw, Alnlja /11, IJS.150, T u.tWp f'<, U:i:uü,1 'Uuh rsülotl 4ut,'u,omu Metru¡wlttmw /;wpalaµu,
SiJ11 RajU,,J Atlirco /81.. 09J./O; Mén('lJ ¿ U m vt 1·n dw lt- Fc:d1,ru/ Ju Punimi: ,,'JjJJ..99(), Currtd,u . PR- HnitU

AUSTRACT

In thi;r \1,--ort l i/ t1·)'e<L'fl M m /u,\' isrJ/a1t•J (m m tlu! sµc1h!m,111tu• 11irohohc. fc•n uc11dt tw 11 1>/'r\g:.we duranguen is *,a ¡,roduc mt:cM, w.:rt> t ·u:d usinJ,? lht.• ,lrmhlr* C'<lttp lm g 1,r:.tt!m *J)i., ,, W<J. t.1' we n : front tl11..· gumtru* richia. l orula,p ora, Sac\'hrí>myc.cs. K lu.yv\.,1omyC4.:.,, D" x:kc m, l larL:'t'tmspor.i c111d Ca 11d1k!a. P. lcrmcnt;ins */1'DfJUll>.i wm th,·l,cst ,sntJmyl (tn.•{(lft• produt'cr. 1,•1eldmx U.3S g.11.o/ ester t1/fcr innrbmionfor 24 h, 11hilc* K. m.ir xianu:. *ITDOfJlJ f prnd,o:ed O/ 2 gil nf f \'U'1 '/'lm.,; t'* C:nncntan., */11)0f>lftJ cnuh! he t·rms ,dn ed u\ ,111 ;.xn•/1(111 r-hnfc•1• (m• u c lrl opti111i:atto11 $/11diitf o/ 1'1 ndturt• m'1(/füm ami h ,or ,•nr tq,. vpt.rotm.i:. e<mduloll...\' t.o J,•,,elap tJ f>l'Ol't!SJ' .far h1,m¹1hnologu:al produr1101t o/ i..,ua,rw/ 1u,•J(1t(!*

Kcy word\: U tnan:1;u'mna, FooJaJ <litivc, Na11vc yc.3Sl S!i.nn.?>

INTROOUCTI0.'1

, \ vasl array ol' compo unds. sm:h as akohob. cslcrl. fauy ae ids. a nd ru1phut compounds may bl' rcspo,ns blc fo r lhc ílavor or foods (Grnt lid d. 1988; Dut>a l el al. 008: Krings l 99R). o,>d p1occssmg can ..:a n:-c a wc:.uk a1uma in thc final prodm·t hcncc. u ,s acccssary 10 u:-.c. th additivc:, (Lc mos el ol. 2010). :vio;¡ o r 1hcsccom¡x,und are produccd by tite cuc,m c• I synthcs,, , but a rap,d shiil to btosynlhC!iiS is ta king place (Jnnsscn1'.<''1 11, 1992) bccausc co11stm1crs havc de, clopcd a 1endcm ·y to preft!r tlu.:: food wtth n ••na.tur:ll'' l;1l>e l (Jansscns et al. l99 ; Lcmos e, al. 101O). Jso;¡myl acc1at..: is :m ester w11h g r c at 1mcrcst in thc íood indusl l) '. ll ha; a consumpuon o r 74,000 kg pcr ye.ar duc 10 its charactcris1ic ba1H11la smcll {Ton'C.S cɪ aJ. 2009).

YcaslS r roctucc CSlcrs by cs1crifica1ion l)Í a.lcohots w1thacc1yl co -,enymc A (Vcrs1rcpco et al 2003) Two çenes c:odinn i'or thc cnz,v mc alcohot a..:e tyllr:msforasc havc bec:n 1dcntiflcd in *Sai rlwromy,A•.,·.,·.,•rf!wsi<le* (M al)on :tnd Dufour ::000, r his .:nzymc i.a tal yzcs thé fi:!.¡h.1011 b tw n acc1yl co-c n1.ymc A and alcobob Ycasts also produce cnzymcs w11h ester hydrolasc:1ctivi1y and lite balance b 1Wl'-CD thcsc 1wo a ntagoni:;t.ic entymi! activnics dch.:nm nes 1he final coucéutrndon of 1soamyl accmlc in thc ícrmcma1i t1nsy wm (lnnue et ni. 1997: Fukuda et al. 1998; Yt>s,hi noto el (11. 1999; Rojas et a l 200 1). Oda (1996) dc vcl opcd a sys lcm fo r thc ¡>ro<luction oi c«crs, <,1llcd a doublcdcouplc,I systcm ! DCS).

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J"';,.,./'111,1,, ,,,,.,;/,,JJI ::· l, I .' ,.., !•1,';
1'uw,n,t/•.· lt1•fm·,C ¡ ·..,,,,,,,,1,11,i,,,, t / 1 '''
l JV .fi",V(,. -.J.f1iJ •t l •, l f"_i: .J 41-r,1i/1,11
nor· 111 u '"l·'" "N.' 1.10Y11J .,;·j,1·::,..,.·

Taylor & Francis

Yeasts Isolated from the Alcoholic Fermentation of *Agave duranguensis* During Mezcal Production

Jesús B. Pó ez-Lermo1, Armando Arios-Gorcío•3 Oigo M. Rutoi g a -Qu1ñon es[1] Elodío Barrio ond Nicolás O. Soto -Cruz '

1 D•cp íl.t anw n to dt· J o;en i(•1fa.-:: Quf l) 1t-.1y IiL1q111mi ca, Jn stiluto 1'"ecnolg ico d1· Durango. **Mexico**
JU<:partarnento de (:enl·tlcn. Universidad dt.' Valtncia, Spam
: in pn n a me 1lt u de Rotruuca y ZovJogin. Univc:r$idad cfo Cuad11lajru·a, Mcxlt:u

) Icz fl il i a spint. prnrluccd Hl ;,;orne rcginnsof Méxicn. In thr SlalcofDurang<'. mczcal iR
fl t l d t1C(.×f via t r':c!c.lllion3] fcrment.af mu Df Ih,, *A,!?tfl* /u r,r1iJ[111-11si.,* p)mu.To bc1I.PLun dcr- sta ndlra d itoh n J fermenuu1011 processes , it 10- necessa r.v t.o know \Vh h .vea.st .apecies Hre r1·(!:;tmt in f ,imw n.tation: 111 diíl'BT\•ni pmducer rcgmn. 'l'ht> aun oft h l r N n ; h wo Lo, cu dy ycrt.$1.- lrn oi \1•d m u Mnnon m inc1J. 11 fel mt•ntatHm Ih Dilrango,Mé.x uo,
!':llll l In\IC' t1go(.d h<þ h ,vlngc ny of I h .. nAI ,*ve* Sr,n:hrt.rnm_wv. ,·,14l.•i ,,*lcu* :-b·Ains involvt. J m thi proc s. The5.SS-í'J\") genomll' regLOn was }lnalyzed to 1denti(y strains prcsent tn theferm ún t .ain procc.;.ssamples in thls study.'To diffcrenliat strruns belonging to thl!g'cnus*Saccftar<m1y(·e.;:.* ditl\•rcnt 111olc 1.:tild r tc..·d 111iq 11l..•S \\' e n • u:<;:,d induding analySÍ!í of mitocbondrfal ON'A and \ clPmcnt:;. imd ió!Pqucnr.i.ng of the: fi.8S -1TS gt'nomic region AJthough 3h i h dlvr,r•nty ol mict<>orgao, m:- w:\;:; rOund al Lht' hc;nna ing ()f forme n La- tion, *Sw·d1<u·umyc:,.,:s 1·t:r1.·c..·1 w,·* was the on lv) t-ast prc.scnt at thc encl of fenuc.ntation in rt:gion J, whil '*J.Orufosporo rlc>lhru ·cku* was fuuncl in u hi lwr numb\.·t titan *S. c1?1-evrs1ac* :ll rlw c lu l of fn uc o tn 1ion in tJu..- l'<:"ginu 11 :'\Jult·t·ul:ir tcc..·bni1111t· d t.·h r lr .-it d lhat Sa(·ch,,n,rn.,,• ..... *r·,1·1 •t·1sw v* i:..o1nt Pd in Dnrnn n are phylnfeot ticaUy u'Jdflpendent from t.he stniins isol Lcd in •Jlhcr' 1'fi:g10ns uf Lutrn ..\ml'1'ícn :1nd EurOpL-

Key Words: mezcal; native yeasts; *Saccharomyces cerevisiae*

IN TRODUCTION

Fermeoted bevc•rnge bav heen an 1mpor ta nt J)al'l oJ' Centra l Americancu -l ture .a:incqun '-H is pnn ic tin1c-s, wlu)n Mt•sonu10rica11 c1vili.zations fein rl' to d

Adc lrc r n t T C' JMuclcrt<C' lo Nicoh\i:: (J So10 -Cn 1,¿, DcparLamPnto de.·1"l lgt•mcr lns Quúnica

y liw¡u lm ica, lis l!tuto Tecnológico ele IJur:rn¡¡o, lil,·d Fd11:>e Pesc«dor 1830Ot«. 3 40 80,
Dur a ngo, Dgo.¡ e:tJco: E-m¡-¡j)· nsotr,@itduunis:w.edu mx

Evaluation of *Eichhornia crassipes* as an Alternative Raw Material for Reducing Sugars Production

Héctor /\. Filc to-Pérez." José G. Rutiaga-Quiñoncs,° Cristobal A¡:uilar-González; Jesús D. Pácz,' Javier Lóp :rry• and Ol¡rn M. Rutia)!a•Quiñones '·•

Water hyacinlh was analyzed lo determine its he micellulos ellignin conlenl, evatualing lhe condilions for the saccharification process with commerc1al microblal enzymes. Plant material, inctuding leaves and stalks. was pretreated at several temperatures (100, 110. a d 120 'C) wilh dlfferent sulfuric acid concenlrations (0.5, 1.0. 1.5. 2.0. 2.5. and 3%) and residence times (O. 15. 30, 45, 60, 90, and 120 mln}. Total reducmg sugars were measured by the d1n11ros a lic ylic ac ,d method. The optimum conditio ns that maximized the yield of reducing sugars included a pretrealment w,th 2% (v/v) sulfuric acid at 11O 'C for 90 min. The optimum conditions *for* enzymatic saccharificat,on used the commerciat enzyme Celluc ta s t al 50 ·e for 24 h of hydrolys is. The max,mum y,eld was 0.54 g of fe rmentable sugars per gram of bíomass. Data demonsttated lhal /:. *crassipes* is s uitable as a raw material fo r products such as bioethanol; however. furlher fermentatron studiesare required.

Keywords: Bioethanol; Lignocellulose; Pretreatment; Reducing sugar; Water hyacinth

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INTRODUC TION

Water hyacintJ1, a frcs hwa1c r aquatic plat11, , nativc 1013razil. 11is an ornamental plan1 found in dillcrcnt countri, s around che wo rlc.l. *Eíc/1h{)r11ia cr assipes* is uscd in tradi1io nal medicine and 10 removc hcavy meca!s l'rorn water bodics (Ganguly *et al.* 2012).

E. crassipl!s is considcrcd a wccd m1d so mctimcs cvcD a plague around tl1e world: howcver it can polcntially he a rcsource duc i1s h1gh carbohydratc content (18% ccllulose, 50% hcm icc llu losc). *E. 1;ra ss 1pes* may he an cxccllcm sourcc or sugars, which chen can be fonncnted to produce cthanol. The biocthanol prClduclion 1s achicvcd througb threc stcps: prctrcatmc nt to libcr:uc ccllu losc and hyc.lrolyzc hcmíccllulosc; hydro!ysis of both ccllulosc and hcm1ccllulosc 10 obt in free sugars. and 1hcn fcnncntatton LO convcn ú1c sugars to alcohol (Singh and Bishnoi 2013).

In 1vlc xico. ut1li, a1io n ofncw lignoccllulostc matcnals for biorucl production is of viat l importanct' to thc futurc of biocthanol. Thc use of li¡,'Tloccllulosíc matcrials for cthanol production is favorcd by abund ncc and low cost. *E. cnt<s1pes* grows very fast undcr thc climat1c conditions prcscm in somc rcgions in :vlcxico (Kumar and Wyman 2009).

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() JGIJ'IAL l'APER

Volatile co,npound production in *Agave duranguensis* juice fermentations using four nativc yeasts and NH_4CI supplen1entation

O. l\1iriam Kutiaga-Quiñunc · Érica Córdovu ·
M1)rín. A. Mt, rt cll- cn:ircz · J,)sc i\J. GuiUamón ·
Nil·olas H:uzC.S • J t S lí Pác-1.

R cci,·cd, 24 Janu11ry WJ::!/ R", lwJ. JO htH:h1012/ Accc.-pt.:J . 5 1\rnl 1lll!
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SHORT COMMUNI CATI ON

Effect of glucosc concentrat.ion on the ratc of fr uctose consumption in nativc strains isolatcd from thc fcrmentation of *Agave duranguensis*

M. Díaz-Campillu · *N.* Urtfa • Ó. Soto ·
E. 6:1rrio · ;\l. Ruliaj!:1 · J. Píícz.

Rcccl \(.;J ; 9 Ja:nUiJ!Y 20121,\n :\.•pct-J . 3fl July 2<.J J 2/Puhh11h(.,J ..-.ul mi:. 11 AUL! ',I" I :?Ol2
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Ahstrr1c1 Stud1c:,.. on h xn:,.c ('On mnplicrn hy *.\tlrd,arti-mvr:ts cer11·i¡ i(l(*' show thm lucosc is con umcd Iaster1han fnicto,;c whcn holh re pr :-.cn1 (Q:1 Jrucw c Lo glucn,I!) m Lht' mcd1111n during lhl! tcrmcntmion c,f Aga\tc Thc objccuvc of lhi:-. worl wn., 10 8clcc1 $trai11:,. nf *S. ,:t1r<'nM cU'* th:'H t o ns.umc íructosc cqu::11 to or fas 1cr than glui.:ose ttl high frucLo.,c conccn1ra1io:1<. by amdyz111:;. thc inrlucucc uf difforem glucosc conce.ntt:uion on the fn.ictose com,ump-1iou ratc. The oplimal _gnwllh t.·:nmlilionswcrc dc1cnniucU by :L ldneLics assa} us:ing lugh perfonn,111cc Jiqu1d chw-111atog:r:.iph y (I I PL C) u,;rng *50 g* uf glucosc t1nd SO g of frunosc Pt:1 li1cr ot ymhclK medmm tom:nnrng peptone nd)'e3)tlcxtrncL Usini;Ihc.\ame ubMr;Ltec-once111ra1io1h. !'Lrain fl'D ()()l85 Wn!<i :,;h11.wn tn h11\'C.a highcr n.:.iCliOO J':ttl' for fru.:Hl-C owr glucosc. At 75 l! oJ' rnK \11Ɒ:.: :rnd 25 *g* 1,f gl ucoi.t· pcr hter, srroin l'rD-00185 b:iJ ::i product1\'1l)' ol 12 g-l.. I h I af1 1 40 h J.nd a ím c1osc 1-a1c cons 1am uf 0.07J-h t . h was ,hscrvc<l that S,?lu.:o cnni."Cntrmion pc.,.i1ivdy rnliucrn.:cs fructvi-c L't111..:umplion whi.:n pn.....c11t m J I r:ttíooí ft U(.'JOi:' to glucosc, Th..:rero,c:. a<laptc;d tr.1111, :11hi h íructo..:c cnn.•.cnw,tiun:-.could he u:,.C"d .L, on itltcr• na11vc to 1r,ldilionnl formcnhllion proccsse .

Kcywords *.t,t1<·tJwmm\•ces* · Fermcnrnuon Rcattion mtc

Jntroduclion

Gluc<>í..é and fruc1oe are simple sugar!i> th;u are fo11nd in d11fc n:111 foods. The c !-'.U ars :tre len11en1cd by yeast lO p111dui.:c cthaoo l, w;ucr. l'arbon <.lio . idc. und otJicr comptl· n('nL-..1 Arroyo·L1.1pc;, el al 2009). In mmc :,.tudi . ti h bccn ,hown thm *Succlmr1w1yc,•\ ur ('I't nne* prefor-, (o t:0l1 ume gJm·osc. In e, pcrimens wuh bo1h gfucose and lrud1Jsc• .glUL'u:,.e l!i: l:'Jo:huus1eJ 111 Lhc miJJle (1(thc ícr• mt•n1.11ion, Jcavrng a higher proport1o n ot fruc1osc CHofor .mtl Jcn wcin l·•1•: W:.m)? and Nohel Iq rJ ; Ll)pe.7. el .ti. ,: w1\ B1!)Ull ft><N1. 111 comrasL. *S. cerevisim:* h:.:.s beco :-.bu\\tl to ptck r ilu.:us1,.• o vc r *Irm:W \'* con:,;u1n¡nm n <lu1i11g r't•r1111;•n1:11on (B;;"rth.ch e l J.t 20 flJ). Bauer auc.l Pre1orn1s t1ll0111 m cot io m·d t.h;H c.hei:e differen l.'e. in i,;uhi-trntc con. ,:m11pön *.in:* tluc m vinous formcuuuion a, thc cnd 11f J...:u nc11t;1lton. a n: 11fu,1 wnuuol of fructusc, ;ioJ possiblc cn111.1rnm1tion 111 1h c wo n , 'fhi.; m;1y he duc to 1hc spccd of LJ:mi,.porl ::icros thc mcmhrnnl' or diífcrcm Hl1C..'" of hcxo.'\C pho,,.phnry·J.Hion th..11 occur wilhin thc ccll tKunki:e 19!-U ílcrtld s c1 af 200s : Ozctm und Johns1on J'.1")5 Rcifcn-hcr r et :11. l9 ll7). íi luco in *S. ceu1;siae* not 01tly ':iCCVC$., s,. ..:arho a 'iOU1Cc hui :1(,;o :1c1; H'- ;1 glnhal reguf:ttor oí mc11nohsm and l J h \ lh Rc prcssion and inducuon of glu-coi,.c 111r.:twu 1mporn1n1rl'gu lamry mcchanisms thttl act on .g11c 1:,.c u-::hscri>1io n lcvds (Arm)o-López et al. 200Q), In thi.'pm1·.C::-ltol mnkmJ; mc:-<:al, Mh.:hcl•Cucllo Cl:il. (20m;) n p\mcd th;.u */\gm·t1.,a/mi(l1111* aci<J hydrol)·1'1S w11h h at trl!lllmcnt ,g:1vc a Iruc!Ose .:-onccntrn1ío11 of 155.9 mg/ml.

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Resea,ch Al!1c le

M ixing Analysis for a Fermentation Broth of the Fungus *Beauveria bassiana* under Different Hydrodynamic Conditions in a Bioreactor

Keywords: Bioreactor, Filamentous fungus, Hy
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DOI: 10.1002/ceat.201200130

ynamics, Numerical simulation, Rheology
pted: July 16, 2012

1 lntroduction

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dynamics of complex mixing systems independent impellers [13–15]. The

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Full/ Length Research Paper

Saccharomyces cerevisiae strains with robust responses to fermentation stresses isolated from the alcoholic fermentation of *Agave duranguensis* musts

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Yeast used in fermentation processes are subject to different stress conditions, including low pH, high initial substrate concentration, accumulation of toxic compounds (e.g. ethanol), and temperature fluctuations. The fermentation of mescal is conducted under variable environmental conditions throughout the year. One of the most important environmental factors is temperature, as autumn and winter fermentations occur at low temperatures, but fermentation temperatures are much higher in summertime. The aim of this work was to compare the response of *Saccharomyces cerevisiae* strains isolated from agave fermentations to different stress conditions and two different medium culture one mimicking metcal production, using agave must and other synthetic must development for analysis in wine industry. The strains isolated from agave were compared with a commercial strain used in wine elaboration, which exhibits good tolerance to the different stresses found in industrial fermentations. All strains grew in the presence of glucose and fructose irrespective of the sugar concentration, and low pH did not affect the formation of colonies. Differences in growth were observed among the strains at dow temperature and high concentrations or ethanol. Only 28% of the tested strains exhibited good tolerance to high ethanol concentrations, a desirable trait for avoiding stuck fermentations. The strain ITD00185 was able to grow in alcoholic stress condition, consuming sugar and producing ethanol in agave must. This strain shows tolerance to the different stress conditions and may be a useful starter culture for agave fermentation, the potential of the native strains to be used to improve other industrial fermentation processes that involve low temperatures and high ethanol yields.

Key words: Ethanol, tolerance, Mescal, native strains.

INTRODUCTION

The fluctuating conditions of fermentation processes can affect the growth of the microbes that contribute to the breakdown of sugars and production of alcohol. Different geographic regions *and* their particular environmental conditions can affect the distribution of native microbial species (Folch et al., 2004). Microorganisms encounter many different stresses during industrial fermentation. Both traditional and industrial fermentation are complex processes due to the multitude of conditions that are created during fermentation. Yeast cells, which play a central role in the fermentation process of wine making, are never in a physiologically optimal environment during wine production. Throughout this process they are exposed to a variety of different stresses simultaneously (Bauer and Pretorius, 2000).

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[illegible]

OPTIMIZACIÓN DEL PROCESO DE HIDRÓLISIS ENZIMÁTICA DE UNA MEZCLA DE PAJAS DE FRIJOL DE [illegible] VARIEDADES

OPTIMIZATION OF THE ENZYMATIC HYDROLYSIS PROCESS OF FOUR STRAW BEAN VARIETIES

[illegible]

Recibido 22 de Noviembre 2010; Aceptado 8 de Febrero 2011

Resumen

[illegible]

Palabras clave: optimización, paja de frijol, hidrólisis enzimática, pretratamiento, celulosa

Abstract

[illegible]

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)OURNAL
M ICROBIOL OCY
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Study uf the Rhcological Propcrtics of a Ferrncnration Broth oft hc Fungus *Be "1:1dria hassi"1u1* in a Biorcactor lJndcr Oill c rcn t r1\'drodynnn1ic Con d it ions

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F r· 111l:11ti11ion "ith líl,1tnl·11tuu, fu 11_l!1 in a b i o rt.•;l lt 1rl b.ll llh: .i.... uH1\1),1tl1111 ,.,, hi,;1111 1,, or 1l,' }- nth 1.:,.u ,:d m x.lu'!

,t·t m plt.•\ cJJn:11nk prm:l·, tlrnt is :1tfT•t.·hcl h lth ,

l'Ufl(lí tt,u :md lhc t \ohuio11 of 1h c r lu.:ulogk :tl 1n·up<'rlil·'- or Uu: nwdium. T hC:<ot· Jro pt•rru:s :tn • 1nninl :iffl"1.Hsd li lhl• biom co uc'l ntn Hiun .i11d 1hr morpholo , *uf* lht r uu:::us. In 1hi,,;, or l,.. l ht• rhl'o lugit.-:11p ro pt>tI' Í('.o l n f•t rrm· nt.ttio11 ,,irh lht· fu11 11, */Jt.l•1111•,ri" btt,,,Jw111* ul ulcr di fl'c'rc,11 ll\cfrnth nami(· t.·ontliliotb' H·r1•1udit•d :iud t h•t. rhC'Olo;!kaJ hC'll:niur of rhi hro1h "a' ,;1m11l:Hl'd thrnu;!h tm h tu n: of r:1rho,) m1.·th) l l'dluJow ,udium :mdú •lu b M·

fibcr, (C\1('\ :1-' F). l ht· hion.'a cto r w ;u, a 1 0 1 ("'IJH

:l m k 11pc ra t,-cJ .u d ill,\· ·t'u1 ,1i, , ctmd ru•,. t<lu·uh ,ll C"al l "S Ur's \\ I.Tc :,.imll:1r :u 1110 ;UHI ,l OO ı pm lor hu rh"\ :,,h:,111 . J l n \\ t' V<r. 1twrr H:1 a si 11ific:t11f incrN1,t• in rlit.\ t, c iJ :i.l\ ,, c ·t.mu,p rnicd ll\ 11 ch:rni::t• in 1hr l'Ofü;i, hm t't.· inctl•,, t··dt:ul:trt•d JIC'rurdint 1(1 th t· ¡>oH er J:t\\ mo<dl . for ht11h .¡ :,.ln• is :11 S IIO I p n1. '1111: :,.), 1tnh \'.\hihirl'd , h•t: ·lhi on i 11i.:. l wh :i\'ior :ir :ill :-t i,· H•lot iric, . \\hkh \\:1, lit ·1·m i11cd ,, 1lh ih l· 1>ow cr 1:m m 1t.Jd . 'J fu: mi\iuc 1lmc"•b uh, l'tH· cl to i m n ,;i . 11,; lhi:. 1Cllulos t• 1:, , nt1.ur in rh, • :,. ,lN n inm · it, t•d

a mi. l'CJll \l '(lll' lHI\ , tht.• (.)Ok i1.·nt of mi,in dimini w t.1. Tbt l' nosulh !ll"C rhuug lu ru he dut: tu Hu· r h1i.l 11!ka l 111d morpbnlo il'af imil; 1ri1,i,· ol 1J1t·. n, o tun :11 :' H h'u1:,., Thc Mrrsu lh "ilJ hdp in lhC' 111Himiz:11ion of , l1j '1:. llf) p m d ut•.riuu of th <•.st· fu u;?i.

Kt·,,onis: Rh..·lth1g.,. byllmJ 1 11.m1\.,; ri1.m .·m,\, ,..tw , j;11, :-lmul.1lm11 h11,¡,wl.'-.."'

ll 4t. lt.'nm; flla l hlll bn •th l•J 111hT\\•fl.!•tm1 1l :-.....pi..\:1..ill

l'mq lll ' 1111h: ,·n111inutm, 1t1111.hJk..11u,u l'f lh'-• rh\:<,Jog i,.:11

prnp\.•n:-..:.. ._,r tlll': m\.·\.hum l'l'•\lul.'.<-tl 111 .1 hio l' 1.'J' ll1 r, \, *I,•r:* 1, ..·r. ti11, 1111.:1.hum i..; lh.: li.'r\1¡4,.R'1•11:-i 11\\ing ll> t.t ,t'm h•nn.ui-11,11 111<l rl."'d rl..'ulau,, u. l nJ,:r llu.·,-,..: cc mdniun!\.0111:qJ lh\.• Uh•,. llllf' u rtJ ll t r rt,hh.•ni... IP h\. :,.l ,h \'J t:,. h1.: tat-.h...h 11 . tJu JJ,U, flt1", 1 · m11l..•.m<l pw \,.·, :-111g par..im('h:fo lo \'l ll. , o u t. 1111•l 1ur111I h.•ni 1t.'llhllh111. . \ 11t1thi..·r prnhk n1.,n:--1.\, \\ h"·u m i :.n,• f ,:.!1111:-.Jlh :-ud1 ... Jil.11n.:11h,u, it Ut¡..lt r rod w.ct l 1111hL"

f..'n11'"llltJ lh•ll ;,tr'-' 1;:,.H1\1,·. lo ln-i:,h h ar :-.1r,::-:-, í5J flr.:

lhr t..ul-111-..· h•l'111 \•I lh-.:,.t fllll;!I 1.1\':tti..•, lrll lir11Ll, io11, I 11\.'l\\11rJ.. -:-,;,..-.k'II" ,th 11 pro<lut,: h1µhl ' ¡...\.PU ., .uuJ IHIU- , ..:,\h•l11i.11k m w1,1tt1u,n ,oup, \\h-.•n.· IH,l't, tr.:m, fir um.i l11•l1h1--.:...111,1r1h,n .1r..,·, r '!'tlra111,;<l. Tlti: 1111pk u1i.:m;11111n 111 l11 tt ,tu \.,•fl n lh.!"! Jt'o ,I \'t lll ll tlll 1rp1,,ld t h1 \I\.;f1· •IHUI lh...·!-:: Ph •lkn 1:.. 11 11\ \ (' \ 1,,'r. liwl! 1 1:\'."d l,Jn 11:,.1f l'tln.."!'-:-, 1..:111,r" th 111 cdlL1l.11 Ll.11111;!.... k·JJ 1rn: h' hllh.! il ,·l'll d111·nt nl.1li 1l1 *t*,. 1-1 l11 r\•v.:111 ·',;,u·. th,:n.: h.1., hc,.·11 i.Jn llll'l'"\':blll:;! 111.:ri..·:-: 111 ,h: '.'!\!ti) ,,1 llu: op11111i1...,tlio11 o l lh.:l ''\lR

JIIOC\.'-. \,\ltlJ:111111, ltl ttrnt.. 1•1 1nhi11,g lll lle.":15. . 14 1$. l1'j. l' •\t,·r úlhl1111p11011 1-n rh,•11fvd,it:d l-xhJ\ or 11. (1J, .mJ \."11. 1111...il .irtll 111l1q, lh•h •!! 11.,1I ..m.tl .:,. f.2. •,. 1.5 . (>11 1it1.'l1th1.·1li,111<l. l\\'.llth..·...·ompk, 1111.,rphcil\'!:!)(•fthi..·fün,;;i lll\Ph ..:d.il i:-.dt\U lliJl n0 1111<1n n1,t i.... r1..·qu lr n l .J1 tf1.·m l,.1-r, .111J llllldth\\lplt k, d.,h .'\ 11fut1rn1 vi th..: llo,, pn• p..:rti..::-.:nd 1111.!:.!1.' .u 11J ;",;. ,,1 lh1i.· ht\•th tt,1 pn •pi1.· c, ,n lp l tiit'lw 11,11t1,·11h•li:-,oltllhnl fl.m 1.:111,d U•J1 p1Y.:;·:,,,,, Thi..'t lpt mi1 ..J 1t,

,,, lh, 1 :, l\1h·... 1:-JJl:t:li.· =a,r: 11,.:th,· ,· t ¡x:,t l' !i.m,_!in ·1.P I rl'J I :: 11¡'i1rt,1t1.1.·el\\111' tl, Ll11:1r 111,.:Lu iJ..tlJ ;t1 , H. ,, hich t 111nH J, , ir i IJ 111 111,,·1.·1, , ·:h , Th t· 1.lt,b.ch• un!;.: 1.•I

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Ful/ Length Research Paper

Effect of fermentation temperature on chemical composition of mescals made from *Agave duranguensis* juice with different native yeast genera

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Accepica Augusl 'l:l 2011

In **thiss tu dy the fermentation** behavlor **at 18 and 28'C ol different native yeast** genera **onju** lce Irom *Agave duranguensis* **was evaluated and** the volatlle compounds **produced in the obtalned mescals from these fermentatlons WE!re identif ied.** The lermenlatlve **capadly of *Hanseniaspora uvarum*, *Kluyveromyces marxlanus*** *and* ***Saccharomyces cerev/slae* increasedal 28'C; howev,re the** fermentatlon **behavlor of** *Torulaspora* ***delbrueckii* was** not **affected** by temperature. In **the mescals produced by *H uvarum*,** *.T delbrueck/1 and* S. ***cerevlsiae* a greater** number and **abundance of compounds were** ldentlfled **at 18"C than at 28'C. Conversely *K. marxianus* showed a hlgher** production **of these** compounds **at 28 'C** Sorne compounds **ldenUfied** In **all mescals were** z-me hyl- 1 -propano ,l 3-me t hy-l 1-bu tano, l acellc acid, 1·(2-furanyl)-ethanon e, furlural, a-terp ineol, **ethyl** phenyl **acetate and** phenylethyl alcohol. For **strains *H. uvarum*, *T. delbruec k/1 and* S. *ce revislae*,** the most **abundan!** compound idenllfled was 3-methyl 1-butanol at both **temperaturas. However, for *K marx lanus*, phenyl ethyl acetate was the** most **abundan!. The *non-Sacc haromyces* genera s u d e,d exhlblt d ifferen behaviors to tho se reported for** wlne fermen tation wh en **the same genera was used. T here fo r, E!** they **presented** a major **fermentative capaci ty** and **also** volatile compounds **characteristic ol mescals were produced.**

Keyw ords: *Non-Saccharomyces* temperature, volatile compounds, SPME-GC-MS

INTROOUCTION

Mescal rs a lraditiona l alcoh ol,c beverage lrom Mexico 1ha1,s made simílarly 10 tequi la. The process begins wilh the harvest of *Agave* al ter 8 years of growth. Al this stage s!age, the plants are cut from lheir base, ob1a lrnng the *Agave* heart. lalef, these are cooked in ovens or autoclaves. During this stage. polysaccharides, mainly frJctans. are hydrolyzed by heat Into simple, molecules such as glucose. fructose and sucrose. The hydrolyzed sugars are ex!racted from the must by pressing and camed out !he alcoholic lermenlabon *by* nat,ve yeasts or selected strains Finally, the mus1 wilh elhanol concen-1ration of approxrmately 3 to 6%(v/v) is distilled to obtain whte mescal or young mescal wi1h a ooncentration ol 35

·c orresp oo,on g author . E-m a,l; m1r,ain @tdpogs ado bioqulmica.com*mx*. Tel: 61829 99033 ext. (t1O)

Abbreviations: HPLC, High pcríormancc hqtud chrom atography **LSD,** loast s1ngw1fnco dittorent, DVB/CAR/PDMS,div nylbonzenelcarboxcn1polydimdhylsiloxac **SPME ,sofidpilase,mero extraction.**