Journal of Microbiology, Biotechnology and Food Sciences • Volume 10, Issue 3, Pages 354 - 360 • 2020

Document type
Article

Source type
Journal

ISSN
13385178

DOI
10.15414/JMBFS.2020.10.3.360

Publisher
Slovak University of Agriculture

Original language
English

LACTOCOCCUS LACTIS STRAINS FROM INTESTINAL ORGAN OF BLACK TIPS SHARK CARCHARHINUS LIMBATUS PRODUCING NISIN-LIKE BACTERIOCIN ACTIVE AGAINST SHRIMP AND FISH PATHOGENS (VIBRIO PARAHAEMOLYTICUS AND VIBRIO ALGINOLYTICUS)

Abdul Hamid T.H.T.[a], Ahmad Zahli K.I.[a], Alotaibi M.[a]

Save all to author list

[a] Department of Biotechnolohy, Kulliyyah of Science, International Islamic University Malaysia, Department of Biotechnology, Jalan Istana, Bandar Indera Mahkota, 25200, Kuantan, Malaysia

Abstract
Author keywords
SciVal Topics
Metrics
Funding details

Abstract

Shark can be a potential source for host-associated probiotics destined to be used in aquaculture. In this study, intestinal tissues of Black tip shark (Carcharhinus limbatus) was used as the source sample for inhibition screening based on spot-on-lawn and agar well diffusion methods. Out of the 80 isolates, only four showed antagonistic activities against selected indicator strains . All of the 4 isolates FA1, FA2, FA3 and FA4 were found to be Gram positive coccus, non-spore former, oxidase and catalase negatives, as well as lactose fermenters. The isolate FA1, FA2, FA3 and FA4 were found to demonstrate broad range of inhibitory spectrum on gram-positive indicator bacterium (Staphylococcus aureus and Bacillus cereus) and the gram-negative bacterium (Escherichia coli, Pseudomonas aeruginosa, Salmonella typhimurium, Vibrio alginolyticus and Vibrio parahaemolyticus); with the highest inhibition zone at 20.0±0.1 mm, recorded on V. parahaemolyticus. The genotype of the isolates was characterized using 16S rRNA sequencing. Each sequence with a given GenBank (NCBI) accession number (MN975529 for FA1; MN982712 for FA2; MN982711 for FA3; and MN982710 for FA4) showed at least 99% similarity with Lactococcus lactis subspecies. The crude cell free supernatant (CFS) of the isolates potentially contained a putative bacteriocin displaying nisin-like properties. The pH and catalase treatments showed that neither organic acid nor hydrogen peroxide (H2O2) was the inhibitory component. An almost 95% inactivation of the CFS's antimicrobial activity was observed following treatment with trypsin suggested a presence of proteinaceous agent. Growth and inhibition studies on all isolated strains demonstrated that the inhibition properties were growth associated, with maximum inhibition achieved at ~20.0 ± 0.1 mm (or ~168 ± 17 AU/ml) at 17 hours by FA2 strain against V. parahaemolyticus. A study on the mode of inhibition demonstrated a bactericidal killing against V. parahaemolyticus. The isolation of Lactococcus lactis strain from shark is rather unique since it was commonly reported to be isolated from human and animals. These strains show bacteriocinogenic properties, broad spectrum inhibition, and more importantly, they are able to antagonise some pathogens implicated in fish or shrimp diseases. Therefore, these strains have potential for use as probiotics in aquaculture.

Author keywords

lactic acid bacteria; Lactococcus lactis ; nisin ; probiotic

SciVal Topics

Metrics

Funding details

Funding sponsor	Funding number	Acronym
Ministry of Higher Education, Malaysia		MOHE
International Islamic University Malaysia	RIGS17-089-0664 IIUM KPT	IIUM

See opportunities by MOHE

See opportunities by IIUM

Funding text
Acknowledgments: The authors wish to thank to the Ministry of Higher Education, Malaysia; and the International Islamic University Malaysia (IIUM) for completing this work under grant no RIGS17-089-0664 IIUM KPT.

References (34) View in search results format >

1 Abee, T., Delves-Broughton, J.
Bacteriocins - Nisin
(2003) *Food Preservatives*, pp. 146-147. Cited 13 times.
N. J. Russell & G. W. Gould (Eds), Boston, USA: Springer

2 Ahmad, A., Hamid, R., Dada, A.C., Usup, G.
Pseudomonas putida Strain FStm2 Isolated from Shark Skin: A Potential Source of Bacteriocin
(2013) *Probiotics and Antimicrobial Proteins*, 5 (3), pp. 165-175. Cited 7 times.
doi: 10.1007/s12602-013-9140-4
View at Publisher

3 Ajitha, S., Sridhar, M., Sridhar, N., Singh, I.S.B., Varghese, V.
Probiotic effects of Lactic acid bacteria against Vibrio alginolyticus in Penaeus (Fenneropenaeus) indicus (H. Milne Edwards)
(2004) *Asian Fisheries Science*, 17, pp. 71-80. Cited 41 times.

4 Amenyogbe, E., Chen, G., Wang, Z., Huang, J.S., Huang, B., Li, H.
The exploitation of probiotics, prebiotics and synbiotics in aquaculture: present study, limitations and future directions. : a review
(2020) *Aquaculture International*, 28 (3), pp. 1017-1041. Cited 22 times.
www.wkap.nl/journalhome.htm/0967-6120
doi: 10.1007/s10499-020-00509-0
View at Publisher

5 Banerjee, S., Kim, L.M., Shariff, M., Khatoon, H., Yusoff, F.M.
Antibacterial activity of neem (Azadirachta indica) leaves on Vibrio spp. isolated from cultured shrimp (Open Access)
(2013) *Asian Journal of Animal and Veterinary Advances*, 8 (2), pp. 355-361. Cited 7 times.
http://scialert.net/qredirect.php?doi=ajava.2013.355.361&linkid=pdf
doi: 10.3923/ajava.2013.355.361
View at Publisher

6 Barman, S., Ghosh, R., Mandal, N.C.
Production optimization of broad spectrum bacteriocin of three strains of Lactococcus lactis isolated from homemade buttermilk
(2018) *Annals of Agrarian Science*, 16 (3), pp. 3286-3296. Cited 19 times.
https://doi.org/10.1016/j.aasci.2018.05.004

Abstract
Author keywords
SciVal Topics
Metrics
Funding details

Bindiya, E.S., Tina, K.J., Raghul, S.S., Bhat, S.G.
Characterization of Deep Sea Fish Gut Bacteria with Antagonistic Potential, from Centroscyllium fabricii (Deep Sea Shark)

(2015) *Probiotics and Antimicrobial Proteins*, 7 (2), pp. 157-163. Cited 11 times.
http://www.springer.com/new+%26+forthcoming+titles+%28default%29/journal/12602
doi: 10.1007/s12602-015-9190-x

View at Publisher

8 Cao, J., Zhang, J., Ma, L., Li, L., Zhang, W., Li, J.
Identification of fish source Vibrio alginolyticus and evaluation of its bacterial ghosts vaccine immune effects (Open Access)

(2018) *MicrobiologyOpen*, 7 (3), art. no. e00576. Cited 18 times.
http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)2045-8827
doi: 10.1002/mbo3.576

View at Publisher

9 Edwards, U., Rogall, T., Blöcker, H., Emde, M., Böttger, E.C.
Isolation and direct complete nucleotide determination of entire genes. Characterization of a gene coding for 16S ribosomal RNA (Open Access)

(1989) *Nucleic Acids Research*, 17 (19), pp. 7843-7853. Cited 2076 times.
doi: 10.1093/nar/17.19.7843

View at Publisher

10 Gharsallaoui, A., Oulahal, N., Joly, C., Degraeve, P.
Nisin as a Food Preservative: Part 1: Physicochemical Properties, Antimicrobial Activity, and Main Uses

(2016) *Critical Reviews in Food Science and Nutrition*, 56 (8), pp. 1262-1274. Cited 167 times.
www.tandf.co.uk/journals/titles/10408398.asp
doi: 10.1080/10408398.2013.763765

View at Publisher

11 Gibson, G.R., Hutkins, R., Sanders, M.E., Prescott, S.L., Reimer, R.A., Salminen, S.J., Scott, K., (...), Reid, G.
Expert consensus document: The International Scientific Association for Probiotics and Prebiotics (ISAPP) consensus statement on the definition and scope of prebiotics (Open Access)

(2017) *Nature Reviews Gastroenterology and Hepatology*, 14 (8), pp. 491-502. Cited 1526 times.
http://www.nature.com/nrgastro/index.html
doi: 10.1038/nrgastro.2017.75

View at Publisher

Abstract
Author keywords
SciVal Topics
Metrics
Funding details

12 Givens, C.E., Ransom, B., Bano, N., Hollibaugh, J.T.
Comparison of the gut microbiomes of 12 bony fish and 3 shark species

(2015) *Marine Ecology Progress Series*, 518, pp. 209-223. Cited 154 times.
http://www.int-res.com/articles/meps2014/518/m518p209.pdf
doi: 10.3354/meps11034

View at Publisher

13 Goh, H.F., Philip, K.
Purification and characterization of bacteriocin produced by weissella confusa A3 of dairy origin (Open Access)

(2015) *PLoS ONE*, 10 (10), art. no. e0140434. Cited 51 times.
http://www.plosone.org/article/fetchObject.action?uri=info:doi/10.1371/journal.pone.0140434&representation=PDF
doi: 10.1371/journal.pone.0140434

View at Publisher

14 Hata, T., Tanaka, R., Ohmomo, S.
Isolation and characterization of plantaricin ASM1: A new bacteriocin produced by Lactobacillus plantarum A-1

(2010) *International Journal of Food Microbiology*, 137 (1), pp. 94-99. Cited 84 times.
doi: 10.1016/j.ijfoodmicro.2009.10.021

View at Publisher

15 Heller, K.J.
Probiotic bacteria in fermented foods: Product characteristics and starter organisms (Open Access)

(2001) *American Journal of Clinical Nutrition*, 73 (2 SUPPL.), pp. 374S-379S. Cited 353 times.
http://www.ajcn.org/contents-by-date.2005.shtml
doi: 10.1093/ajcn/73.2.374s

View at Publisher

16 Ibarra-Sánchez, L.A., El-Haddad, N., Mahmoud, D., Miller, M.J., Karam, L.
Invited review: Advances in nisin use for preservation of dairy products (Open Access)

(2020) *Journal of Dairy Science*, 103 (3), pp. 2041-2052. Cited 21 times.
http://www.elsevier.com/wps/find/journaldescription.cws_home/721317/description#description
doi: 10.3168/jds.2019-17498

View at Publisher

17 Jiang, H., Zou, J., Cheng, H., Fang, J., Huang, G.
Purification, Characterization, and Mode of Action of Pentocin JL-1, a Novel Bacteriocin Isolated from Lactobacillus pentosus, against Drug-Resistant Staphylococcus aureus (Open Access)

(2017) *BioMed Research International*, 2017, art. no. 7657190. Cited 32 times.
http://www.hindawi.com/journals/biomed/
doi: 10.1155/2017/7657190

View at Publisher

Abstract
Author keywords
SciVal Topics
Metrics
Funding details

☐ 18 Rohmin, S., Rusul, G., Radu, S., Ling, F.H.
Bacteriocin-producing lactic acid bacteria isolated from traditional fermented food
(2001) *Malaysian Journal of Medical Sciences*, 8, pp. 63-68. Cited 21 times.

☐ 19 Kua, B.C., Ahmad, I.A.R., Siti Zahrah, A., Irene, J., Norazila, J., Nik Haiha, N.Y., Fadzilah, Y., (...), Teoh, T.P.
Current status of acute hepatopancreatic necrosis disease (AHPND) of farmed shrimp in Malaysia
(2016) *Paper presented at the Addressing Acute Hepatopancreatic Necrosis Disease (AHPND) and other transboundary diseases for improved aquatic animal health in Southeast Asia: Proceedings of the ASEAN Regional Technical Consultation on EMS/AHPND and other transboundary diseases for improved aquatic animal health in Southeast Asia*. Cited 10 times.
(22-24 February 2016). Makati City, Philippines

☐ 20 Lazado, C.C., Caipang, C.M.A., Estante, E.G.
Prospects of host-associated microorganisms in fish and penaeids as probiotics with immunomodulatory functions
(2015) *Fish and Shellfish Immunology*, 45 (1), pp. 2-12. Cited 100 times.
http://www.elsevier.com/inca/publications/store/6/2/2/8/3/2/index.htt
doi: 10.1016/j.fsi.2015.02.023
View at Publisher

☐ 21 Lemoine, F., Correia, D., Lefort, V., Doppelt-Azeroual, O., Mareuil, F., Cohen-Boulakia, S., Gascuel, O.
NGPhylogeny.fr: New generation phylogenetic services for non-specialists (Open Access)
(2019) *Nucleic Acids Research*, 47 (W1), pp. W260-W265. Cited 156 times.
https://academic.oup.com/nar/issue
doi: 10.1093/nar/gkz303
View at Publisher

☐ 22 Lima, E.T., Andreatti Filho, R.L., Okamoto, A.S., Noujaim, J.C., Barros, M.R., Crocci, A.J.
Evaluation in vitro of the antagonistic substances produced by Lactobacillus spp. isolated from chickens
(2007) *Canadian Journal of Veterinary Research*, 71 (2), pp. 103-107. Cited 44 times.

☐ 23 Matsusaki, H., Sonomoto, K., Ishizaki, A.
Some characteristic of Nisin Z, a peptide antibiotic produced by Lactococcus lactis IO-1
(1998) *Food Science and Technology Internatinal Tokyo*, 4 (4), pp. 290-294. Cited 14 times.
https://doi.org/10.3136/fsti9596t9798.4.290

Abstract
Author keywords
SciVal Topics
Metrics
Funding details

☐ 24 Mulyani, S., Jenie, B.S.L., Kusumaningrum, H.D., Arief, I.I.
Characterisation of crude bacteriocin produced by Pediococcus pentosaceus 2A2 in enriched molasses medium

(2019) *International Food Research Journal*, 26 (1), pp. 187-192.
http://www.ifrj.upm.edu.my

☐ 25 Ninawe, A.S., Selvin, J.
Probiotics in shrimp aquaculture: Avenues and challenges probiotics in shrimp aquaculture: Avenues and challenges A.S. Ninawe et al.

(2009) *Critical Reviews in Microbiology*, 35 (1), pp. 43-66. Cited 120 times.
doi: 10.1080/10408410802667202

View at Publisher

☐ 26 Oelschlaeger, T.A.
Mechanisms of probiotic actions - A review

(2010) *International Journal of Medical Microbiology*, 300 (1), pp. 57-62. Cited 377 times.
doi: 10.1016/j.ijmm.2009.08.005

View at Publisher

☐ 27 Pasteris, S.E., Vera Pingitore, E., Ale, C.E., Nader-Macías, M.E.F.
Characterization of a bacteriocin produced by Lactococcus lactis subsp. lactis CRL 1584 isolated from a Lithobates catesbeianus hatchery

(2014) *World Journal of Microbiology and Biotechnology*, 30 (3), pp. 1053-1062. Cited 9 times.
doi: 10.1007/s11274-013-1524-9

View at Publisher

☐ 28 (2016) *QIAamp DNA Mini and Blood Mini handbook*, pp. 55-58. Cited 34 times.
Qiagen

☐ 29 Rossi-Tamisier, M., Benamar, S., Raoult, D., Fournier, P.-E.
Cautionary tale of using 16s rRNA gene sequence similarity values in identification of human-associated bacterial species (Open Access)

(2015) *International Journal of Systematic and Evolutionary Microbiology*, 65 (6), pp. 1929-1934. Cited 84 times.
http://ijs.sgmjournals.org/deliver/fulltext/ijsem/65/6/1929_ijs000161.pdf?itemId=/content/journal/ijsem/10.1099/ijs.0.000161&mimeType=pdf&isFastTrackArticle=
doi: 10.1099/ijs.0.000161

View at Publisher

Abstract
Author keywords
SciVal Topics
Metrics
Funding details

30 Thirunavukkarasu, A., Sheela, R., Singh, A.K.
Growth profile and partial characterization of bacteriocin produced by lactobacillus plantarum atm11 isolated from slaughterhouse soil

(2019) *Songklanakarin Journal of Science and Technology*, 41 (1), pp. 37-44. Cited 2 times.
http://rdo.psu.ac.th/sjstweb/journal/41-1/5.pdf
doi: 10.14456/sjst-psu.2019.5

View at Publisher

31 Van Doan, H., Hoseinifar, S.H., Ringø, E., Ángeles Esteban, M., Dadar, M., Dawood, M.A.O., Faggio, C.
Host-Associated Probiotics: A Key Factor in Sustainable Aquaculture (Open Access)

(2020) *Reviews in Fisheries Science and Aquaculture*, 28 (1), pp. 16-42. Cited 70 times.
http://www.tandfonline.com/loi/brfs20
doi: 10.1080/23308249.2019.1643288

View at Publisher

32 Yusuf, M.A., Hamid, T.H.T.A.
Pistricoccus aurantiacus gen. nov., sp. nov., a moderately halophilic bacterium isolated from a shark
(2013) *Journal Agrobiology*, 30 (1), pp. 1593-1642.
Isolation of coagulase negative Enterococcous sp. strains from non-broiler chicken producing bacteriocin active against Staphylococcus aureus, 33, https://doi.org/10.2478/agro-2013-0004, Zhen-Xing, X., Qi-Yun, L., De-Chen, L., Guan-Jun, C., & Zong-Jun, D. (2016). Antonie van Leeuwenhoek, 109(12), 1603
https://doi.org/10.1007/s10482-016-0760-z

33 Zhou, L., van Heel, A.J., Montalban-Lopez, M., Kuipers, O.P.
Potentiating the activity of nisin against Escherichia coli (Open Access)

(2016) *Frontiers in Cell and Developmental Biology*, 4 (FEB), art. no. 7. Cited 38 times.
https://www.frontiersin.org/articles/10.3389/fcell.2016.00007/full
doi: 10.3389/fcell.2016.00007

View at Publisher

34 Zouhir, A., Hammami, R., Fliss, I., Hamida, J.B.
A new structure-based classification of gram-positive bacteriocins

(2010) *Protein Journal*, 29 (6), pp. 432-439. Cited 43 times.
doi: 10.1007/s10930-010-9270-4

View at Publisher

Abdul Hamid, T.H.T.; Department of Biotechnolohy, Kulliyyah of Science, International Islamic University Malaysia, Department of Biotechnology, Jalan Istana, Bandar Indera Mahkota, Kuantan, Malaysia; email:haziyamin@iium.edu.my