

**Research on utilizing the  
traditional vegetable  
"makuwa-uri" as feed for  
cultured ayu fish.**

**Gifu Senior High School of Agriculture & Forestry  
Department of Animal Science, Ayu Team**



# Makuwa-uri (Oriental melon)

Makuwa, Motosu city, Gifu prefecture



**Makuwa-uri has been  
cultivated for over 450 years**



香瓜



참외



**WHAT'S**

# **Fruit Fish**

Fruit fish are bred by mixing local specialties in their feed to added value



**Ehime prefecture**

**Mikan-tai(Orange Red seabream )**



A photograph of two Ayu fish (Kogyo) resting on a woven bamboo tray. The fish are dark green with a lighter belly. The tray is surrounded by several clear ice cubes and fresh green leaves, likely shiso or perilla, which are used to keep the fish fresh and add flavor. The background is a light-colored bamboo mat.

Another name for **Ayu fish** is **Kogyo**(aromatic fish)

**Ayu fish** smells like watermelon.

A metal tray containing several farmed ayu fish. The fish are arranged in a row, showing their characteristic silver and yellowish-brown coloration. The tray is set against a dark background.

**Farmed ayu fish in the  
Gifu prefecture**

A basket of Makuwa-uri melons. The melons are green and yellow, with a characteristic striped pattern. They are arranged in a basket, with some leaves visible in the background.

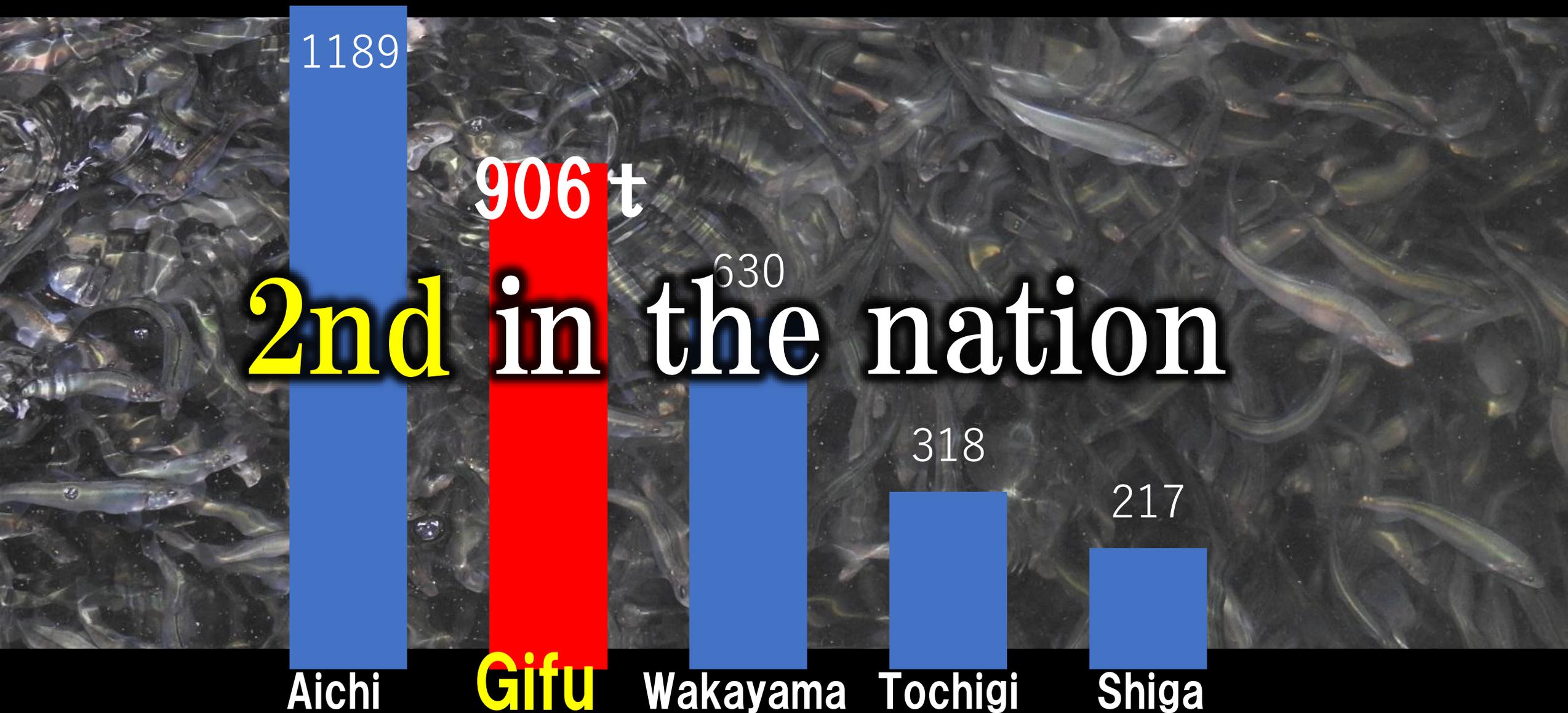
**Attractive Fragrance  
Makuwa-uri**

# Ayu of the Nagara River System



Recognized as Globally Important  
Agricultural Heritage Systems in 2015

# Farmed ayu production in 2020 (Statistics of MAFF)

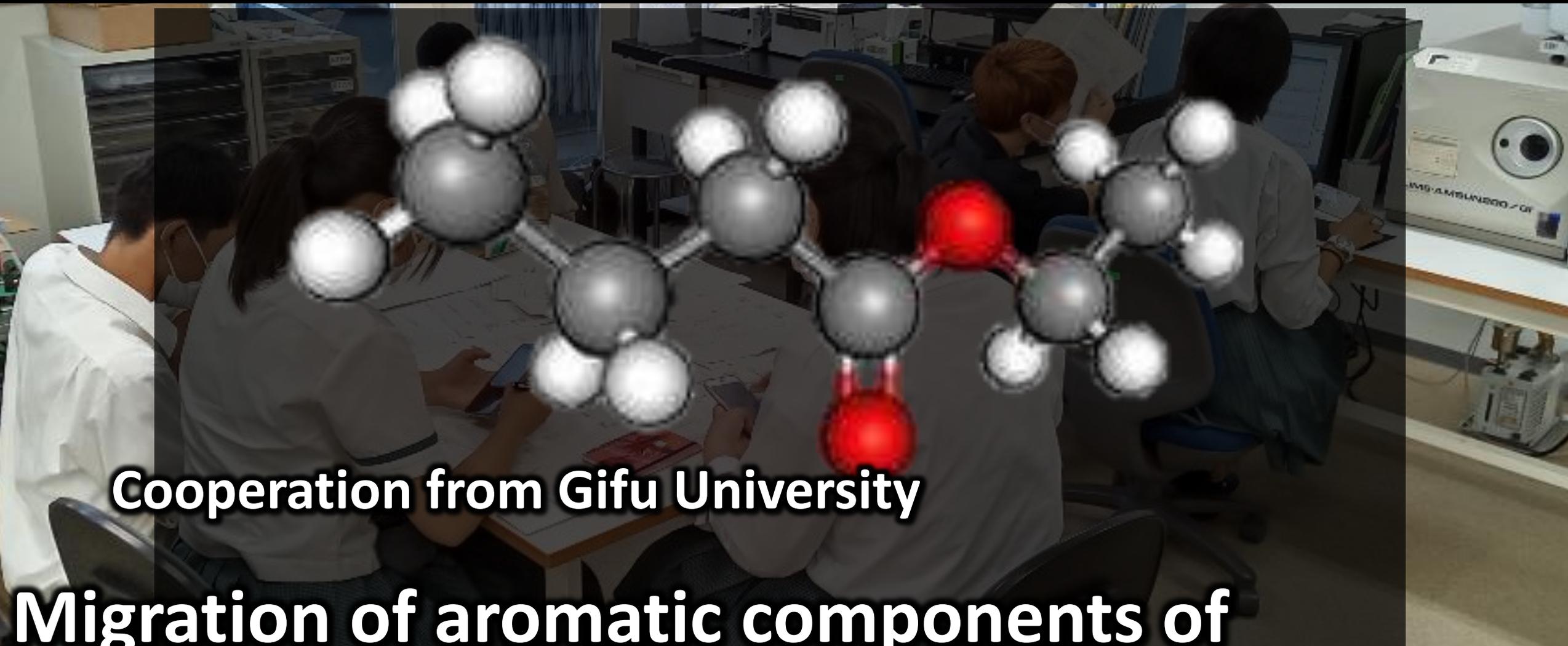




**Gifu Prefecture's new  
brand of Ayu fish**

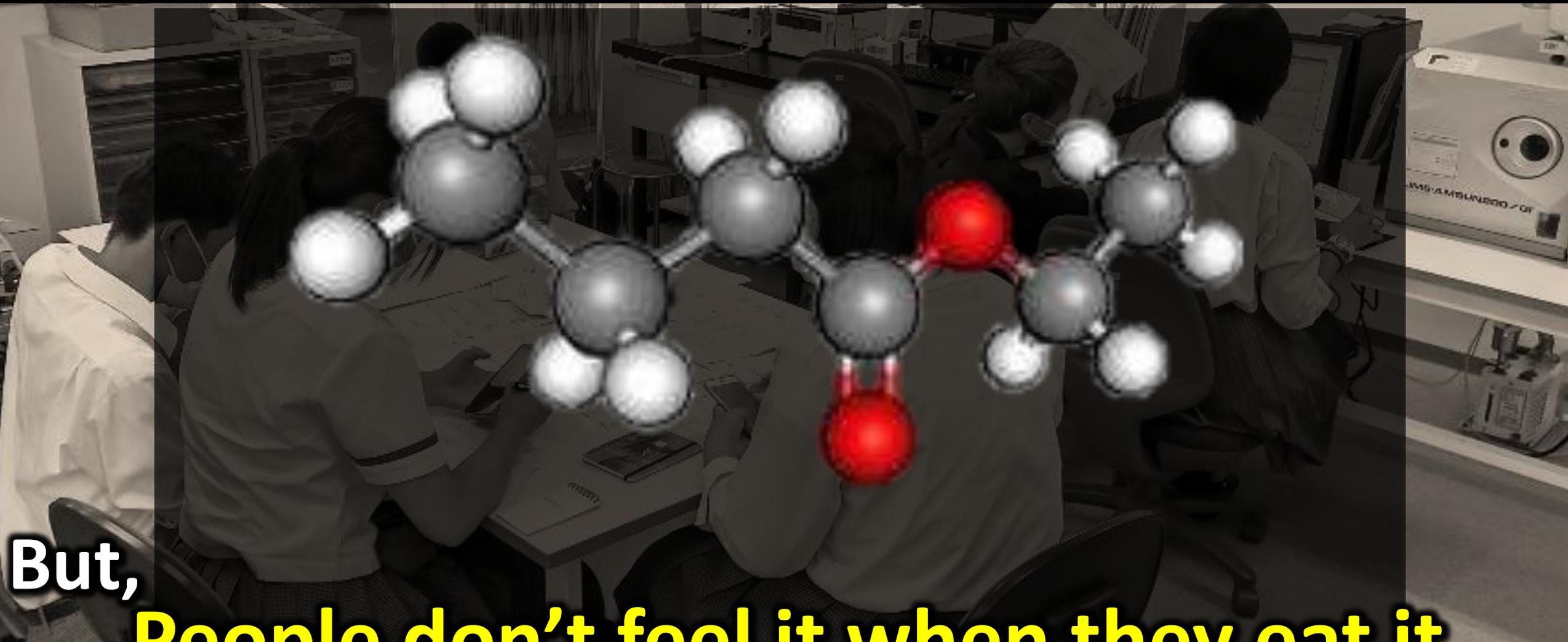


**Fragrance migration failed.**



**Cooperation from Gifu University**

**Migration of aromatic components of  
Makuwa-uri was confirmed**



**But,**

**People don't feel it when they eat it**

Unexpected

**Bitter taste of  
Ayu fish reduced**



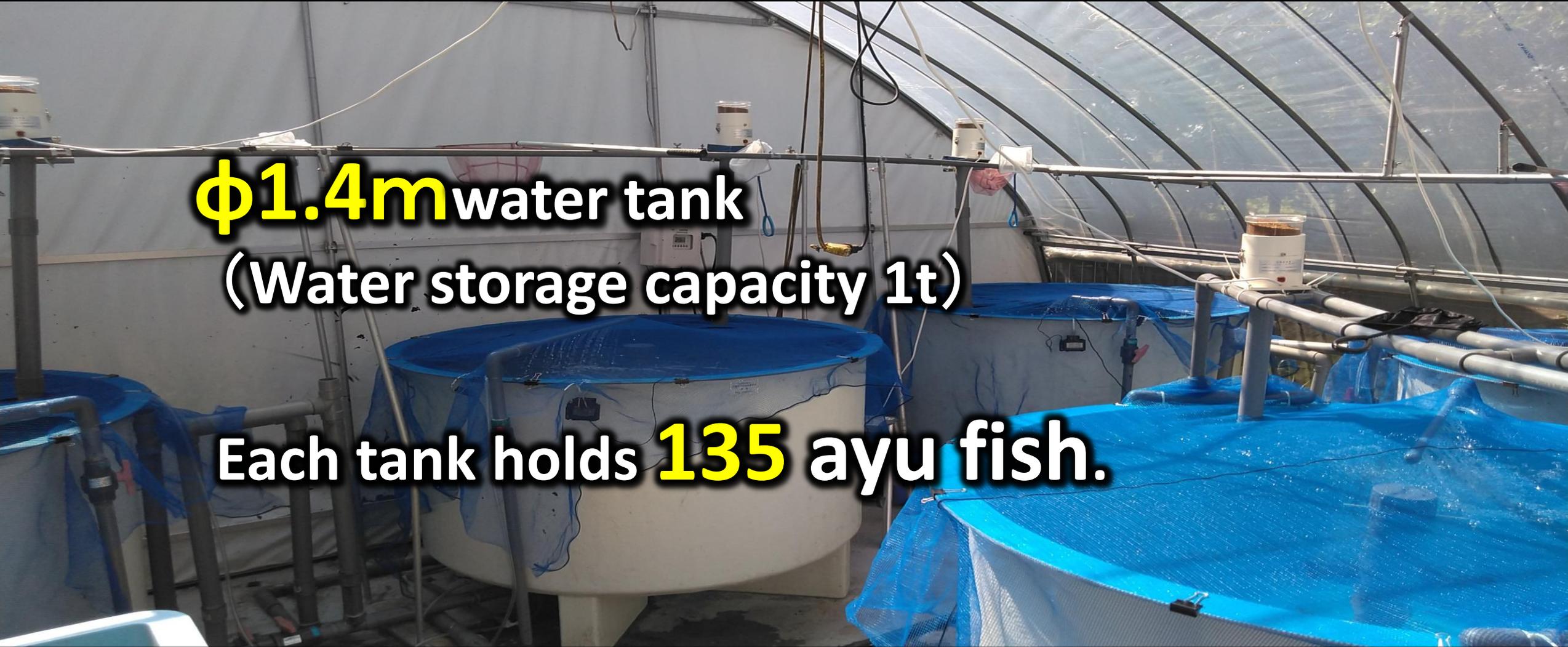


**This gives us the possibility to  
differentiate ourselves from other  
Ayu fish**

This is our school's environment for raising ayu fish

**φ1.4m** water tank  
(Water storage capacity 1t)

Each tank holds **135** ayu fish.



This is our school's environment for raising ayu fish

The key point in the breeding environment is

**water**

Our school is constantly running on  
groundwater

It also maintains **water quality, water  
temperature, and oxygen supply**

**This is our school's environment for raising ayu fish**

**Feeding Method**

**27 times a day**

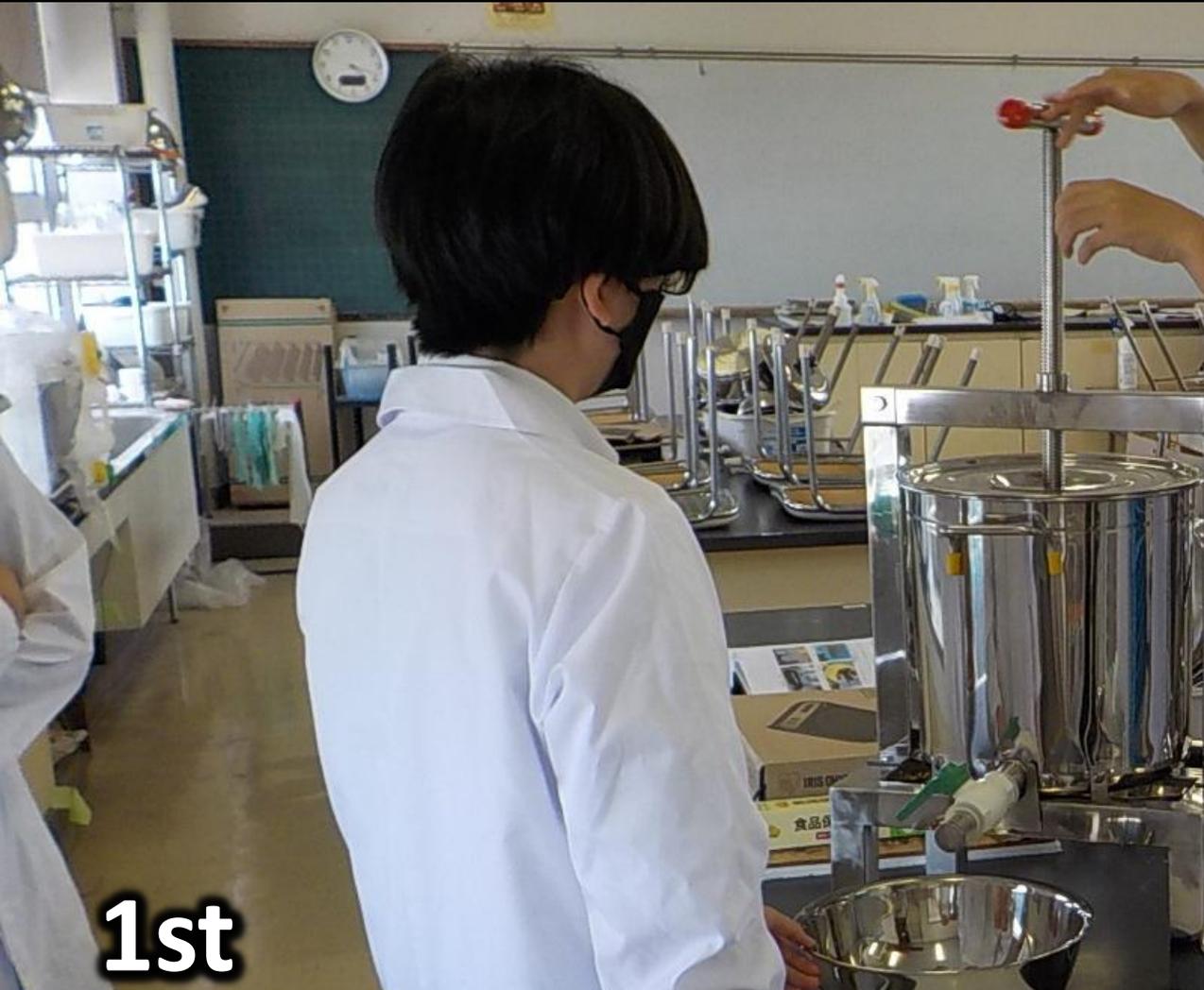
**Automatic feeding**



**Our school is equipped with automatic feeders.**

**This is the same method used by  
aguaculturists.**

# How to add makuwa-uri to feed



1st



# Press the makuwa-uri

# How to add makuwa-uri to feed



2nd

**5% of feed weight** of fruit juice

weighed and added

# How to add makuwa-uri to feed



**mixing machine**

**2nd**

**5% of feed weight of fruit juice**

**weighed and added**

# How to add makuwa-uri to feed



**mixing machine**

**3rd**

**Add the same amount of vegetable oil as the fruit juice to the feed and stir.**

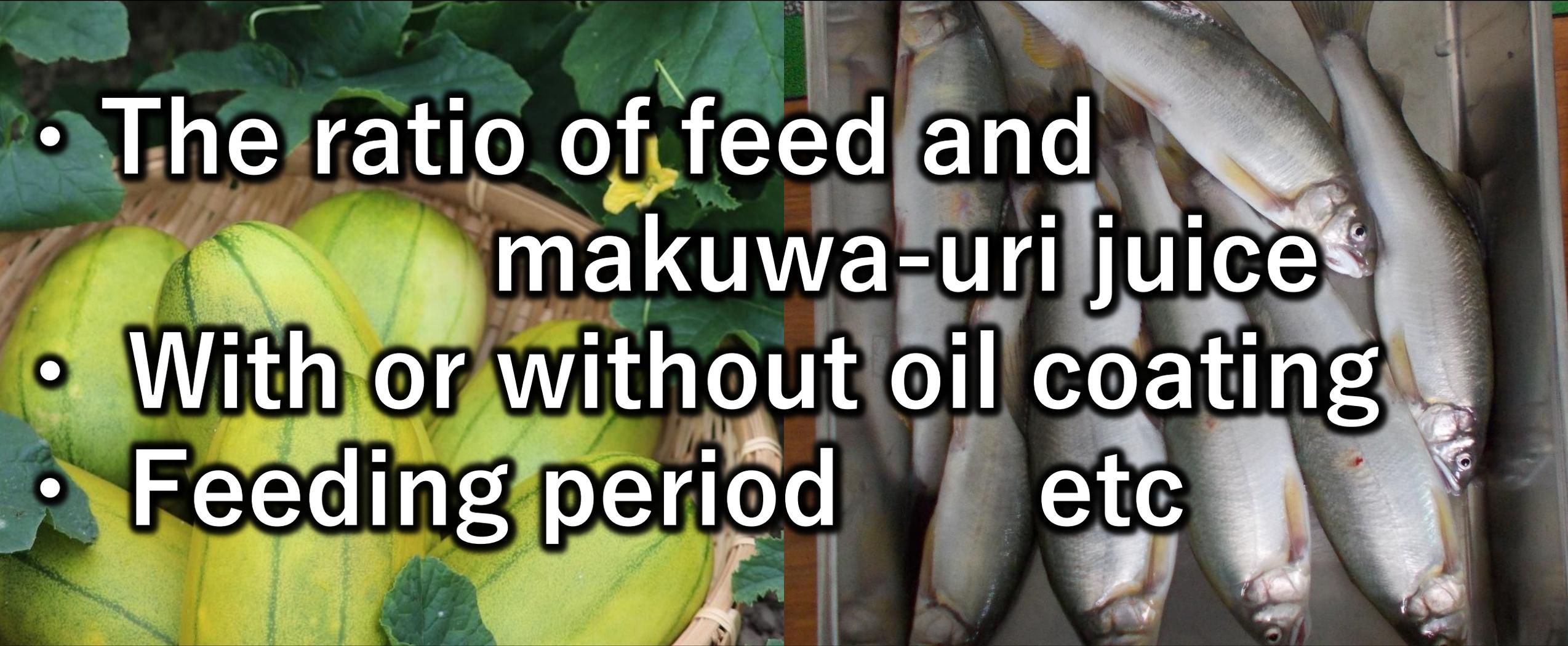
**How to add makuwa-uri to feed**



**Completion**

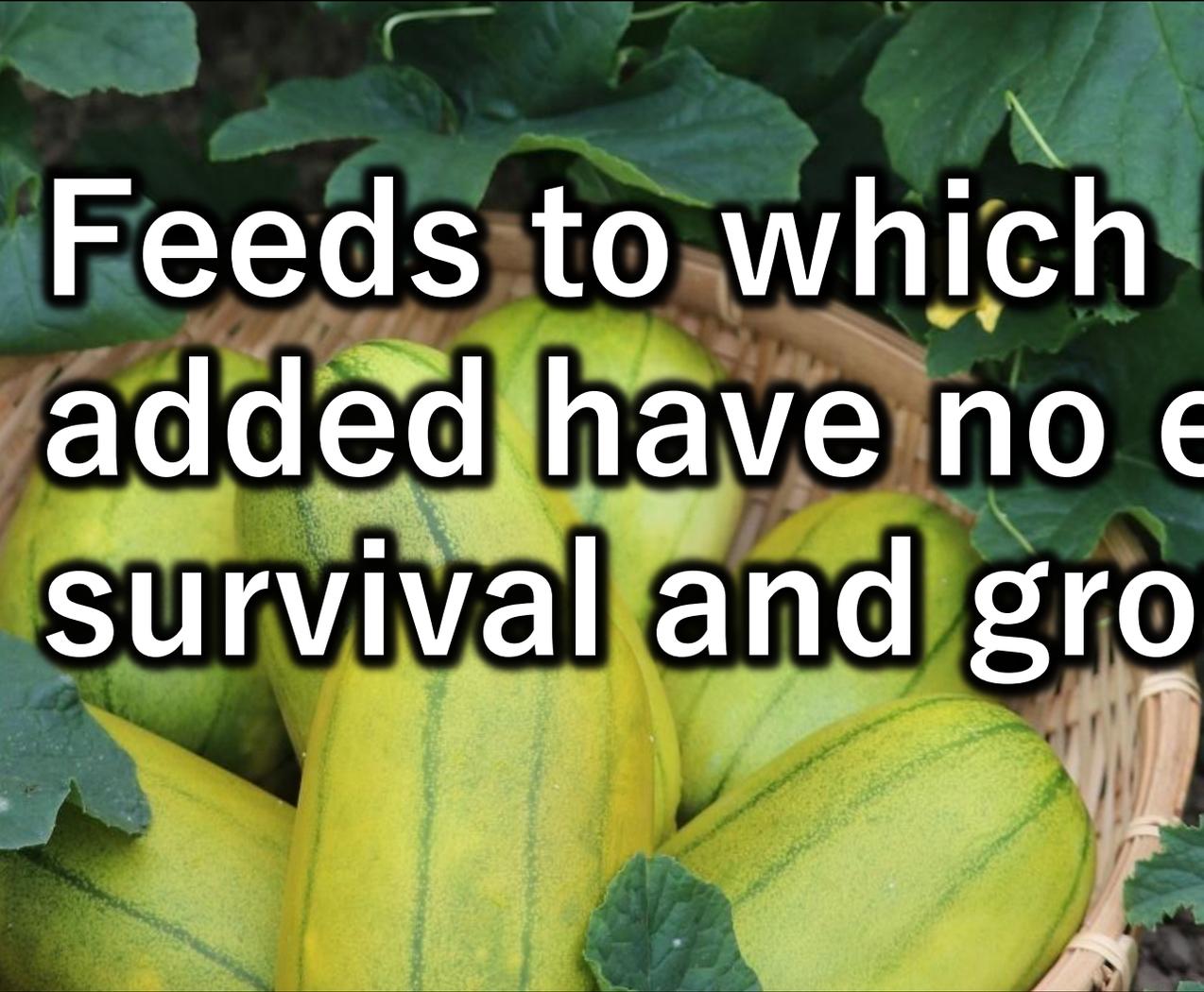
# Previous Studies

- The ratio of feed and makuwa-uri juice
- With or without oil coating
- Feeding period etc



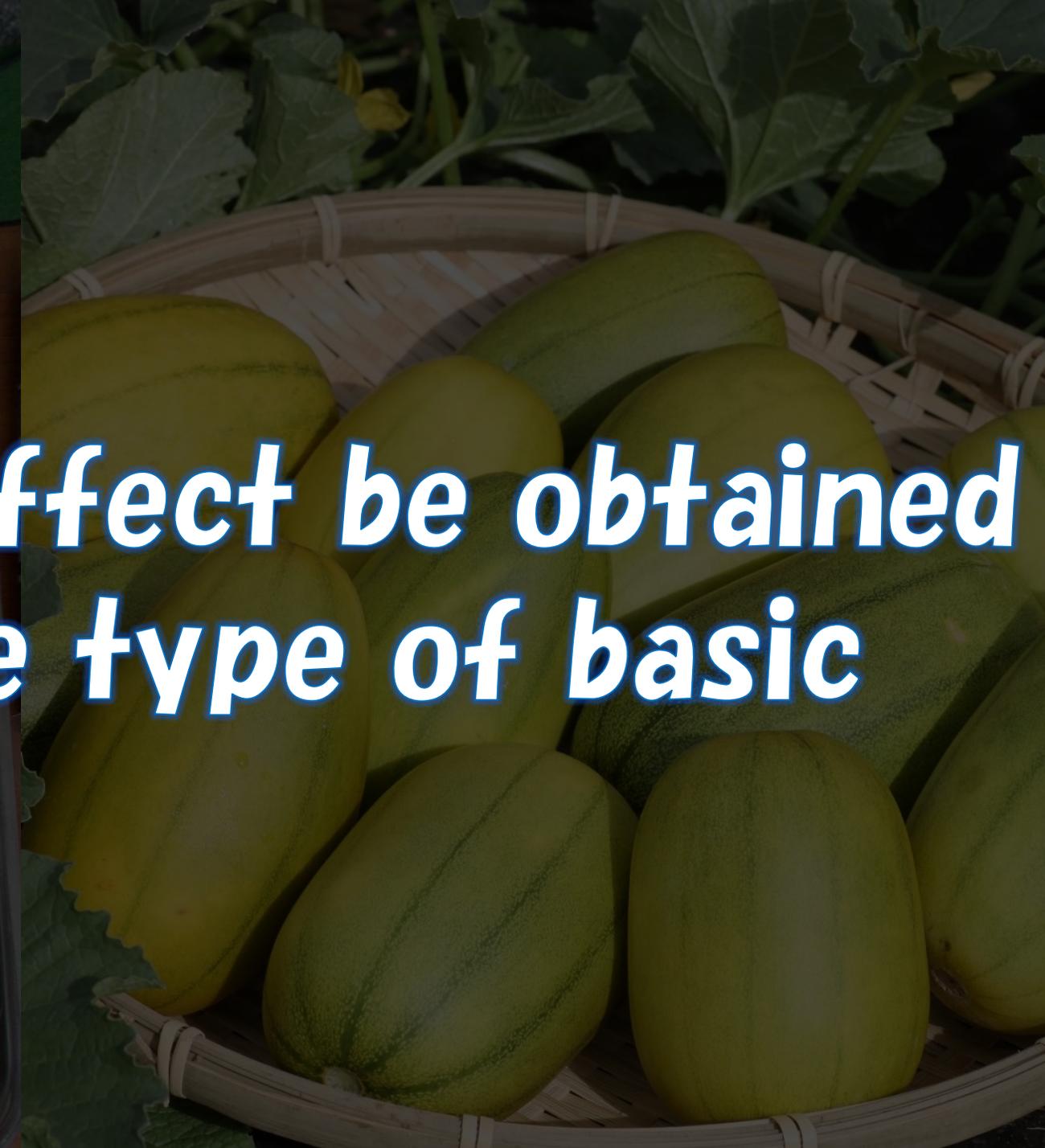
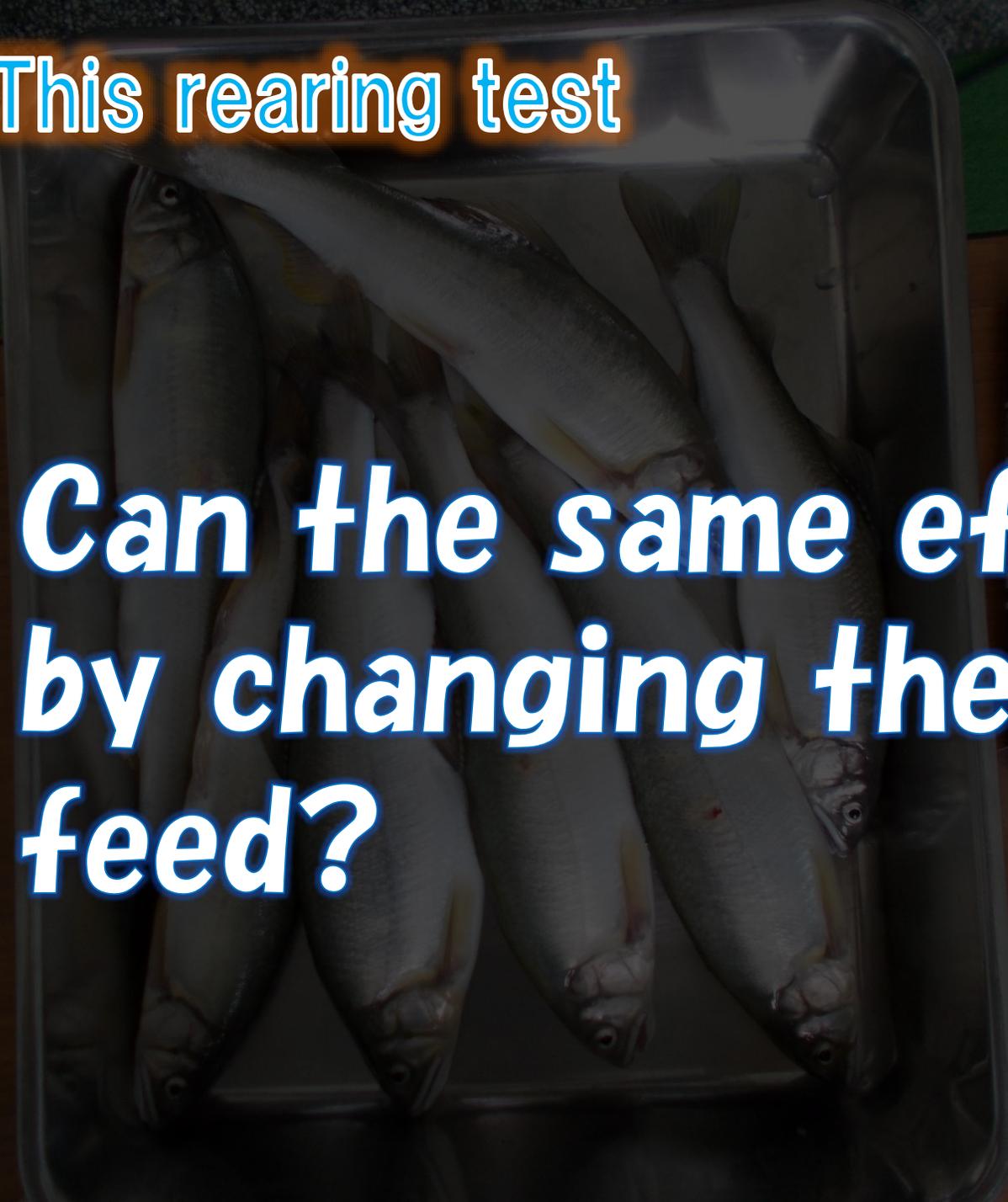
## Previous Studies

**Feeds to which Makawauri is added have no effect on survival and growth rates**



**This rearing test**

**Can the same effect be obtained  
by changing the type of basic  
feed?**



# Breeding test area setting



Conventional feed for control  
**Ayu-sofuto EPC**



Other company's feed  
for comparison  
**Ikuseiyo-PC3**

# Rearing test area setting

**Rearing period**

**May9-July31,2023**

**Test period**

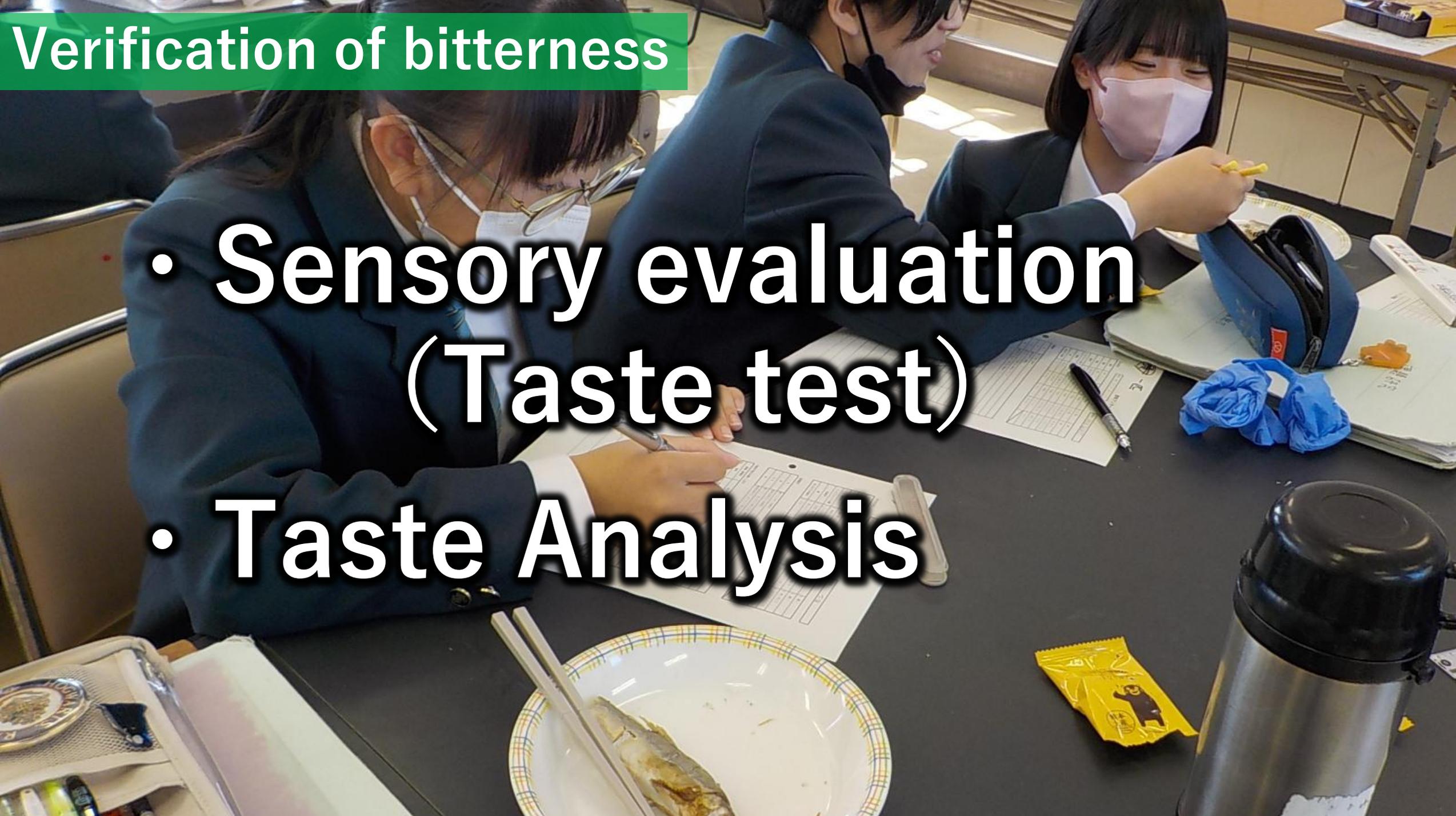
**July15-July29**

**Test case**

A	B	C	D
Ayu-sofuto	Ikuseiyo-PC 3	Ayu-sofuto + Makuwauri fruit juice 5 %	Ikuseiyo-PC 3 + Makuwauri fruit juice 5 %

# Verification of bitterness

- Sensory evaluation (Taste test)
- Taste Analysis



# Sensory evaluation

The subject of this is four of four students and two staff.  
Sample size is four

	Bitterness	Numerical difference	Bitterness	Numerical difference
Ayuda	3.5	0.2	3.5	0.2
Adachi	3.5	0.2	3.5	0.2
Makuwa-uri addition	3.3		Makuwa-uri addition	2.7

This allowed us to confirm the **reduction of bitterness** with conventional and separate feed. **-0.8**

## Taste analysis

# This is the result of tast sensor analysis

sample	Bitter taste	Umami	Salti-ness	Bitter-ness	Umami-koku
Ayu-sofuto	0.71	8.93	20.25	-0.74	2.87
Ikuseiyo-PC3	0.68	8.32	18.03	-0.69	3.91
Ayu-sohuto + fruit juice	0.11	9.12	20.52	-0.63	4.55
Ikuseiyo-PC3 + fruit juice	0.27	8.83	21.63	-0.63	3.19

※This is an excerpt of the detected values.

# Taste analysis

## Bitter taste

This is **the bitter first taste** you get when you put it in your mouth.

入れた時に感じる苦味の先味

## Bitterness

This is **the bitter aftertaste** that lingers in the mouth for a short time after putting it in.



# Taste analysis

## Bitter taste

This is **the bitter first taste** you get when you put it in your mouth.

Ayu-sofuto	Bitter taste	Numerical difference	Ikuseiyo PC3	Bitterness	Numerical difference
Additive-free	0.71	-0.6	Additive-free	0.68	-0.41
Makuwa-uri addition	0.11		Makuwa-uri addition	0.27	



We could see a **reduction in bitterness** not limited to the type of feed.

The image is a composite of two photographs. The left side shows a woven basket filled with several large, green, striped melons, likely muskmelons, surrounded by large green leaves and small yellow flowers. The right side shows a stainless steel tray containing several whole, silver ayu fish, arranged in a row. The fish have a characteristic elongated shape and a slightly humped back.

Summary

Easy-to-eat ayu fish  
with reduced bitterness

Helping to **increase**  
**ayu fish consumption**

**Production of cultured ayu fish  
No food is fed to farmed ayu  
fish prior to shipment.**



**Strongly bitter taste**

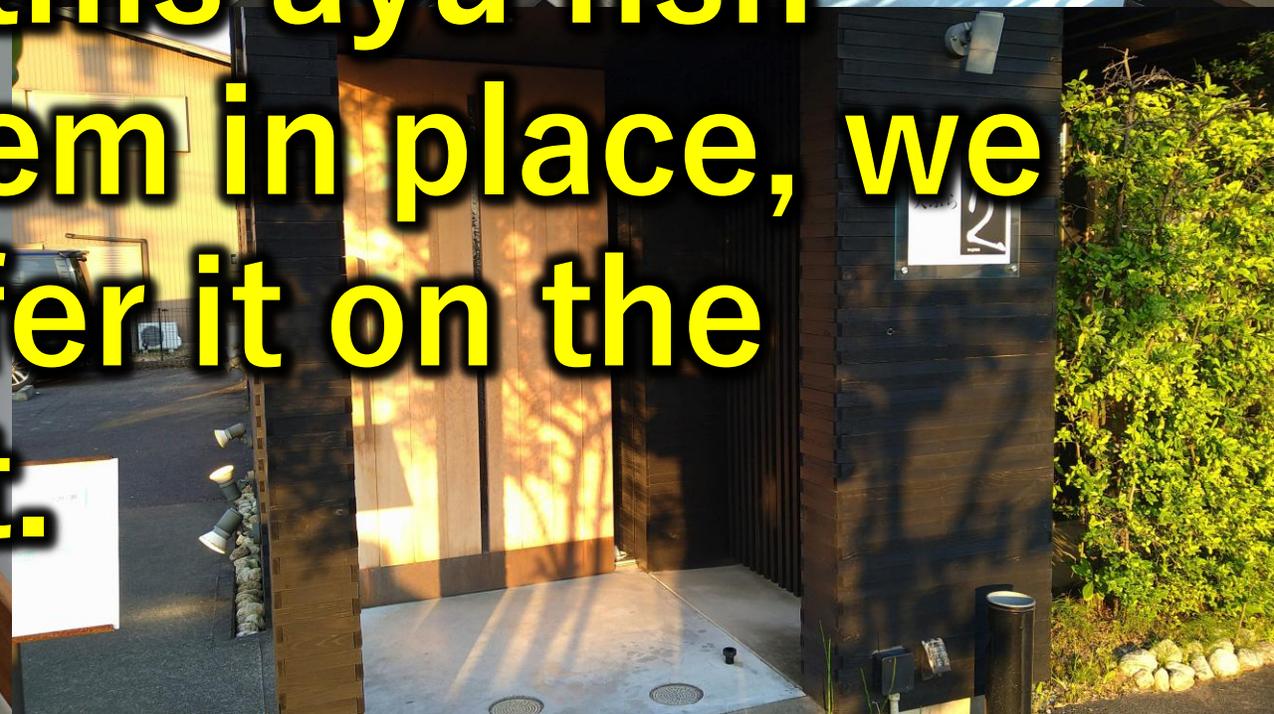
**This phenomenon is troubling  
producers and processors**



**Ayu fish raised on food supplemented with makuwa-uri were served at restaurants in the area on a trial basis.**



**The owner of the restaurant told me, "Once we have this ayu fish production system in place, we would like to offer it on the menu in earnest."**



A close-up photograph of several ayu fish (Salvelinus maxillirostris) being grilled. The fish are skewered and arranged on a metal grill. The background is slightly blurred, showing more fish and the grill structure. The text is overlaid on the center of the image.

**We want to make the  
results of our research into  
a new brand of ayu fish in  
Gifu Prefecture.**