Interview with Professor Kumi Yoshida

Laura Dyster: Welcome to the Biocolours2024 conference podcast, where you get a glimpse of the upcoming conference next June. My name is Laura Dyster and I am part of the conference organizing team. I'm so excited to have Emeritus Professor Kumi Yoshida from Nagoya University, Japan, here with me. Welcome, Professor Yoshida.

Kumi Yoshida: Thank you. It's very happy to participate in Biocolours2024 and to revisit Helsinki, a beautiful city, I think.

LD: Oh, you've been to Finland before!

KY: Yes, in 2013, I stayed in Helsinki University as Professor Wähälä, do you know, to stay for four weeks as Erasmus Mundus lecturer.

LD: Okay, but I'm sure you enjoyed it.

KY: Yes, I really enjoyed it and I gave a lecture on natural product chemistry and also the instrumental analysis.

LD: Okay. So you're looking forward to coming to Helsinki again to see it in June, which I think is one of the most beautiful times of the year to visit Finland when summer is starting.

KY: Yes, I know.

LD: I'm so happy that you accepted our invitation to be one of the session keynote speakers of the conference. And we are looking forward to hearing you talk in more depth at the conference. But I thank you for joining me in this podcast to talk briefly about your career and also about the pigments in colored beans. So can you introduce yourself and highlight the milestones in your career, especially regarding your work on pigments in colored beans?

KY: Okay, yes. I was born in Nagoya in 1958 and educated and graduated from Nagoya University with a master's degree in agriculture chemistry and natural product chemistry and bio-organic chemistry area. And under the guidance of Professor Toshio Goto, who is

very famous natural product chemist, working on the bioluminescence, chemiluminescence, and pufferfish toxin, tetratoxin, and also the various bioactive compounds involving flower colors, and plant toxins, and others. So under his guidance, I got my PhD in 1993 from Nagoya University, and the title of my thesis is Flower Coloration Involving Molecular Stackings, Molecular Associations. So after that, I got the position at a private women's university near Nagoya University, and I started my colorant research, mainly the edible plants, because I taught there the food chemistry, and the course was around housekeeping and also food producing. So at that time I started my edible beans colorants research. And in 2000, I moved to Nagoya University as a associate professor. And after that, I was appointed a full professor. And last March, I retired from Nagoya University. And still, I'm working as a visiting professor in Aichi Institute of Technology, a private university also in Aichi area. And in 1995, I was awarded the Japan Bioscience, Biotechnology, and Agrochemistry Society Awards for encouraging young scientists. And in 2016, I was appointed the Groupe Polyphenol Scientific Award. And last March in 2023, I was appointed a JSBBA Award in Chemical, Biological, and Applied Research on flavonoid pigments. Do you have any questions, more questions?

LD: Yes. What led you to focus on pigments in colored beans? And what are the key aspects of your research in this domain?

KY: I also work in the flower coloration and why the hydrangea changes color or why the blue morning glory changes color when opened it. And I also carried out the plant physiological studies and also molecular biological studies. And now my major topics is research topics in hydrangea and also azuki bean. Do you know azuki, a small red bean in English? And we Japanese, in Japanese it's very popular bean. It was used for the Japanese sweets. So all the Japanese loves Japanese sweets and know the name azuki. Other colored beans like black soybean or kidney bean, red kidney bean and others are almost all caused by anthocyanins. Also the similar pigments in flowers and leaves and also the red apple, strawberry and purple eggplants color is also anthocyanins. So first, we also believe that the small red beans pigment also anthocyanin, but it shows that they're similar color like red kidney bean, but no anthocyanin was detected in the azuki beans, small red azuki beans. So we have started at the time what the colorant in azuki beans, and why the same color, it was why the peel, the seed coat shows the same color, same red color, but different pigments contained. So, It was a very challenging study because at the time, we started it around 1995, but at that time, almost all the textbooks said that almost all the colored beans pigments are anthocyanin. And also small red beans colorant, it's also anthocyanins. But our study denied the textbook. And so, and after that, we extracted 60 kilograms of beans and only got 0.1 milligram anthocyanin, only 0.1 milligram or less. So we concluded that at the time that the color was not come from anthocyanin, but other pigments should exist.

LD: So was this the purple pigment?

KY: After more than 20 years of research, we could report the structure. It's named catechinopyranocyanidin A and B. The structure is coupled by cyanidin, the chromophore of cyanin. Usually, anthocyanin means that the chromophore with some sugars, sugar parts. So the catechinopyranocyanidin have no sugars, only the chromophore of anthocyanin, named anthocyanidin, and also catechin parts. Do you know catechin? The flavonoids, also the flavonoids. Catechin is contained in tea leaves mainly. And so it's colored structure and anthocyanin the colored structure. The fused, both catechin and cyanidine parts fused and give a new ring system. So it's better to show the structure or to explain. So I'll show you the...

Interviewer 1 [00:11:04]: But it won't show on the podcast, Professor Yoshida.

Speaker 1 [00:11:08]: Yes.

Speaker 1 [00:12:08]: Can you see the structure?

Interviewer 1 [00:12:09]: Yes, I can see the structure now, thank you.

Speaker 1 [00:12:18]: The upper left structure is catechinopyranocyanidin A, and upper left middle is catechinopyranocyanidin B. Both are the purple colored pigment from red azuki bean, and red part shows catechin in parts, and green and blue parts shows cyanidin parts. It shows a fused structure with ring B, new ring D. So this is very, very complicated structure it takes. And so it has a high strain structure, so easily decomposed by irradiation of light. This ring, ring C, destroyed and give colour as compound.

LD: So the pigment is stable and doesn't decompose in a dark place but decomposes in weak light?

KY: Yes, yes.

LD: What significance does this have and how does it impact the applications of the pigment?

KY: However, it should be stable in the seed coat and also it's stable in the paste. So for producing Japanese sweets, the red azuki bean is boiled. And during the boiling, the inside of the bean is a particle. Each particle is a cell of the plant, and it's colorless. But during boiling and cooking, the seed coat is a little bit dissolved in the boiling water, but it is not water soluble, but very hydrophobic compounds. So it transferred to the cell wall and cell membranes of the cell and attached. Each cell is colored with this pigment to give purple color and paste.

LD: Okay. So it has been a significant discovery, the purple pigment in the red azuki beans.

KY: Yes. So this pigment is unstable in solution. However, when it attached to some solid part, particle, solid parts, it stabilized. The color is stable and not decolorized, I think.

LD: But it decomposes when it's in light.

KY: So, when the solution is irradiated by light, the pigment decomposed. However, when the pigment is attached in some solid parts...

LD: Okay, now I understand. So then it doesn't decompose?

KY: I think so, yes.

LD: Okay. Thank you, Professor Yoshida. So, summing it up, what message would you like to convey to the audience about the significance of your research on pigments in colored beans and its broader implications?

KY: Yes, I'm working as a natural product chemist and bio-organic chemist in nature, still unknown and very complicated and interesting natural products should exist. And also some of them have very important functions. I'm now working on the colorant. The high functional function with the safety food colorant with high function, very important, I think. And anthocyanin should have some high potential for colorant compared with the other dyes, which has some high risk for cancer or some other diseases. And also, not only the colorants, but also some lead compounds for some medicine of pharmaceuticals. In nature, we can research very much compounds. So I think the natural product chemistry is a blue

ocean, still blue ocean, I think. And the whole world, not only the Earth, but also in the space field, we can try to search for new compounds. So it's my message.

LD: Thank you, Professor Yoshida. My last question is, when you close your eyes, what color do you see when you think about the Biocolours2024 conference?

KY: Out of blue, blue colors.

LD: Okay. Maybe that reflects the Finnish flag and the sky and the lakes in Finland. Thank you. Thank you so much for this interview, Professor Yoshida. And we all look forward to seeing you at the conference in Helsinki next June. Thank you so much.

KY: Thank you very much. I'm very much looking forward to see you in Helsinki.