Module Handbook:
Technology of Fermented Fisheries Products

Module designation	This course provides knowledge related to microbial physiology in the fermentation process, the factors that influence the fermentation process, the fact that the fermentation process traditionally uses natural microbes and modernly uses inoculum starters, enzymatic processes in the production of protein hydrolysates and chito-oligosaccharides, and the production of metabolites from microbes.
Semester(s) in which the module is taught	Second Semester
Person responsible for the module	Indun Dewi Puspita, S.P., M.Sc. Ph.D. Prof. Dr. Amir Husni, S.Pi., M.P. Mgs. Muhammad Prima Putra, S.Pi., M.Sc., Ph.D.
Language	Indonesian
Relation to curriculum	Elective Course
Teaching methods	Activities: a) Lecture (lecture and discussion) b) Examinations c) Take-home assignments d) Quiz e) Student presentation
Workload (incl. contact hours, self-study hours)	Working hours: 2 credits of theory. Total Workload: 2 SCU (Semester Credit Unit) = 2 x 45 hours within 1 semester = 3.34 ECTS.
Credit points	2 Credit points
Required and recommended prerequisites for joining the module	*None*

Module objectives/intended learning outcomes	**Program Learning Outcomes:** PLO3: Applying logical, critical, systematic, and innovative thinking by utilizing information technology for fish farming, fishery resource management, or fishery product processing PLO5: Critically evaluate and innovate to solve problems in aquaculture, aquatic resource management, or the processing of fishery products. **Course Learning Outcomes:** CLO1: Able to understand microbes as a cell factory and the factors affecting the fermentation process. (PLO3) CLO2: Able to understand the types of fermentation and their characteristics (strengths and weaknesses). (PLO3). CLO3: Able to understand the traditional/modern fermentation applied for food/non-food production and the health and safety effects of fishery fermentation products. (PLO5)

Content	1. Introduction a. Definition of fermentation b. Fermentation History c. Fermented products 2. Microbial diversity in fermented fishery products a. Microorganisms in various fishery fermentation products b. Bacterial population dynamics in the fermentation process c. Effect of bacterial population dynamics on product characteristics 3. Microbial physiology in the fermentation process a. Metabolic processes in bacterial cells b. Aerobic respiration (glycolysis, creb cycle, electron transport) c. Anaerobic respiration d. Fermentation 4. Bacterial, mould and yeast fermentation (2 times meeting) a. Bacterial fermentation b. Mould fermentation c. Yeast fermentation d. Process characteristics and fermented products 5. Factors that affect fermentation a. Starter selection and analysis of microorganisms b. Effect of nutrition, temperature, pH, and inhibitors on the fermentation process 6. Type of fermentation (2 times meeting) a. Batch, fed-batch, continuous fermentation b. Solid state, submerge, liquid fermentation c. Fermentation process characteristics d. Strengths and weaknesses

	7. Traditional fermentation of fishery products (2 times meeting) a. Fermentation process of fish sauce and shrimp paste b. Whole fish fermentation process c. Chemical changes in fermented products d. Chemical characteristics of fermented products 8. Modern fermentation of fishery products (2 times meeting) a. Fish protein hydrolysate production process b. Fermented fish oil c. Algae fermentation (production of bioethanol and biogas) 9. Production of bioactive compounds through fermentation of fishery products (non-food) a. Biological processes in chitin / chitosan oligomer production b. Biological processes in the production of bioactive compounds from fisheries waste 10. Health and safety impacts of fishery fermentation products a. Beneficial microorganisms in fermented products b. Increase the nutritional value of fermented products c. Bacteriocin and bioactive marine peptide d. Safety of fishery fermentation products: biogenic amine, putrefaction

<table>
<tr><td>Examination forms</td><td>
<table>
<tr><th>Evaluation Basis</th><th>Evaluation Components</th><th>Percentages</th><th>CLO 1</th><th>CLO 2</th><th>CLO 3</th></tr>
<tr><td rowspan="2">Participatory Activity</td><td>Group presentation</td><td>10%</td><td></td><td>√</td><td></td></tr>
<tr><td>Quiz</td><td>10%</td><td>√</td><td></td><td></td></tr>
<tr><td>Project results/case study results</td><td>Individual/Group Assignment</td><td>30%</td><td></td><td>√</td><td></td></tr>
<tr><td rowspan="2">Cognitive</td><td>Mid Exam</td><td>25%</td><td></td><td>√</td><td></td></tr>
<tr><td>Final Exam</td><td>25%</td><td></td><td></td><td>√</td></tr>
<tr><td></td><td>Total</td><td>100%</td><td></td><td></td><td></td></tr>
</table>
The total percentage of participatory activities and project results/case studies/PBL results is at least 50%.
</td></tr>
<tr><td>Study and examination requirements</td><td>Students can join the course by registering the study plan (KRS) to enroll in the chosen subjects in each academic semester. The students must meet minimum attendance requirements 70% for joining the final examination.</td></tr>
</table>

Reading list	1. Steinkraus, K.H. 1993. Fish Fermentation Technology. United Nations University Press. 2. Madigan, M.T. & J. M. Martinko. Brock Biology of Microorganism 11th Ed. 2006. Pearson Prentice Hall. International Journal, such as: 1. Crisan, E.V. & A. Sands. 1975. Microflora of Four Fermented Fish Sauces. Applied Microbiology. 29(1): 106-108 2. Se Hee Lee, Ji Young Jung, Che Ok Jeon. 2015. Bacterial community dynamics and metabolite changes in myeolchi-aekjeot, a Korean traditional fermented fish sauce, during fermentation. International Journal of Food Microbiology. 203: 15-22 3. Xuefeng Zeng, Wenshui Xia, Qixing Jiang, Fang Yang. 2013. Chemical and microbial properties of Chinese traditional low-salt fermented whole fish product Suan yu. Food Control International Journal of Food Microbiology. 30: 590-595 4. Gaden, E.L. 2000. Fermentation Process Kinetics. Biotechnology and Bioengineering. 67(6): 629-635. 5. Chisti, Y. 1999. Fermentation (industrial): Basic consideration. In: Encyclopedia of Food Microbiology, Robinson, R., Batt C., and Patel P., editors. Academic Press, London. pp. 663-674. 6. Thomas, L., C. Larroche, A. Pandey. 2013. Current developments in solid-state fermentation. Biochemical Engineering Journal. 81: 146-161.