FY2024 Annual Report

Yoko Nomura

2025/4/1

1. Introduction

I continued to engage in two independent research projects during FY2024, namely, engineering of functional RNAs with Nucleic Acid Chemistry and Engineering (NACE, Yokobayashi) Unit (2A) and investigations on natural fibers (e.g., Bashofu, as a PI, 2B).

2. Research activities and findings

A. Engineering of functional RNAs

(a) RNA aptamer AC17-4

We have focused on exon-skipping regulated by an RNA aptamer AC17-4 that binds to a small molecule ASP2905 (Fukunaga et al., 2023, *J. Am. Chem. Soc.* 145(14), 7820-7828). Based on this research, we succeeded in tuning the reporter gene EGFP's expression level by adjusting the stability of the P1 stem of AC17-4. The results with the application of phenotype regulation of mammalian cells were published in a scientific journal (**3a**). I continued with mammalian cell experiments regarding riboswitches binding to small molecules that the Yokobayashi unit synthesized.

(b) A new project in the Yokobayashi unit

I joined a new collaborative project with a pharmaceutical company. Our primary goal is to discover RNA aptamers that specifically bind to the small molecules our collaborator selected. During the first year of this project, we prepared large RNA libraries and started in vitro selection experiments based on the SELEX method (**Figure 1**). We are planning to analyze the enriched RNA sequences through SELEX.

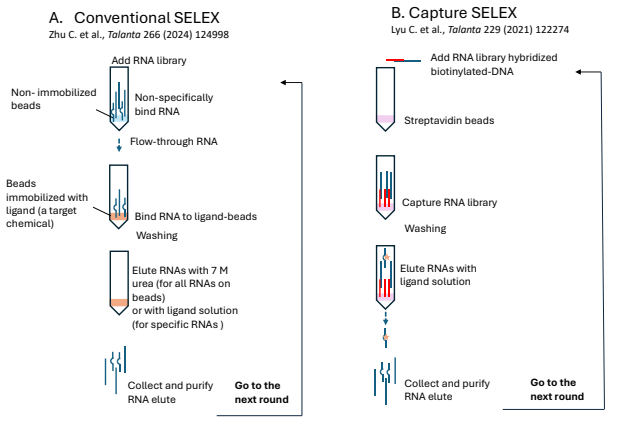

Figure 1. Systematic Evolution of Ligands by Exponential Enrichment (SELEX)

B. Natural fiber project (KAKENHI projects)

(a) Bacterial treatment to improve Bashofu fiber extraction

Our research of the previous JSPS KAKENHI KibanC (19K02308) was published (**3b**). In this paper, we proposed a minimal improvement to the traditional method (Important Intangible Cultural Property) of Bahosfu making. We isolated *Stenotrophomonas* sp. from a local material banana field to degrade fatty acid esters in unwanted hard parts (plant cuticle layer) of the materials. The material

treated by this strain was thinner and softer, allowing easy mechanical separation of the fibers from the materials.

(b) Morphological analysis of Kimono-grade Bashofu fiber (JSPS KAKENHI project Kiban C 20K02354, Co-PI)

We carefully observed morphologies of fine Bashofu fibers of Kimono grade, and we concluded that the artisan's fiber selection was reasonable for plant science. Furthermore, we investigated the ratio of plant cell wall area to lumen area (W/L value). We considered that large W/L values may contribute to fiber hardness, while small values (large portion lumens) result in the breathable and lightweight properties needed for summer wear. Bashofu is usually used for summer wear, and the W/L value of Bashofu kimono fibers (processed and purified fibers) was approximately 1.5.

(c) Identification of materials of old Okinawan textiles (**5a, b**)

In this project, I take charge of the accurate identification of textile materials, and co-PI proceeds with a high-quality imaging analysis for noninvasive identification.

This year, we tried to analyze species specificity genome region Internal Transcribed Spacer (ITS) region of ribosomal RNA unit in genome DNA (Nwakanma D. C. et al., 2003, *Theor. Appl. Genet.* 108, 154-159). We succeeded in amplifying the ITS region by adjusting the PCR conditions.

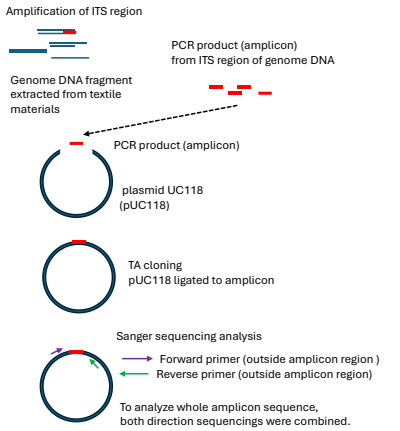

Figure 2. Sequencing analysis using a plasmid

To completely read a target ITS DNA sequence, we integrated the PCR amplicon into pUC118 (**Figure 2**). However, the sequences from the textile samples turned out to be of fungus or yeast origin, not from material *Itobashou*. This was because the PCR primers used in this study were common to the Musa family (banana; Bashofu material plant) and other microorganisms coexisting in banana plants. Then, we designed a specific primer set for Musa family. Furthermore, we are trying to condense and clean up template DNA (the genome extracted from Bashofu materials), and we plan a PCR amplification with this specific primer set for Musa family based on the concentrated and cleaned template.

About the imaging study, we presented primary results at meetings of the Japan Society of Home Economics (**4a, b**, **Figure 3)**. We showed the difference in the surface of the textiles by different traditional finishing. For example, although Miyako-jofu and Bashofu are traditional textiles in Okinawa, material and finishing methods differ. Miyako-jofu is strongly beaten at the finishing step to enhance softness, which causes the threads to get partially frayed. However, such fraying was not observed in Bashofu's surface because of Bashofu's chemical finishings.

Developing from these observation studies of textiles, we realized that careful analyses of textile images were useful in new application nursing and care settings. As water permeability of fabrics is an important factor in these fields, we started analysis of water permeability for traditional textiles with textile surface observation.

All data in this table were measured by a public testing agency.

	1. Miyako-jofu	2. Bashofu	3. Ojiya-chijimi	4. Noto-jofu	5. Bed sheet 1	6. Bed sheet 2
Material	Ramie (Okinawa)	*Itobashou* (banana)	Ramie (outside Japan)	Ramie (outside Japan)	Cotton 100%	Cotton 70% PET 30%
Weight (g/m^2)	88.7	119.5	109.2	103.3	150.4	142.4
Thickness (mm)	0.22	0.35	0.28	0.28	0.38	0.34
Warp thread density (per inch)	70.6	61.4	63.8	74.4	67.4	71.4
Weft thread density (per inch)	74.4	67.5	52.6	61.4	61.4	61

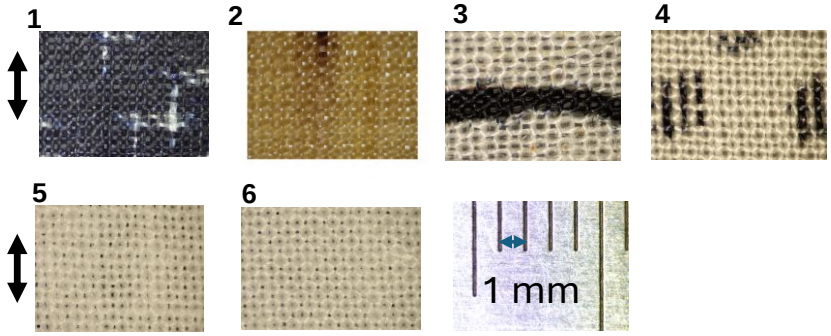

Figure 3. Observation of surfaces of traditional Japanese textiles (1-4)
1. Miyako-jofu (Okinawa), 2. Bashofu (Okinawa), 3. Ojiya-Chijimi (Niigata), 4. Noto-jofu (Ishikawa),
5. bed sheet (cotton 100%), 6. bed sheet (cotton 70%, PET 30%).
The number of each image corresponds to the number in the table.

3. Peer-reviewed publications

(a) Y. Nomura, N. Kim, B. Zhu, M. Hamzah, H. Zhang, Y. Yokobayashi. Optimization of Exon-Skipping Riboswitches and Their Applications to Control Mammalian Cell Fate. *ACS Synthetic Biol*ogy, 13(10), 2024, 3246-3255. https://pubs.acs.org/doi/full/10.1021/acssynbio.4c00295

(b) **Y. Nomura** and K. Koizumi. Fusion of Biotechnology and Craftsmanship: Bacterial Treatment to Improve Bashofu Fiber Extraction. *Journal of Natural Fibers*, 21(1), 2024. Article number: 2351166. **Corresponding author Nomura.** https://doi.org/10.1080/15440478.2024.2351166

4. Presentations

(a) H. Kawasaki, Y. Maehara, K. Koizumi, F. Kakihara, and Y. Nomura. Investigation of Characteristics of Traditional Ramie Textiles —for Use in Nursing and Care Settings—(伝統的麻織物の特性調査—看護・介護現場への活用を目的として—). The 76th Annual Meeting of the Japan Society of Home Economics, Nagoya, May 26th, 2024. Poster presentation P-068.
https://www.jstage.jst.go.jp/article/kasei/76/0/76_148/_article/-char/ja/

(b) Y. Nomura, Y. Maehara and K. Koizumi. 目視による判別を目的とした沖縄の伝統布の特徴. The Japan Society of Home Economics, Kyushu Chapter The 68th Annual Meeting, Kagoshima, Oct 5th, 2024. Oral presentation.

5. Others

(a) Collaborators

OIST Scientific Imaging Section (Dr. Koji Koizumi); Kato Tech CO., LTD.; Japan Women's University; Niigata University of Pharmacy and Medical and Life Sciences.

(b) Fundings
JSPS KAKENHI Exploratory Research 22K18489, FY2022−2024, **PI**, ¥6,370,000 over 3 years, “Development of an accurate and noninvasive identification method for Ryukyuan textiles”.

(c) Invited talk & panelist
Y. Nomura, Scientific research of a traditional Okinawan textile Bashofu. Speaker and panelist from clothing field, Symposium “Development of Home Economics by Tradition and Technology” シンポジウム「伝統とテクノロジーで発展する家政学」パネルディスカッション「衣」領域から　～沖縄の伝統布（芭蕉布）の科学研究～. The 76th Annual Meeting of the Japan Society of Home Economics. May 25th, 2024. https://confit.atlas.jp/guide/event/jshe76/static/shinpojium

(d) Service for research consortium
From 2024 June to present: Secretary of the Kyushu Chapter (Okinawa), the Japan Society of Home Economics