Bionatura
Latin American Journal of Biotechnology and Life Sciences

Bionatura Issue 1 Vol 8 No 1 2023

Article

Isolation and identification of some types of histamine-producing bacteria from shrimp in local markets

Doaa Adel Qasim[1]
[1] *Market Research and Consumer Protection Center, University of Baghdad, Iraq*
** Correspondence: doaa.a@mracpc.uobaghdad.edu.iq*
Available from: http://dx.doi.org/10.21931/RB/CSS/2023.08.01.47

ABSTRACT
Different genera and species of bacteria were isolated from shrimp, which were brought from the Al-Faw area in the Basra governorate, and these isolates were diagnosed after purification through studying their phenotypic characteristics and conducting API confirmation, biochemical tests, motility examination and staining with gram stain, in addition to using different types of diagnostic tools bacteria. Twenty-five bacterial isolates of genera and species of bacteria were isolated and diagnosed from shrimp. *Morganella morganii sub. Morganii,, Klebsiella pneumonia sub. Pneumonia, Proteus marina, Enterobacter cloacae, Klebsiella oxytoca, Enterobacter aerogenes, Proteus mirabilis, Proteus vulgaris, Enterobacter tailored, Cronobacter sakazakii, Escherichia coli, Hafnia alvei, Citrobacter amalonaticus, Citrobacter freundii, Vibrio harveyi, Vibrio vulnificus, Serratia marcescens, Pseudomonas aeruginosa, Staphylococcus intermedius, Staphylococcus saprophyticus, Pseudomonas fluorescens, Bacillus subtilis, Bacillus licheniformis, Staphylococcus epidermidis, Aeromonas sobria.* The results of the detection of histamine-producing bacteria, which were detected by using broth media such as Histamine decarboxylase broth (HDB), Trypticase Soy broth-histidine (TSBH) and solid media such as Histamine decarboxylase agar (HDA) showed that all bacteria were producing histamine in different proportions except *Aeromonas sobria* and *Hafnia alvei* were non-histamine-producing.

Keywords: histamine, shrimp, bacterial contamination

INTRODUCTION

Thousands of people suffer yearly from food poisoning by foods and drinks contaminated with bacteria, viruses or toxins. They may show symptoms such as high temperature, diarrhea, vomiting and digestive disorders. The foods most often associated with food poisoning are meat and poultry products, unpasteurized milk and dairy products, eggs, uncooked shellfish, fish and rice [1].

Fish is considered more perishable than red meat due to its high moisture content and its content of protein and carbohydrate compounds, as well as minerals and salts. Its pH represents a favorable condition for the growth of many microorganisms that cause undesirable changes in addition to the softness and

disintegration of fish tissues because fish fat is oxidized faster than other types of meat [2].

Crustaceans are invertebrates that lack an internal skeleton, but they are characterized by a rigid external structure called the exoskeleton, which protects the crustacean bodies. The term shrimp is used to refer to some decadal crustaceans. Shrimp is a delicious seafood that is usually a part of every traditional meal, and the demand for its products has increased worldwide. [3]. Living organisms, including bacteria, have a significant variation in the production of histamine due to the presence of specific genes responsible for the production of histamine [4]. Histamine is formed in fish from some microorganisms (HDC) capable of producing the enzyme Histamine decarboxylase, produced by Gram-positive and Gram-negative bacteria. Histidine, accessible to histamine, is naturally present in high levels in the muscles of some fish [5].

Biogenic amines such as bio-tricin, cadaverine and tyramine are produced from gram-positive and gram-negative bacteria such as Staphylococcus spp and Photobacterium phosphorus. Researchers have recorded many bacterial species as histamine products and fermented seafood. They were found to be histamine-producing bacteria. With different species or genera, the ability of histamine synthesis depends on the type of histamine [6].

Fish, seafood, and their products are among the foods rich in histamine-producing bacteria [7]. Incorrect processing or storage of fish is one of the main factors that contribute to the production of histamine in fish, and histamine production can occur during manufacturing processes such as salting, smoking, fermentation, drying, and others until the product is ready for marketing, and when eating these histamine-containing fish by the consumer, many changes will occur within the consumer's body, leading to many risks (fig: 1). [8]

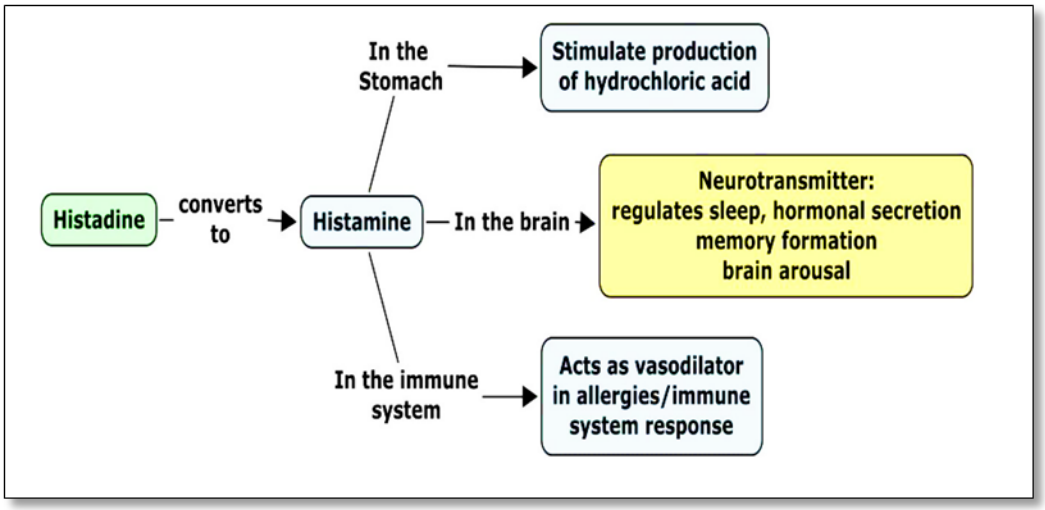

Figure 1. Causes of histamine in humans

Some researchers stated that the bacteria isolated from fish were divided into two groups, a group that did not produce histamine and a group that produced histamines such as histidine, and a moderately thermophilic and cold-resistant group of various marine foods and the bacteria were responsible for the production of histamine isolated from all local and imported fish [9].

The study aimed to know the bacterial content of shrimp and its role in the production of histamine and food poisoning events and cases of allergies resulting from eating shrimp. This study was conducted because there are no

studies dealing with the role of histamine-producing bacteria isolated from shrimp.

MATERIALS AND METHODS

Sample sources

One kg of shrimp sample was collected from the Al-Faw area in Basra governorate with 3 replications. The samples were placed in sterile plastic bags, kept in a cork container containing pieces of ice and crushed ice, and then transferred to the Market Research and Consumer Protection Center/ University of Baghdad, Iraq laboratory.

Materials used for isolation and diagnosis

Various cultural media such as Nutrient Agar (NA) medium, Nutrient broth (NB), Eosin Methylene medium (EMB), MacConkey medium and Simmon's citrate agar medium, Brain-Heart infusion broth medium, solid mannitol medium, salmonella detection medium, gelatin decomposition medium, casein decomposition, starch decomposition amid indole production, nitrate reduction medium, carbohydrate fermentation medium, Vibrio medium for sucrose bacteria diagnosis (TCBS)) and urease enzyme test medium,6%,7% and 8% NaCl medium, Medium Mueller Hinton broth and medium milk. Ampicillin Dextrin Agar with Medium Additionally (ADA-V) Vancomycin Identification Use many identifiers To diagnose bacteria at the level of type Kit API Hi 25 TM Included: Kit Enterobacteriaceae. Identification Kit API HiVibrio.TM Identification Kit API HiStaph. TM Identification Kit API HiCarbohydrate TM Identification Kit API HiAermonas TM Kit They are all equipped with Identification Kit Hindi. Himedia.

The culture media is used to detect histamine in bacteria.

Histamine and broth histidine (TSBH) liquid media histamine decarboxylase broth (HDB), and histamine decarboxylase agar media (HDA) were used to identify histamine-producing bacteria, and the pH of the medium was set to 5.3. This media was autoclaved at 121ºC For 15 minutes. This method relied on the occurrence of color change in the media.

Isolation and diagnosis of bacteria

Ten gm of the mashed shrimp sample was transferred to sterilized flasks containing 90 ml of sterile physiological dilution solution and mixed well to obtain identical and homogeneous samples using an electric mixer that was previously sterilized with 70% ethanol, Then 1 ml of the dilutions 10^{-7}, 10^{-8} and 10^{-9} were planted in three replications and planted on the different nutrient media in sterile Petri dishes. The media was incubated at 37 ° C for 48-72 hours in aerobic and anaerobic conditions.

Then, the bacterial colonies were purified by taking a colony from a type of bacterial colony of different appearance in shape, color and size. The bacteria were diagnosed by conducting morphological tests, which examine the shape of the colonies and the shape of bacteria through gram staining and bacterial motility examination. Other biochemical tests were performed [10].

Purification of isolates

Inoculating loops of primary isolates inoculated the different selective culture media at 24 hours of age to conduct sifting by systematically planning the bacterial colonies in the middle of the surface of the medium and the occlusal incubation at 37°C for 48 hours in aerobic and anaerobic conditions. As mentioned, it was repeated 3 times to Obtain pure single colonies to perform diagnostic tests for these isolates.

Diagnostic tests for bacterial isolates

Morphological tests

These examinations included the colonies' shape, color, and size and microscopic examinations, which included endospore-forming, bacterial motility test, and endospore-forming [11].

Biochemical tests

The following tests included the catalase test, glucose production test, carbohydrate fermentation test, focus procure test, casein hydrolysis test, starch hydrolysis test, oxidase test, ammonia production test from arginine, nitrate reduction test, gelatin hydrolysis test, indole production test, sulfur dioxide production test, sulfur dioxide production test Urese, methyl red test, esculin decomposition test and temperature effect incubation in bacterial growth and growth in anaerobic conditions [12].

Identification by using of Analytic Profile Index E

From the liquid or solid medium specific to the type of bacteria that had previously been inoculated with the bacterial isolate to be studied, 48 hours at a temperature - and after incubating the tape for 24 37 m, the results were recorded and interpreted based on and followed the same method as Analytical Profile Index with different diagnostic systems according to the API type diagnosis systems Bacterial system. This test was carried out by inoculating 5 ml of physiological solution with pure colonies of bacteria to be tested, then mixing the bacterial suspension well. In light of the appearance of the results, the type of bacteria underdiagnosis was determined by referring to the Himedia kit, which the Indian company supplied. The numbers of bacteria and the percentage frequency of isolates isolated from shrimp samples were calculated [13].

RESULTS

The results showed the presence of different genera and types of Bacteria distributed as follows*:* four species of the Bacillus genus (B. pumilus, B. alvei, B. subtilis and B. licheniformis)*,* and two species of Pseudomonas (P. fluorescens and P.aeruginosa) and three type of Staphylococcus genus (S. saprophyticus, S. epidermidis and S. intermedius) and four species of Aeromonas (A. veronii A. schubertii, A. sobria and A. encheleia) and five different species of Vibrio (V. fischeri, V. vulnificus, V. alginolyticus, V. fluvialis, V. parahaernolyticus) and ten species belonging to the family Enterobacteriaceae, which included (C. amalonaticus and C. freundii) for the genus Citrobacter and three species belonging to the genus Enterobacter (E. aerogenes, E. cloacae and E. taylorae) and three species belonging to the genus Proteus (P. mirabilis, P. vulgaris, and P.marina) And two species belong to genus Serratia (S. fonticola and S. marcescens) And two species of the Klebsiella genus (K. oxytoca and K. pneumonia sub. Pneumonia), In addition to Escherichia coli bacteria and Morganella morganii sub.morganii in addition to Hafnia alvei bacteria.

All biochemical diagnostic tests for bacteria in shrimp showed that there are species of the genus Bacillus spp*.* The isolates were rod-shaped, gram-positive and spore-forming, and the results agreed with some studies [14]. The results agreed with [15, 7]. By isolating them with Bacillus subtilis from shrimp Blacktiger, Bacillus amyloliquefaciens was also isolated from shrimp by [16].

Also, The results showed that the colonies growing on the Pseudomonas selective media it was distinguished as large, and its colonies are sticky and shiny and showed a green color where the color was clear green bluish when growing on

nutrient agar medium because it is characterized by the production of types of pigments like pyocyanin dye. The bacterial isolates of Pseudomonas were Gram-negative and mobile, where negative for the production of gas from glucose sugar and negative for sucrose sugar lactose, galactose, and for the starch and methyl red tests and indole and focus pressure and positive for tests Catalyzes, citrates, fermentation of glucose and xylose and grow at a temperature of 4 ° C [17].

The medium Cetrimide Agar was used to detect Pseudomonas aeruginosa. Three replicates were made for each sample after dilution. It was grown on dishes containing the medium as mentioned above and incubated at 37 °C.

The results agreed with [18]. by the diagnosis of bacteria Pseudomonas ssp from sea shrimp. Also, the results agreed with [19] by diagnosing P.aeruginosa from tissues and muscles of Penaeus monodon Shrimp.

As for the results of Staphylococcus spp isolating bacteria, the results showed that all isolates had it gave a positive result on the (selective Mannitol medium) and mannitol sugar, as well as on nutritious agar, circular colonies have appeared Smooth, slightly convex. The microscopy showed Colonies have aggregated gram-positive spherical cells in clusters, pairs, short chains, not mobile, and the results of the biochemical tests were they were all positive for catalase and negative for oxidase.

The bacterial isolates were subjected to the API HiStaph. TM Identification Kit. It has shown the results of the diagnosis are in complete agreement with the results of [20]. The tests the aforementioned biochemical for staphylococcal bacteria, which included the examination of carbohydrate fermentation and other enzymatic assays.

The study reached the isolation and identification of Aeromonas spp. Its colonies were yellow, slightly above the surface of the medium (ADA-V). The biochemical tests showed its fermentative ability and its ability to withdraw the carboxyl radical from the amino acid lysine. It grew in the presence of 3% and 6% sodium chloride, respectively, as the results showed that all obtained isolates were gram-negative and all isolates were motile.

And it was found through the results of tests and based on the diagnostic kit API HiAermonas. TM identification kit, the presence of types of these bacteria in the shrimp samples, and these types were Aeromonas veronii Aeromonas schubertii Aeromonas Aeromonas sobria and Aeromonas encheleia.

The results agreed with [21] By isolating three types of bacteria identical to what was found in the current study, Aeromonas schubertii, Aeromonas sobria and Aeromonas veronii in the shrimp. The study concluded that six vibrio species were isolated by growing dilutions of samples on TCBS, a differential selection medium on which only vibrio spp grows. The colonies were Yellow or green, after which the bacteria were stained by gram stain. All isolates were negative for gram stain, and it showed that the shape of bacteria cells was in the form of small villi, and all of them were motile, and the results showed that all isolates were positive for the oxidase assay [22].

And the results of the study showed there are eight genera of Enterobacteriaceae. The different genera and types of bacteria were diagnosed using the API Hi TM Enterobacteriaceae Identification kit, and two species of the genus Citrobacter were identified. They are C. freundii and C.amalonaticus, while three species belonging to the genus Enterobacter have been identified they are E.taylorae, E.aerogenes, and E.cloacae. There are another species belonging to Cronobacter sakazakii and isolates belonging to the species Hafnia avail, and the genus Proteus have been identified .Two species, P.mirabilis and P.vulgaris, were diagnosed. It was found through the results that Proteus bacteria was negative for

the lipoprotein test and negative for oxidase testing, pectin degradation and ONPG production And negative for fermentation of mannose sugar, Onositol, mannitol, adonitol, and D-arabitol are positive for the tests of the enzyme ornithine deaminase and the deaminase enzyme from phenylalanine, growth on potassium cyanide, production of gas from glucose and nitrate reduction, positive for the production of H2S gas, liquefaction of gelatin and the production of lipases, and weak in the consumption of citrate, decomposition of urea while bacteria Morganella morganii sub. morganii was negative for the tests mentioned above in addition to citrate consumption and positive for fermentation of mannose sugar and urease test as in [23, 24].

The presence of the intestinal family in fish is an indicator of sewage contamination, and there are strains of Enterobacteriaceae that may cause diarrhea and can cause spoilage in a wide range of foods in addition to giving undesirable flavors and odors due to the action of bacterial enzymes on proteins and fats in foods [4]. As for the frequency of emergence of bacteria isolated from shrimp, the results indicated that Pseudomonas fluorescens was more frequent than the rest of the species.

Primary detection of histamine-producing bacteria in liquid and solid media:

The local bacterial isolates were subjected to a sifting process to determine their ability to produce histamine depending on the color change of the medium to violet color around the colonies growing on the medium HCM. The growth results of bacteria isolated from shrimp in liquid and solid media (HCB, TSBHA and TSBH) gave a color change in the media, indicating histamine production due to the bacteria producing the histidine decarboxylase enzyme and converting it to histamine, which in turn is caused by the histamine pigment, which is the dye. The pH value of the medium (from acidic to basic) and the color changed from green to violet due to bromocresol purple.

After the incubation period, in suitable conditions, such as temperature, etc. In solid media, a violet aura appeared around the growing bacterial colonies. The results showed the presence of strong bacteria in the production of histamine in the solid histamine production medium, and other bacteria that were weak in production in the same medium, as well as other bacteria that were negative in production, meaning that they do not possess the enzyme Histamine decarboxylase (HDC) and have no role in the production of histamine.

This test used the liquid media HCB and TSBH containing bromocresol purple dye. After the incubation period, the color of the liquid media noticeably changed to violet color for the bacteria producing the enzyme Histamine decarboxylase (HDC). It did not change for the bacteria that did not produce histamine. The results showed the isolates also In its enzyme productivity through the variation of the color density of the liquid media during the incubation period.

The previous results showed that all isolates varied in their ability to produce the enzyme to varying degrees. The results also showed the presence of some bacterial species that gave a negative result for the examination in liquid and solid media. However, they can produce histamine from the decomposition of histidine, which may be because the medium's pH does not suit bacteria, which causes them to not grow in the medium, such as Hafnia alvei. Klebsiella pneumoniae and Klebsiella oxytoca bacteria produced histamine in TSBH liquid media, and the results agreed with what was found [25]. There are genera of the family Enterobacteriaceae that produce high a level of histamine, and this was also mentioned [26].

Where [27] confirmed that Staphylococcus bacteria were histamine-producing, while [28] Stated that 76% of Staphylococcus isolates, especially Staphylococcus xylosus, were histamine-producing.

It also showed [29] that Staphylococcus bacteria were histamine-producing for Staphylococcus carnosus, and Staphylococcus piscifermentans bacteria were also found by [30].

Staphylococcus bacteria were also histamine-producing for Staphylococcus plymuthica and Staphylococcus fonticola.

It was found that most of the histamine-forming bacteria are living at moderate temperatures, so the biogenic amines, especially histamine, increase at temperatures ranging between 15-20° C [31] and the results also agreed with [32], who found that Enterobacter aerogenes And Morganella morganii has given a positive result for the production of histamine.

shrimp Metapenaeus affinis					
name of bacteria	**frequencies**	**percentage**	**Type of bacteria**	**frequencies**	**percentage**
Cronobacter sakazakii	4	5.63	A. veronii	1	1.40
E.cloacae	3	4.22	A. schubertii	1	1.40
E.aerogenes	2	2.81	A. encheleia	2	2.81
E.taylorae	2	2.81	A. sobria	2	2.81
P. vulgaris	1	1.40	V. vulnificus	2	2.81
P. marina	4	5.63	V. fischeri	1	1.40
P. mirabilis	2	2.81	V. alginolyticus	1	1.40
S. aprophyticus	1	1.40	V. parahaernolyticus	2	2.81
S. epidermidis	1	1.40	V. fluvialis	2	2.81
S. intermedius	2	2.81	S. fonticola	3	4.22
C.amalonaticus	2	2.81	S. marcescens	2	2.81
C. freundii	2	2.81	B. alvei	2	2.81
E. coli	2	2.81	B. licheniformis	2	2.81
H. alvei	2	2.81	B.pumilus	2	2.81
M. morganii sub. morganii	2	2.81	B.subtilis	1	1.40
P .aeruginosa	3	4.22	K. oxytoca	2	2.81
P . fluorescens	5	7.04	K.pneumonia	2	2.81
V. harveyi	1	1.40			

Table 1. Types of bacteria isolated from shrimp Metapenaeus affinis, their frequencies and percentage.

Name of the bacteria	Positive result	Name of the bacteria	Weak result	Name of the bacteria	Negative result
K. pneumonia sub. pneumonia	++	S. intermedius	+	A. schubertii	-
K. oxytoca	++	E. coli	+	A. veronii	-
E. cloacae	++	Serratia marcescens	+	A. encheleia	-
P. marina	++	Serratia fonticola	+	A. sobria	-
V. alginolyticus	++	P. fluorescens	+	H. alvei	-
C. sakazakii	++	P. aeruginosa	+		
E.taylorae	++	B. subtilis	+		
P. vulgaris	++	B. licheniformis	+		
P. mirabilis	++	B. alvei	+		
C. freundii	++	B. Pumilus	+		
C. amalonaticus	++	S. aprophyticus	+		
V. vulnificus	++	S. epidermidis	+		
V. harveyi	++				
V. fischeri	++				
V. parahaemolyticus	++				
V. fluvialis	++				
E.aerogenes	++				

Table 2. Test of isolated bacteria for histamine production on solid and liquid histamine production media.

The results agreed with [9]. that Aeromonas spp does not produce histamine, while Morganella morganii, Enterobacter cloacae, Enterobacter aerogenes, Klebsiella pneumoniae, Vibrio alginolyticus, Vibrio parahaemolyticus and Proteus vulgaris were histamine-producing. [33] It was found that samples containing different types and numbers of bacteria belonging to the family Enterobacteriaceae that produce histamine had high histamine levels.

The results agreed with [34], who found that the genus Bacillus, especially Bacillus coagulans, weakly produced histamine in fish products in Taiwan.

The results also agreed with [35], which found that Serratia marcescens, Klebsiella variicola and Enterobacter spp. isolated from tuna fish products produced histamine weakly in the liquid media containing histidine TSBH.

The use of culture media methods to detect histamine-producing bacteria that depend on the change in the pH number, its decrease in the culture media affects the growth of some histamine-producing microorganisms such as Photobacterium damselae, which do not grow well in that number, and raising it can affect the failure of The test. Several researchers confirmed that the change in the medium's acidity could be due to the metabolism of some microorganisms that do not produce biological amines.

References

1 Andrade, S. C. S., Mársico, E. T., Franco, R. M., Godoy, R. L. O., Pacheco, S., Queiroz, M. F. & Guimarães, C. F. M. Shelf life of chilled and whole sardines evaluated by physical-chemical, bacteriological and sensory. Ciênci a.Rural, 42: 1901-1907. **2012**.

2 Rodrigues, B. L., Álvares, T. S., Costa, M.P., Sampaio, G. S. L., Lázaro, De La Torre, C. A., Mársico, E. T. & Conte-Júnior, C.A. Concentration of biogenic amines in rainbow trout (*Oncorhynchus mykiss*) preserved in ice and its relationship with physicochemical parameters of quality. *J. Aquacult. Res. Develop*. **2013**, *4 (3)*: 174-177.

3 Takahashi, H., Kimura, B., Yoshikawa, M. and Fujii, T. Cloning and sequencing of the histidine decarboxylase genes of gram-negative, histamine-producing bacteria and their application in detecting and identifying these organisms in fish. *Appl. Environ. Microbiol*. **2003**, *69 (5)*: 2568-2579.

4 EFSA. Panel on Biological Hazards (BIOHAZ). Scientific opinion on risk-based control of biogenic amine formation in fermented foods. *EFSA Journal*, **2011**; *9(10)*: 2393.

5 Bjornsdottir-Butler, K.; Bolton, G. E.; Jaykus, L. A.; McClellan-Green, P.D. and Green, D.P. Development of molecular-based methods for determination of high histamine producing bacteria in fish. *Int. J. Food Microbiol*. **2010**, *139(3)*: 161-167.

6 Satomi, M.; Fukushima, M.; Oikawa, H. and Yano, Y. Diversity of plasmid encoding histidine decarboxylase gene in *Tetragenococcus* spp. isolated from Japanese fish sauce. *Int. J. Food Microbiol*. **2011**, *148*.

7 Bjornsdottir, K. Detection and Control of Histamine-Producing Bacteria in Fish, PhD. North Carolina State University. **2019**; 222 pp.

8 Lehane, L. and Olley, J. (2000). Histamine fish poisoning revisited. Int. J. Food Microbiol., 58: 1-37.

9 Korashy, N.T. and Farag, H.E. Histamine and histamine producing bacteria in some local and imported fish and their public health Significance. Res. *J. Agricult. Biologi. Sci*. **2005**, *1(4)*: 329-336.

10 Benson, H. J. Microbiological application: Laboratory manual in general microbiology. 8th ed. The McGraw – Hill Companies. **2001**.

11 Harley, J. P. and Prescott, L.M. Laboratory Exercises in Microbiology. 5th ed. The McGraw- Hill companies, **2012**; 449 pp.

12 Barrow, G. C. and Feltham, R.K. A. Cowan and Steel's manual for identification of medical bacteria. 3rd ed. U.K. Cambridge Univ. press. **2013**.

13 De Vos, P.; Garrity, G. M.; Jones, D.; Krieg, N.R.; Ludwig, W.; Rainey, F. A.; Schleifer, K.-H. and Whitman, W B. Bergey's Manual Of Systematic Bacteriology. Second Edition Volume Three. Springer Dordrecht Heidelberg New York. **2009**; 1450 pp .

14 Dempsey, A. C. and Kitting , C. L. *Characteristics of bacteria isolated from penaeid shrimp. Crustacea*, **2007**; *52(1)*: 90-94.

15 Barman, P.; Banerjee, A.; Bandyopadhyay, P. ; Mondal, KC and Das Mohapatra, P.K. Isolation, identification and molecular characterization of potential. Probiotic bacterium, *Bacillus subtilis* PPP 13 from *Penaeus monodon*. Research Article, *Biotechnol. Bioinf. Bioeng*. **2011**,*1(4)*: 473-482.

16 Setia, I. N. and Suharjono. Chitinolytic Assay and Identification of Bacteria isolated from shrimp waste based on 16S rDNA sequences. Advan. *Microbiol*. **2015**, *5*: 541-548.

17 Lau, G.W.; Hassett, D.J.; Ran, H. and Kong, F. The role of pyocyanin in *Pseudomonas aeruginosa* infection. *Trends Molecul. Medi*. **2014**,*10(12)*: 599-606.

18 Jiqiu,L.; Beiping, T. and Kangsen, M. Isolation and identification of bacterium from marine shrimp digestive tract: a new degrader of starch and protein. J. Ocean Univ. China, *Ocean. Coast. Sea Res*. **2011**; *10(3)*: 287-292.

19 Narasimhan , N. ; Ravimanickam, T.; Sukumaran, M.; Ravichelvan, R.; Ravichandran, R. and Madhavan, D. Pathogenic bacteria isolated from tiger prawn *Penaeus monodon* in shrimp culture ponds at east coast of Thanjavur District Tamil Nadu, *India. Int. J. Res. Biologi. Sci*. **2013**, *3(2):* 98-101.

20 Hajar, S. and Hamid, T. H. T. A. Isolation of lactic acid bacteria strain *Staphylococcus piscifermentans* from Malaysian traditional fermented shrimp cincaluk. *Int. Food Research. J*. **2013**, *20(1)*: 125-129.

21 Chasanah, E.; Patantis, G.; Zilda, D.S.; Ali, M. and Risjani, Y. Purification and characterization of *Aeromonas* media Klu 11.16 chitosanase isolated from shrimp waste. *J. Coas. Develop*. **2011**, *15(1)*: 104- 113 .

22 Gonza´lez, S.F.; Krug, M. J.; Nielsen, M.E.; Santos, Y. and Call, D. R. Simultaneous detection of marine fish pathogens by using multiplex PCR and a DNA microarray. *J. Clin. Microbiol.* **2014**, *42(4)*: 1414-1419.

23 Actis, L. A.; Smoot, J. C.; Barancin, C. E. and Findlay, R. H. Comparison of differential plating media and two chromatography techniques for the detection of histamine production in bacteria. *J. Microbiol. Methods*, **2009**; *39*: 79-90.

24 Qasim, D.A. Screening the *proteus mirabilis* by isolation from tuna fish and compared the occurrence with local fish. *Biochem. Cell. Arch*. **2020**, *20(1*): 481- 486.

25 Hala´sz, A.; Bara´th, A.; Simon-Sarkadi, L. and Holzapfel, W. Biogenic amines and their production by microorganisms in food. Trends Food Sci. *Technol*. **2014**, *5*: 42-48.

26 Roig-Sague´s, AX; Hernandez Herrero, M.; Lo´pez-Sabater, E.I.; Rodriguez-Jerez, J.J. and Mora-Ventura, M. T. Histidine decarboxylase activity of bacteria isolated from raw and ripened Salsichon, a Spanish cured sausage. *J. Food Protect*. **2006**, *59*: 516-520.

27 Tiecco, G.; Tantillo, G.; Francioso, E.; Paparella, A. and De Natale, G. Ricerca quali-quantitativa di alcune amine biogene in insaccati nel corso della stagionatura. *Industr. Aliment*. **2016**, *5*: 209-213.

28 Silla-Santos, M.H. Amino acid decarboxylase capability of microorganisms isolated in Spanish fermented meat products. *Int. J. Food Microbiol*. **2018**, *39*: 227-230.

29 Straub, B.W.; Kicherer, M.; Schilcher, S. M. and Hammes, W.P. The formation of biogenic amines by fermentation organisms. *Zeitschrift fu¨r Lebensmittel-Untersuchung und- Forschung*, **2015**; *201*: 79-82.

30 LópezSabater, E.I.; Rodríguez-Jerez, J. J.; Hernández-Herrero, M. and Mora- Ventura, M . T . Incidence of histamine-forming bacteria and histamine content in scombroid fish species from retail markets in the Barcelona area. *Int. J. Food Microbiol*. **2016**, *28*: 411-418

31 Flick, G.J.; Oria, MP and Douglas, L. Potential hazards in coldsmoked fish: biogenic amines. *J. Food Sci.,* **2011**; *66(7)*: 1088-1099.

32 Wauters, G.; Avesani, V.; Charlier, J.;Janssens, M. and Delme´e, M. Histidine decarboxylase in *Enterobacteriaceae* Revisited. *J. Clin. Microbiol.* **2004**, *42 (12)*: 5923-5924.

33 Koohdar, V.A.; Razavilar, V.; Motalebi, A.A.; Mosakhani, F.; Valinassab, T. Isolation and Identification of Histamine-forming bacteria in frozen Skipjack tuna (*Katsuwonus pelamis*). *Iran. J. Fisher. Sci*. **2011**,*10(4):* 678-688 .

34 Tsai, Y.H.; Lin, C.Y.; Chien, L.T.; Lee, T.M.; Wei, C.I. and Hwang, D.F. Histamine contents of fermented fish production Taiwan and isolation of histamine-forming bacteria. *Food Chem*. **2006**, *98*: 64-70.

35 Chen, H.C; Kung, H.F.; Chen, W.C.; Lin, W .F.; Hwang, D.F.; Lee, Y. C. and Tsai, Y.H. Determination of histamine and histamine-forming bacteria in tuna dumpling implicated in a food-borne poisoning. *Food Chemis*. **2008**, *106* : 612-618.

Received: May 15, 2023/ Accepted: June 10, 2023 / Published: June 15, 2023

Citation: Qasim, D.A. Isolation and identification of some types of histamine-producing bacteria from shrimp in local markets. Revis Bionatura 2023;8 (1) 47. http://dx.doi.org/10.21931/RB/CSS/2023.08.01.47