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List of published and submitted manuscripts and presentations

Peer reviewed publications


Conference presentations

Oral presentations


Poster presentations


**Other publications**

Abstract

*Rihaakuru* is a cooked fish paste from the Maldives, consumed as a condiment with rice and other food. The product is unique to the Maldives and there is no information on the composition, characteristics and safety of this product. Histamine contamination has been suspected due to symptoms sometimes seen following consumption. This research established that *Rihaakuru* is a nutritious and shelf-stable product. *Rihaakuru* is generally produced from poor quality fish therefore presence of biogenic amines was suspected. This study confirmed that *Rihaakuru* contained up to ten different biogenic amines, with histamine in excess of 500 ppm. This may cause histamine poisoning with symptoms such as skin rashes, vomiting and fever. The product examined in this study contained a few weak histamine forming bacteria. Most of the histamine is likely to be produced by bacteria in the raw fish. These bacteria are likely to die during the manufacture of *Rihaakuru*. Histamine in *Rihaakuru* decreased by 30-70% during storage at -80°C, 4°C and 30°C for 10 months. This showed that the histamine hazard in *Rihaakuru* is unlikely to increase and may decrease during long term storage. Traditional control of histamine in food is through refrigeration of raw material. In the case of the fish used to manufacture *Rihaakuru*, refrigeration is not available or limited. Histamine oxidizing bacteria and enzymes were identified as emerging approaches to degrade pre-formed histamine. Histamine oxidizing bacteria (*Lactobacillus sakei* [AGR 37, AGR 46, Lb 706] and *Vergibacillus halodinitificans Nai18*) tested in this study degraded histamine by 30-50%. The histamine oxidizing enzyme, diamine oxidase (DAO) completely degraded 500 mg/L of histamine at pH 6 and salt 1% in buffer and in the tuna soup used to manufacture Rihaakuru. A regression model was developed that predicted the rate and amount of histamine removal by DAO under varied pH and salt concentration. This model may be used to determine conditions that will reduce histamine in other foods that have similar characteristics to the tuna soup used to manufacture *Rihaakuru*. 
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My mother, Fathimath Agila, without whom none of this would have been possible and to her I dedicate this thesis.
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<th>Description</th>
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<tbody>
<tr>
<td>ANOVA</td>
<td>Analysis of Variance</td>
</tr>
<tr>
<td>AOAC</td>
<td>Association of Official Analytical Chemists</td>
</tr>
<tr>
<td>CCD</td>
<td>central composite design</td>
</tr>
<tr>
<td>CHD</td>
<td>coronary heart disease</td>
</tr>
<tr>
<td>CHO</td>
<td>carbohydrates</td>
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<tr>
<td>DAO</td>
<td>diamine oxidase</td>
</tr>
<tr>
<td>DHA</td>
<td>docosahexaenoic acid</td>
</tr>
<tr>
<td>DNA</td>
<td>deoxyribonucleic acid</td>
</tr>
<tr>
<td>DPA</td>
<td>docosapentaenoic acid</td>
</tr>
<tr>
<td>DSMZ</td>
<td>Deutsche Sammlung von Mikroorganismen und Zellkulturen GmbH</td>
</tr>
<tr>
<td>EDTA</td>
<td>ethylene diamine tetra acetic acid</td>
</tr>
<tr>
<td>EPA</td>
<td>eicosapentaenoic acid</td>
</tr>
<tr>
<td>ETE</td>
<td>eicosatrienoic acid</td>
</tr>
<tr>
<td>FDA</td>
<td>Food and Drug Administration</td>
</tr>
<tr>
<td>FID</td>
<td>Flame Ionization Detector</td>
</tr>
<tr>
<td>GAM</td>
<td>Gifu Anaerobic Medium broth</td>
</tr>
<tr>
<td>GC</td>
<td>gas chromatography</td>
</tr>
<tr>
<td>GDL</td>
<td>glucono-delta-lactone</td>
</tr>
<tr>
<td>GE</td>
<td>Gross Energy</td>
</tr>
<tr>
<td>HDC</td>
<td>Histidine Decarboxylase</td>
</tr>
<tr>
<td>HHP</td>
<td>high hydrostatic pressure</td>
</tr>
<tr>
<td>HPLC</td>
<td>high performance liquid chromatography</td>
</tr>
<tr>
<td>ICMSF</td>
<td>International Commission on Microbiological Specification for Foods</td>
</tr>
<tr>
<td>MAOI</td>
<td>monoamine oxidase inhibitors</td>
</tr>
<tr>
<td>MAP</td>
<td>modified atmosphere packaging</td>
</tr>
<tr>
<td>MPN</td>
<td>most probable number</td>
</tr>
<tr>
<td>MRS</td>
<td>deMan, Rogosa and Sharpe broth</td>
</tr>
<tr>
<td>MS</td>
<td>mass-spectroscopy</td>
</tr>
<tr>
<td>NOAEL</td>
<td>no observed adverse effect level</td>
</tr>
<tr>
<td>NZAID</td>
<td>New Zealand Agency for International Development</td>
</tr>
<tr>
<td>NZDS</td>
<td>New Zealand Development Scholarship</td>
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</table>
NZIFST  New Zealand Institute of Food Science and Technology
NZMS  New Zealand Microbiological Society
PCR  polymerase chain reaction
PUFA  polyunsaturated fatty acids
RDI  recommended daily intake
rDNA  Ribosomal DNA
RSM  response surface model
SBMB  New Zealand Society for Biochemistry and Molecular Biology
sfam  Society for Applied Microbiology
TCA  trichloroacetic acid
TDF  Total Dietary Fibre
TLC  thin layer chromatography
TMAH  tetramethylammonium hydroxide
TSA  trypticase soy agar
TSB  trypticase soy broth
TSBH  histidine tripticase soy broth
UHT  ultra high temperature
USA  United States of America
USDA  United States Department of Agriculture
UV  ultra-violet
WHO  World Health Organization
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