

Studies on the cultured yellowtail (*Seriola quinqueradiata*)

burnt meat and its characteristics

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Ecology and market features of yellowtail



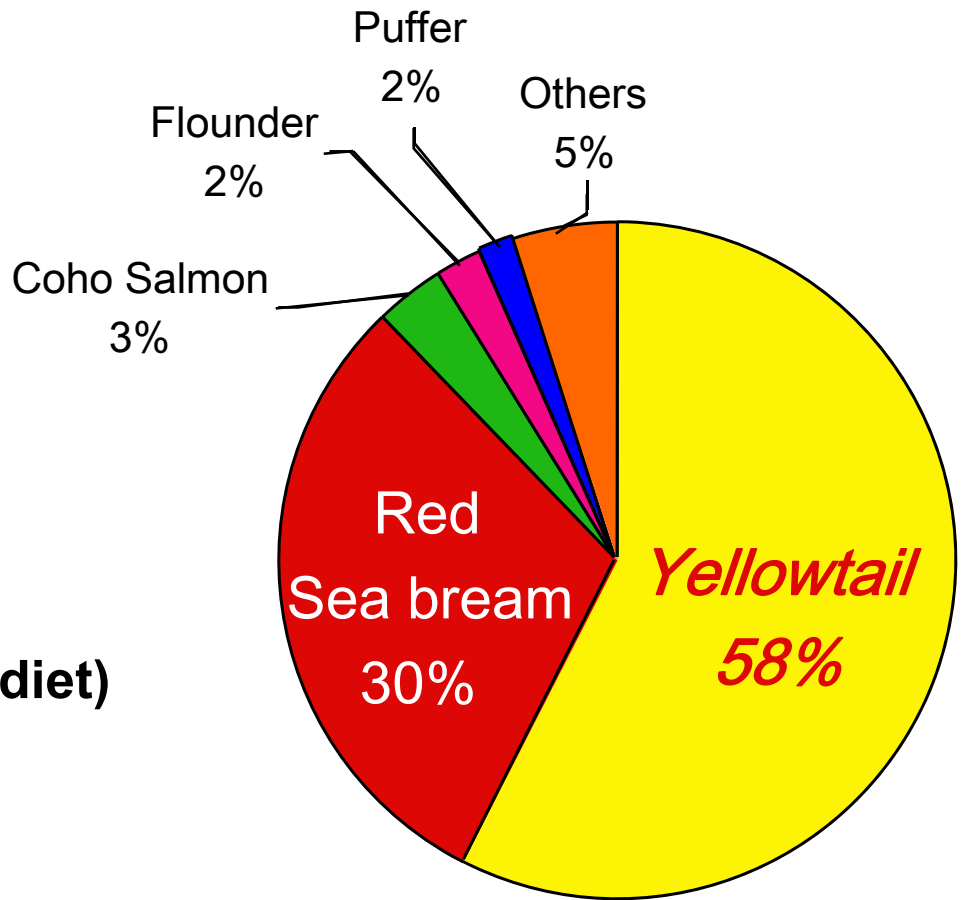
- *Seriola quinqueradiata*
- Pelagic species
- Inhabits rocky shores
- Temperature: 7 - 29°C
- Late April-early May migrates to Kyushu for spawning
- High consumption in winter
- Important sashimi market



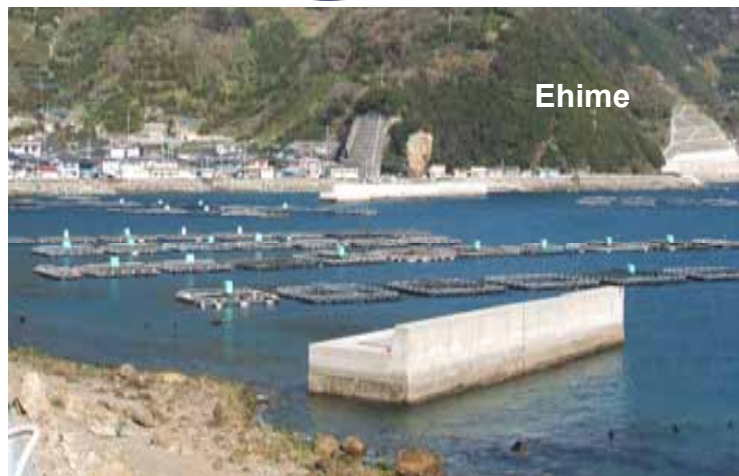
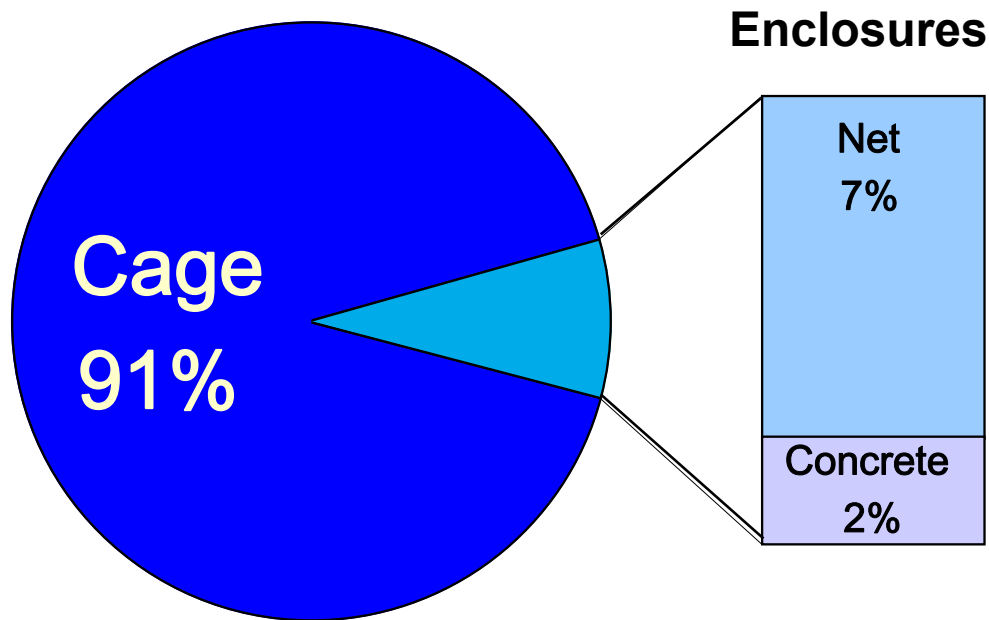
Aquaculture of yellowtail



- **Started by 1960, capture based type aquaculture**
- **Since 1970 exceeds natural catches**
- **Expansion after 1980 (artificial diet)**
- **Progress on maturation and spawning**



Aquaculture systems for yellowtail



Reports on fish burnt meat

- Burnt tuna meat, Itokawa, 1968-9.
- Turbit meat of tuna, possible causes, Nakamura *et al.*, 1977.
- Denaturation of myofibrillar proteins as a cause of burnt meat in red meat fish (mackerel, yellowfin tuna, skipjack, sardine) and white meat fish (flounder, Alaska pollack) Konagaya & Konagaya, 1978.
- Raw tuna (big eye, yellowfin) rapid deterioration in Hawaii, Cramer *et al.*, 1981.
- Jellied meat and yake niku, Konagaya, 1982.
- Ultrastructural study of postmortem changes in tuna, Davie & Sparksman, 1986.
- Etiology of burnt tuna, Watson *et al.*, 1988.



↑ **Temperature** + low muscle pH by stress



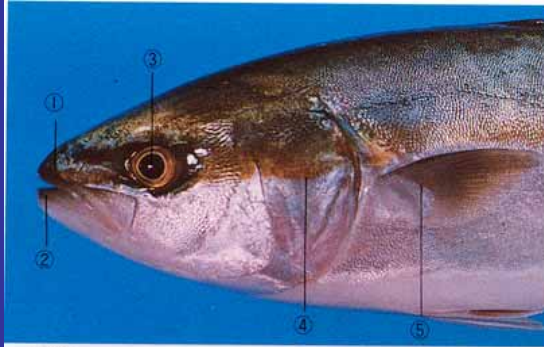
burnt meat

Fish samples

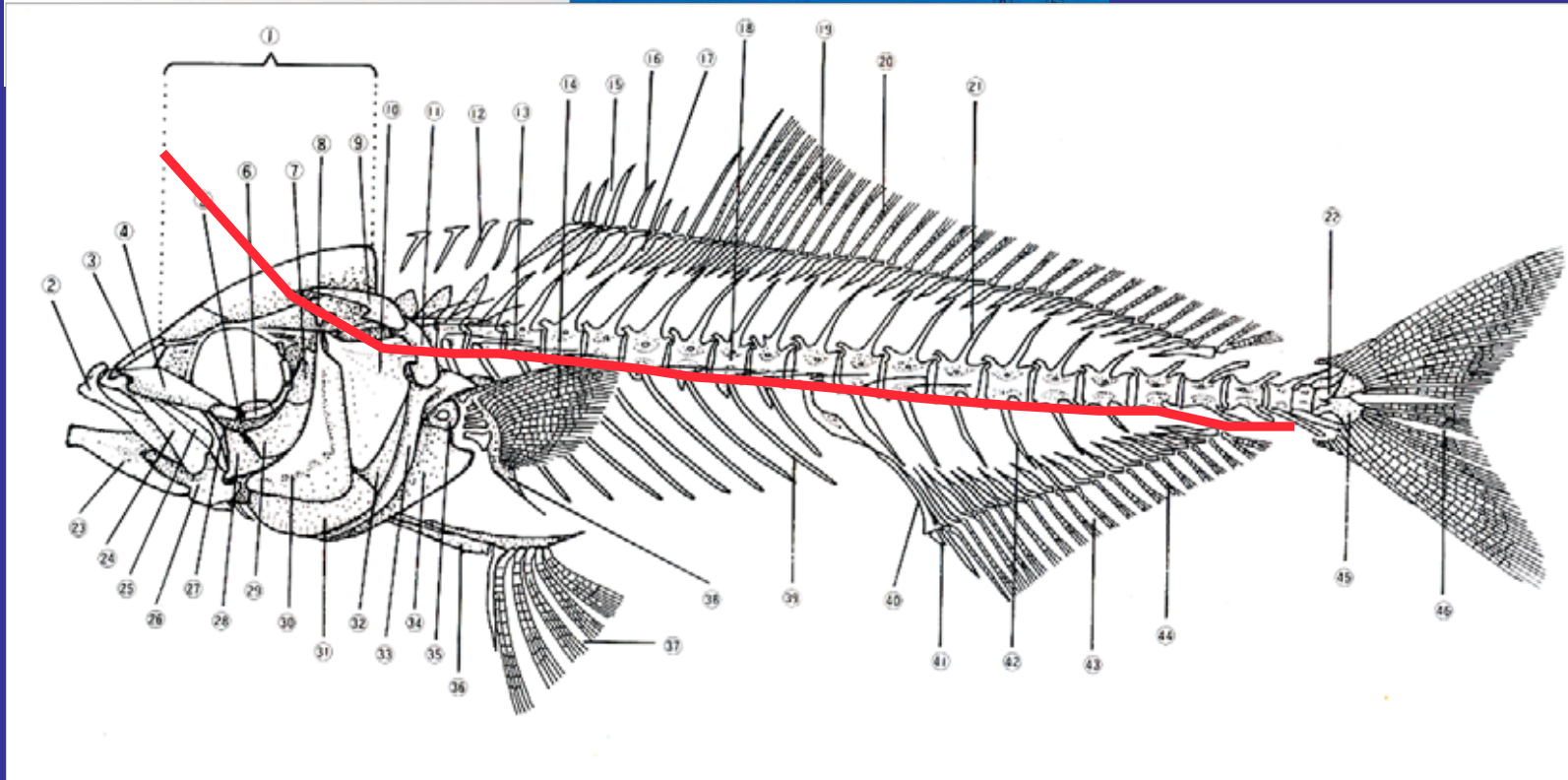
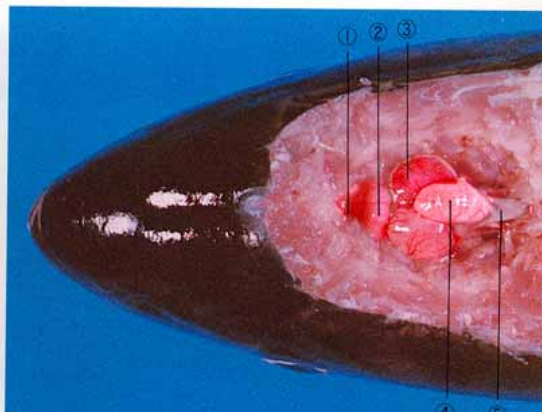
- Cultured yellowtail : **Body weight** 928.0 ± 210.7 g
Fork length 38.1 ± 3.7 cm
- Culture temperatures : **30°C (acclimated for 1 week)**
13°C
- Slaughter methods : **Spinal cord destruction (SCD)**
Suffocation in air (20 min) (SA)
- Experimental groups : **SCD 30°C (n= 4)**
SA 30°C (n= 3)
SCD 13°C (n= 4)
SA 13°C (n= 4)



Method of spinal cord destruction for yellowtail



頭部
①：上顎 ②：下顎 ③：眼 ④：鰓蓋 ⑤：胸鳍



Storage and analysis

- Storage temperature : 32°C (water bath)
- Sampling time : 0h, 1h, 2h, 4h, 6h

Analysis

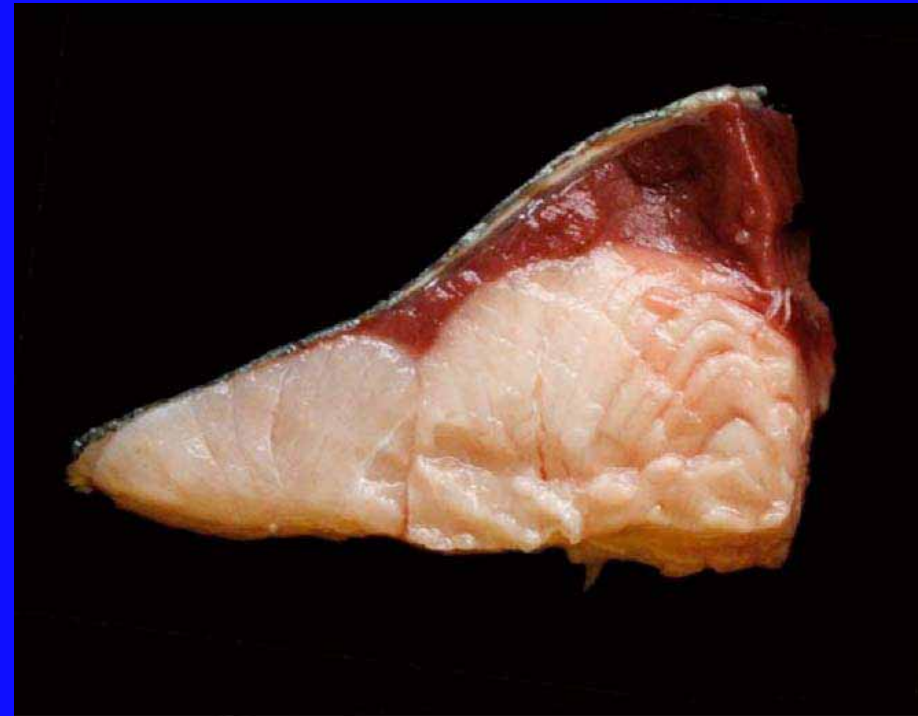
- Muscle color : L*, a *, b *
- Physical changes : expressible water, breaking strength
- Chemical changes : ATP related compounds, lactic acid, pH , Mf Ca⁺² and Mg⁺² -ATPase activities
- Microscopy : cross sections of ordinary muscle
(H&E staining)

Ordinary muscle of normal and burnt meat of cultured yellowtail

Normal meat



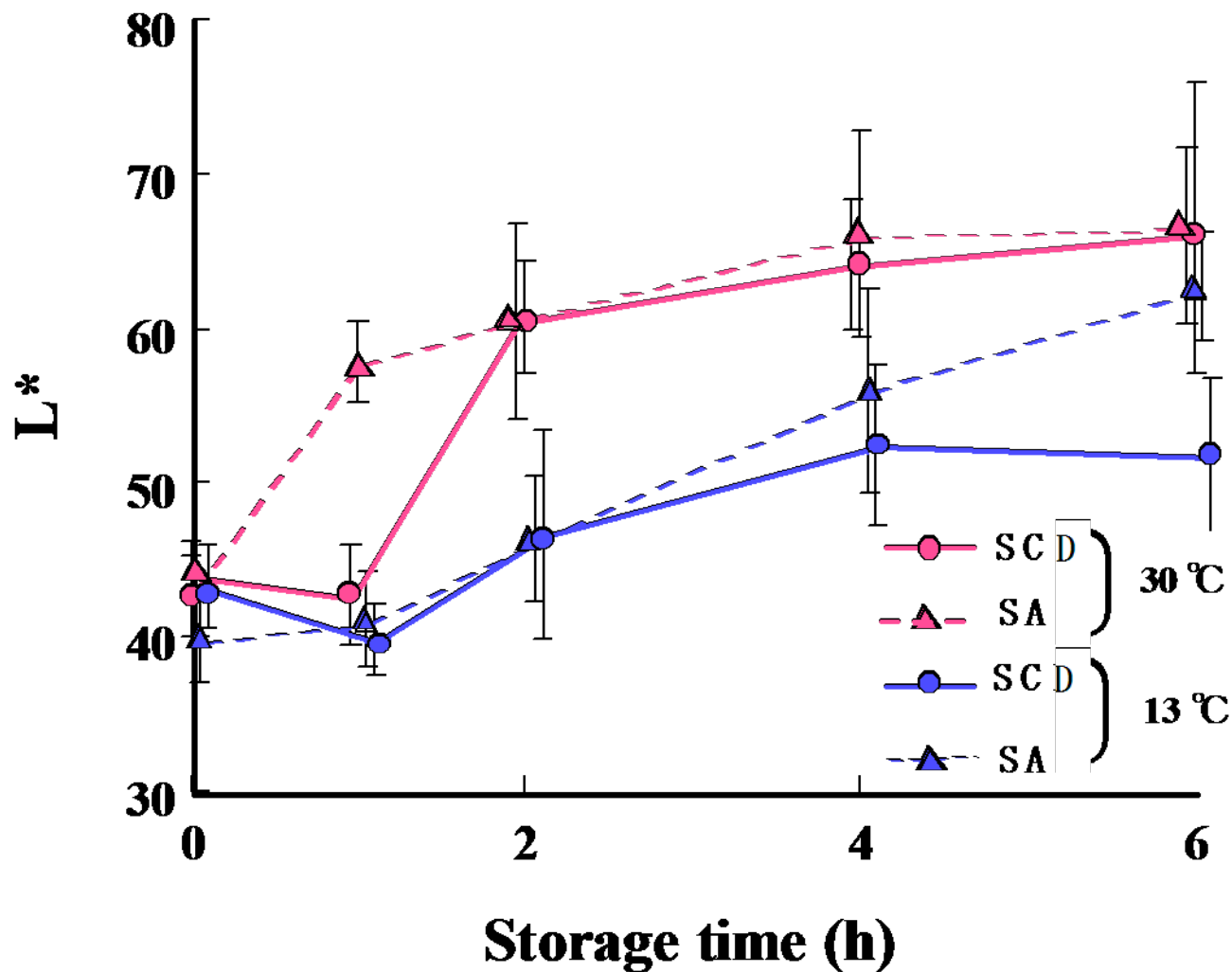
Burnt meat



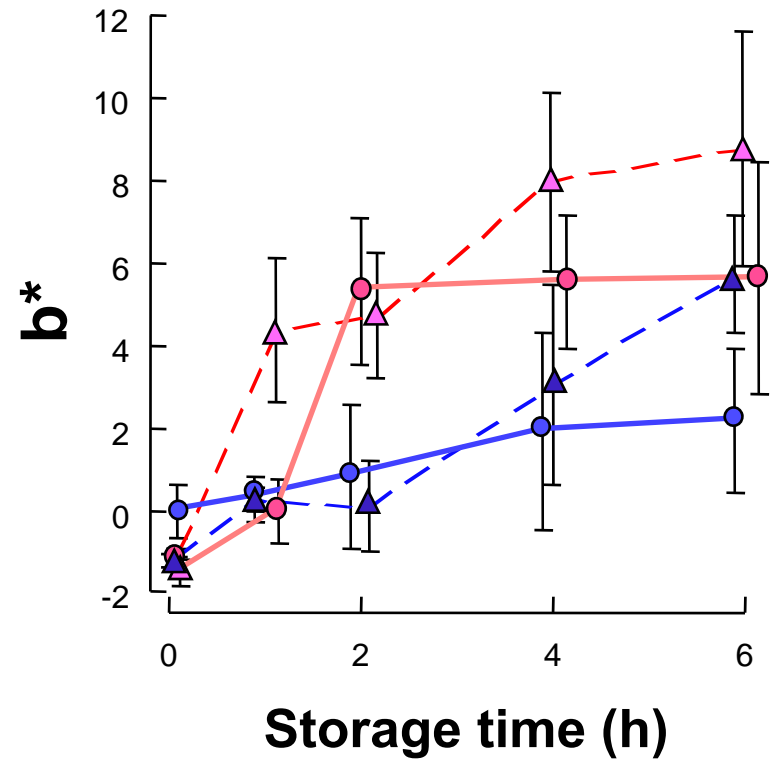
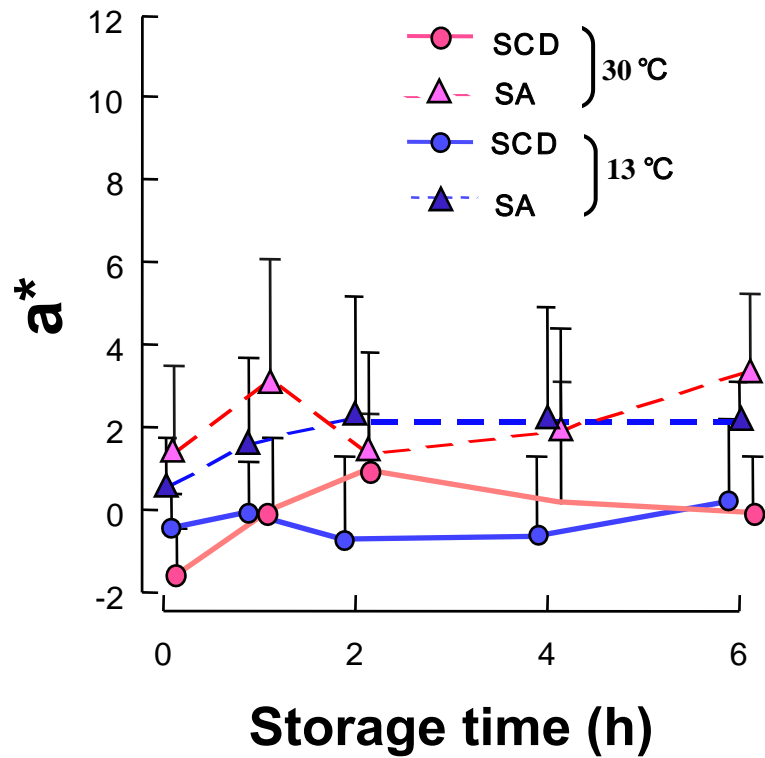
Expressible water 2 h: 13 %

Expressible water 2 h: 38 %

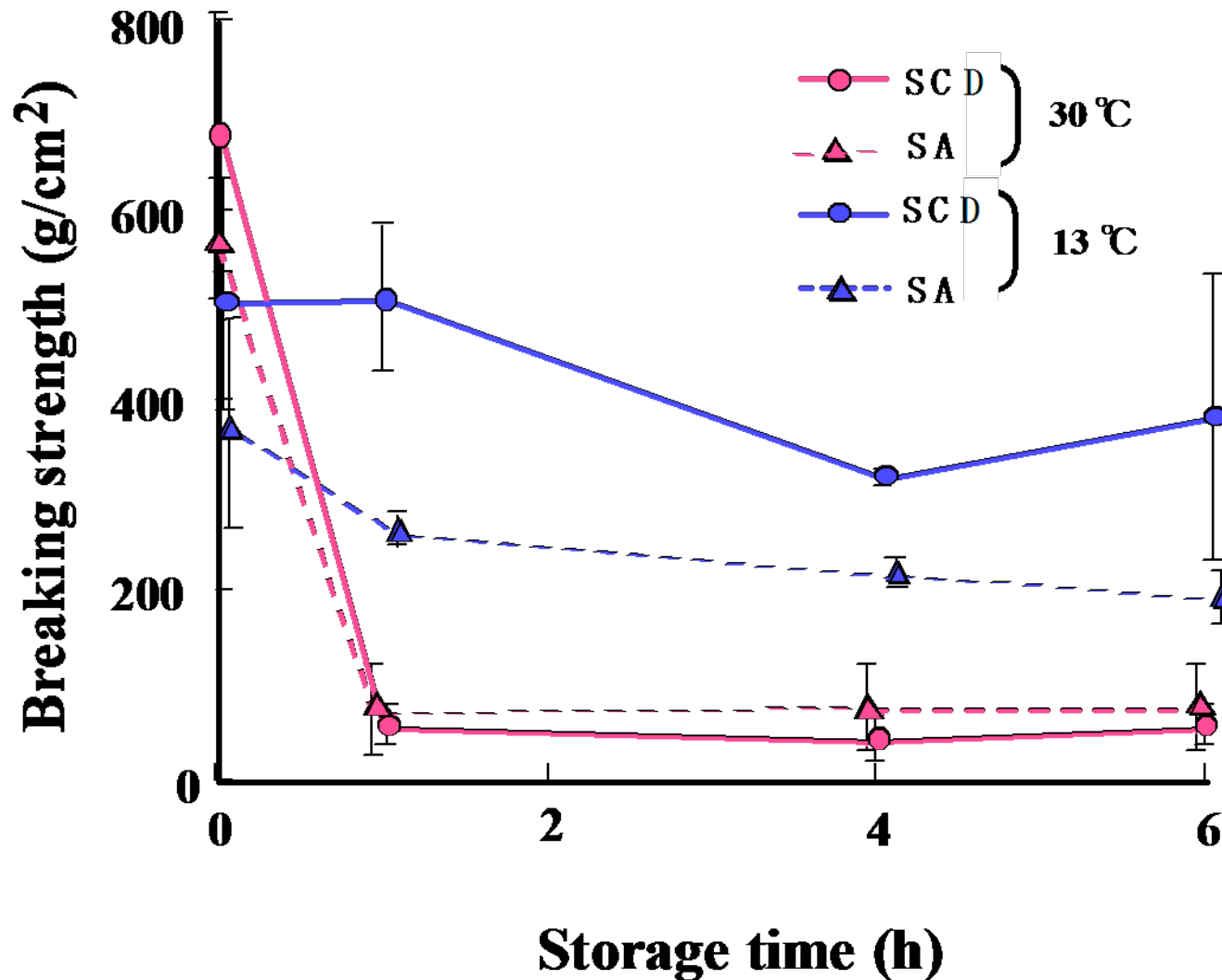
L* changes in cultured yellowtail ordinary muscle during storage at 32°C



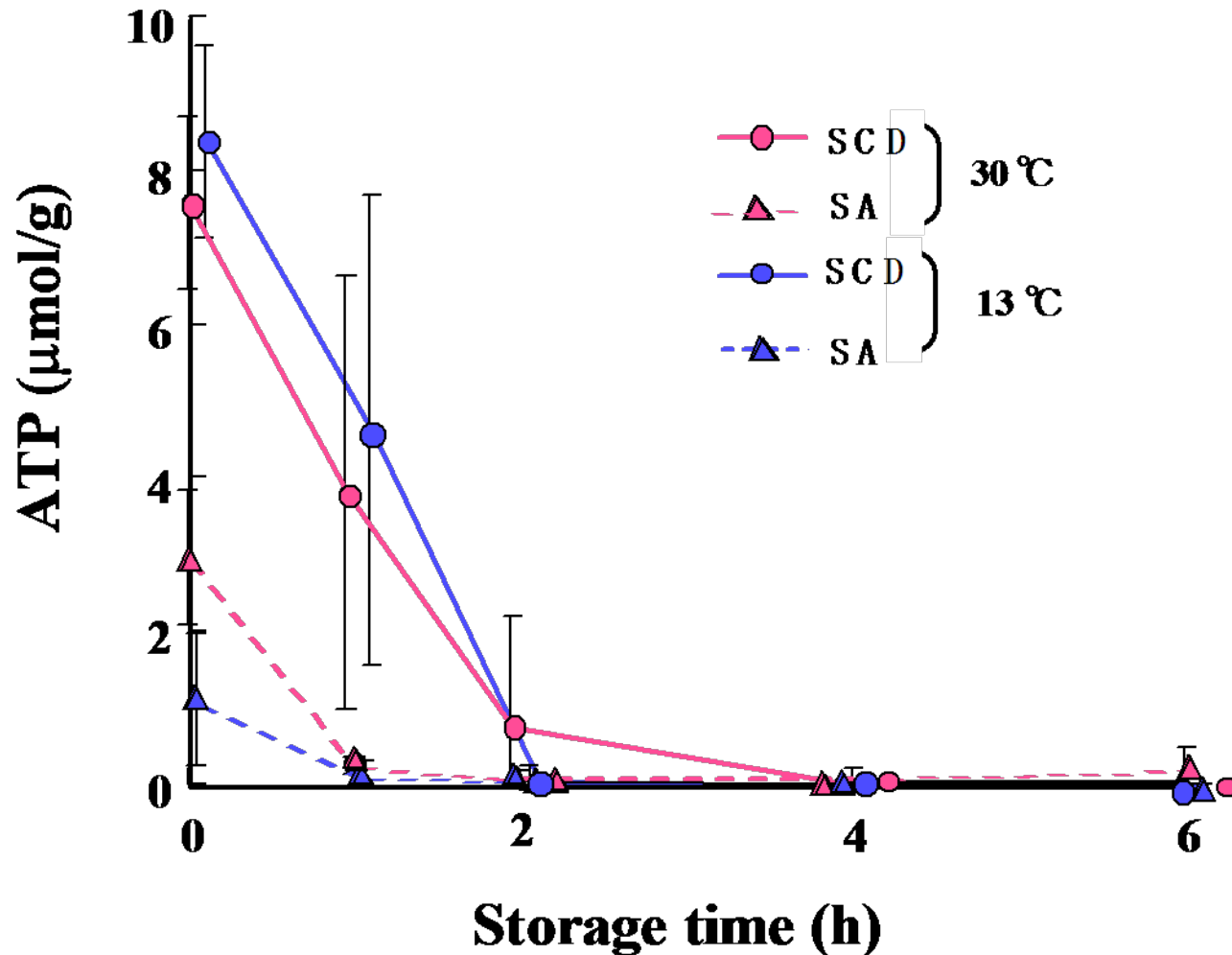
Changes in a^* and b^* during storage at 32°C



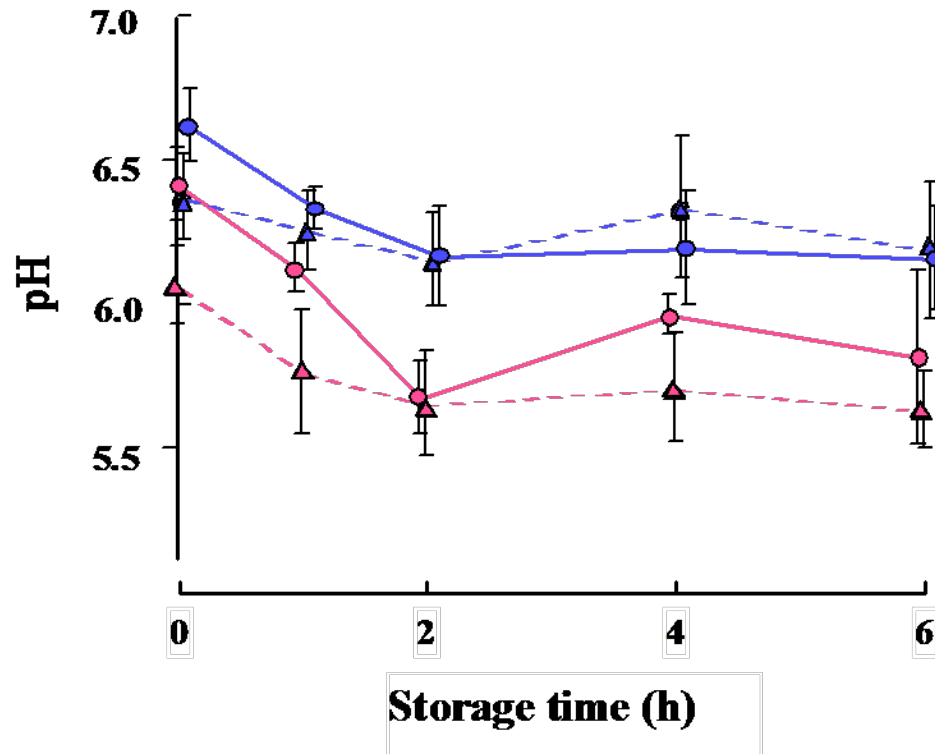
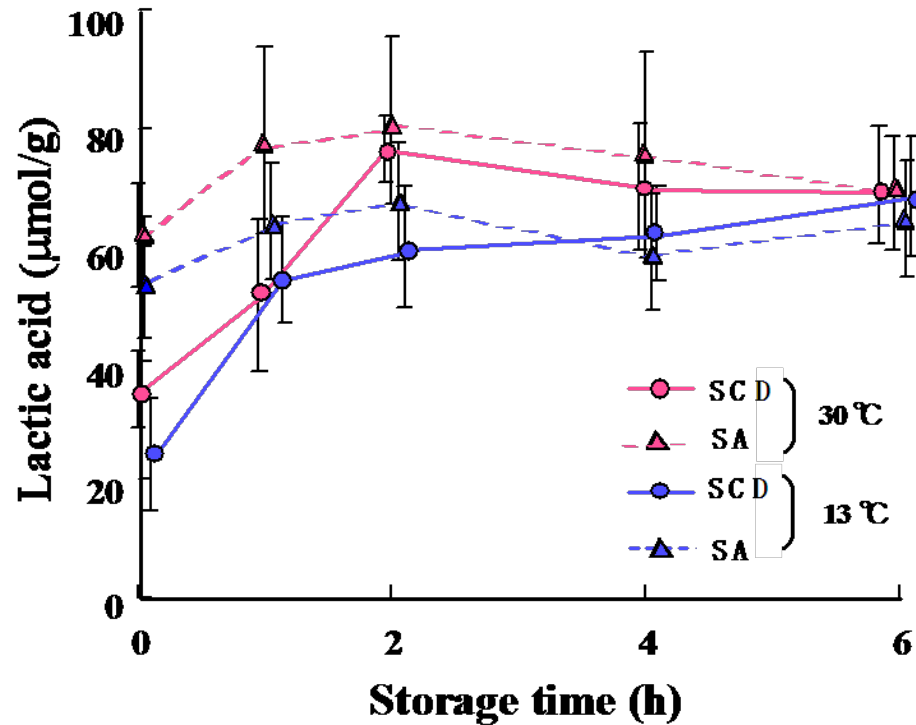
Changes in breaking strength during storage at 32°C



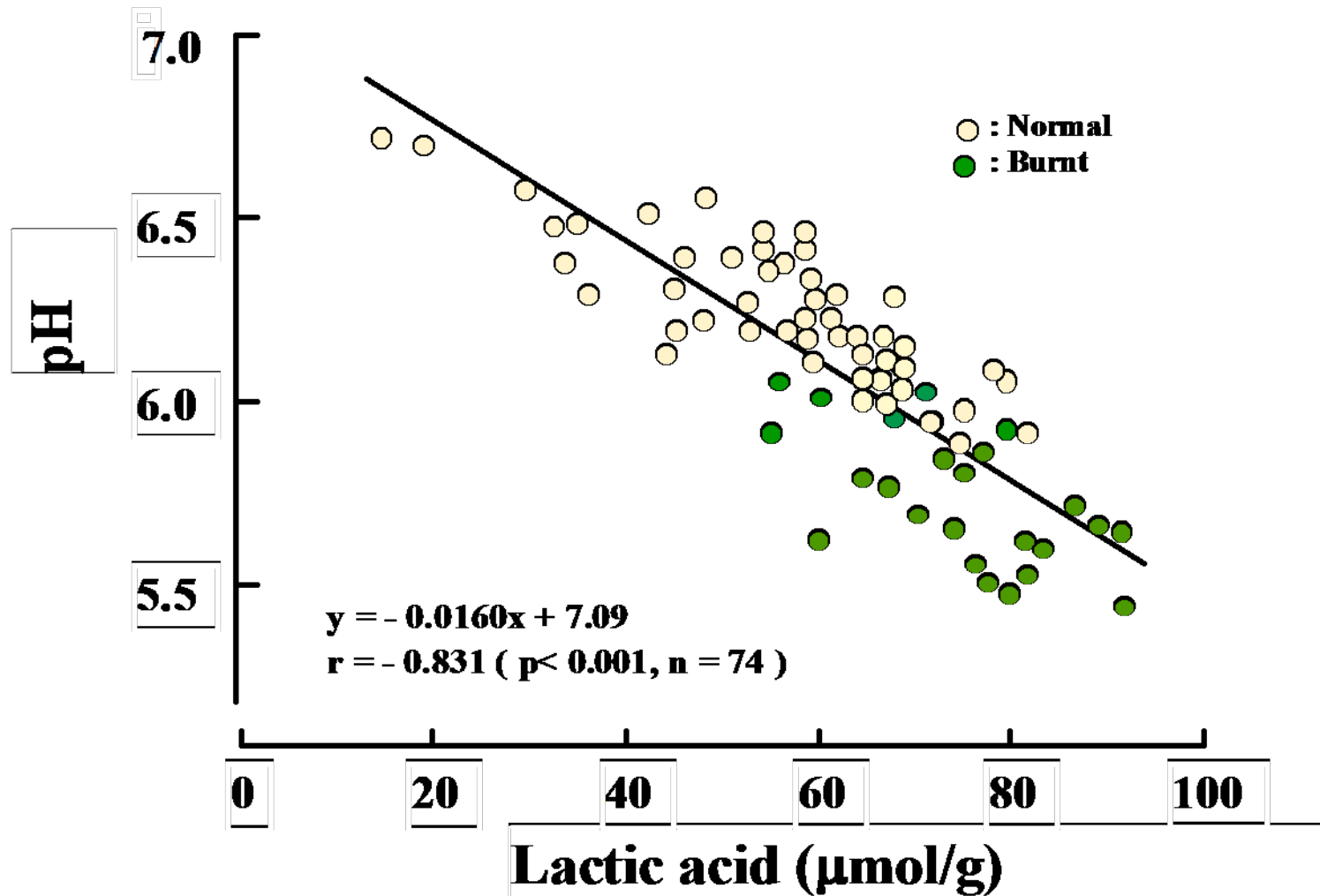
Changes in ATP content during storage at 32°C



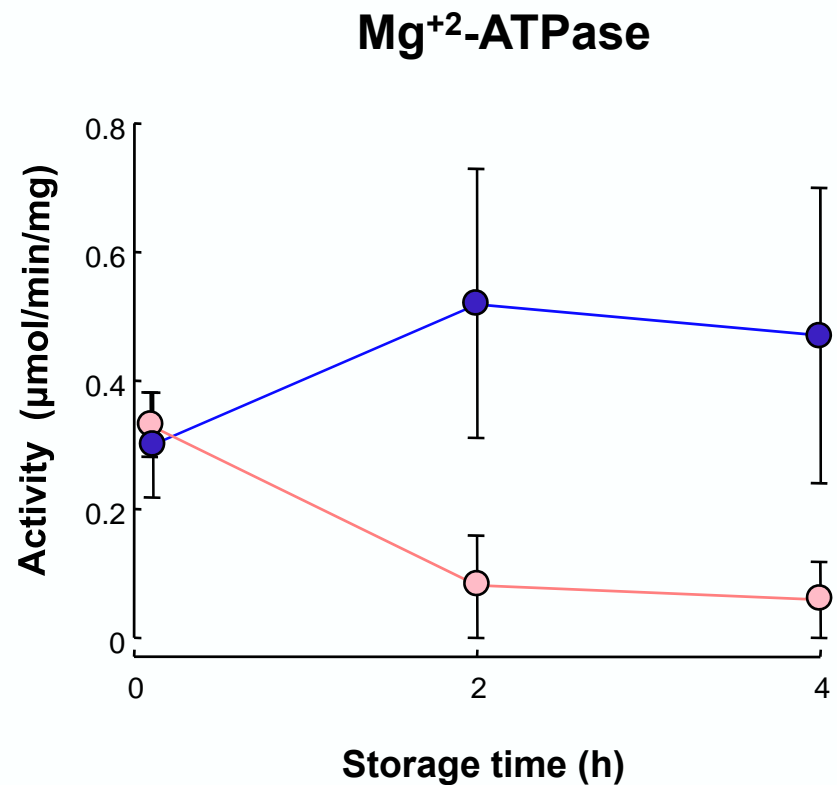
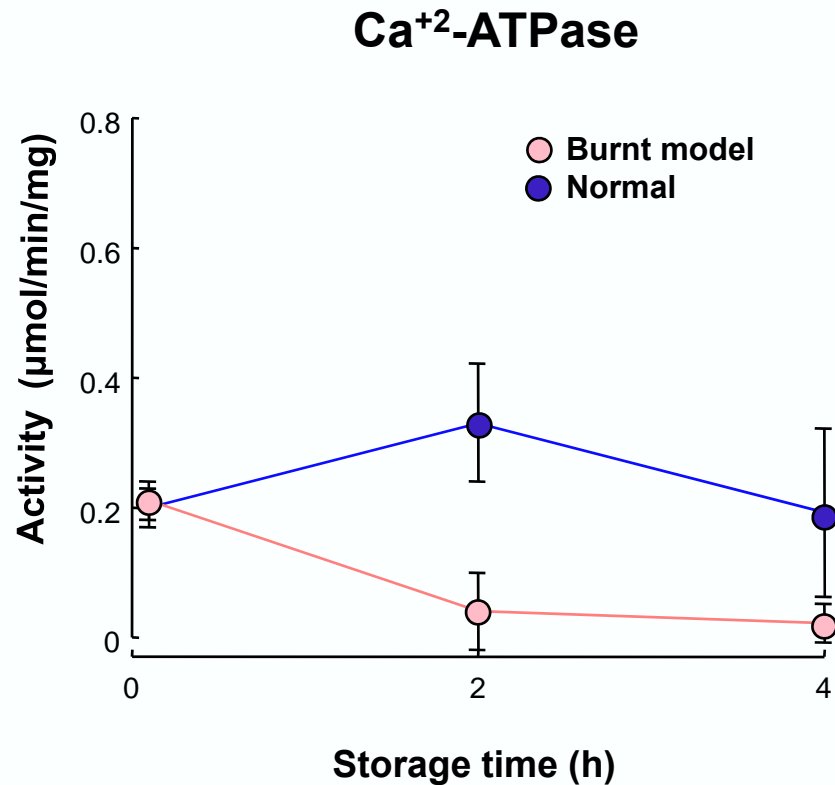
Changes in lactic acid content and pH during storage at 32°C



Relationship between lactic acid content and pH

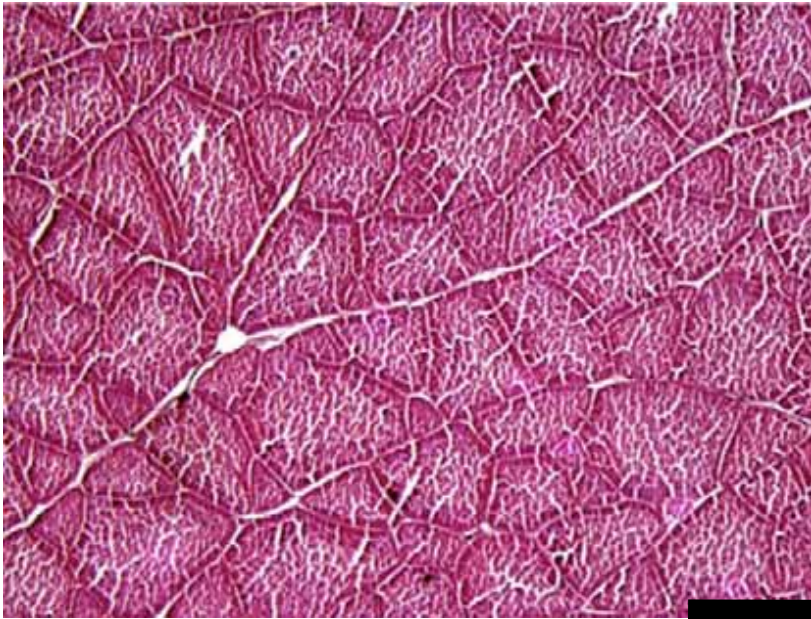


Changes in myofibrillar Ca^{+2} and Mg^{+2} - ATPase activities during storage



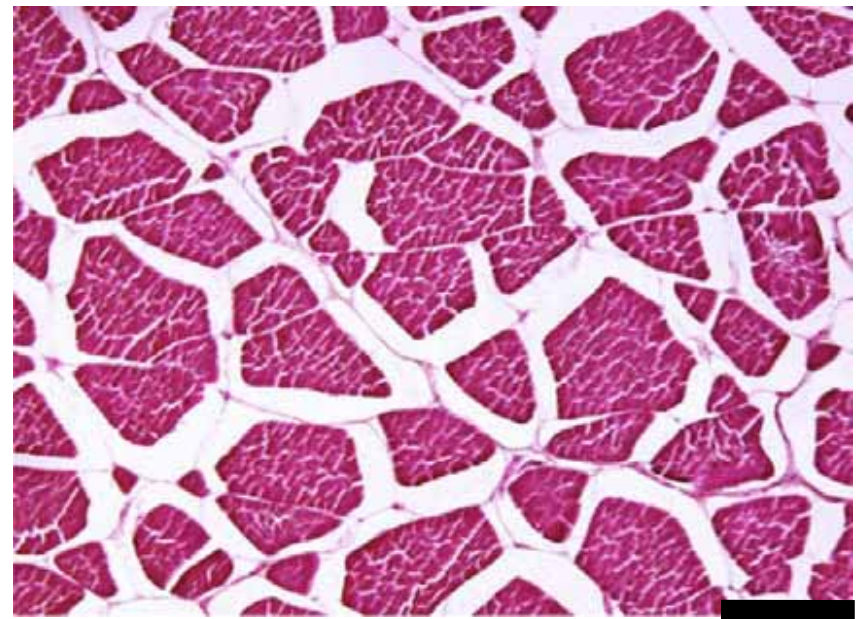
Intercellular space of normal and burnt meat of yellowtail ordinary muscle

Normal



100μm

Burnt



100μm

Conclusions

- **30°C group, at 32°C storage:**
 - SA burnt meat at 1 h
 - SCD burnt meat at 2 h
- **13°C group, at 32°C storage:**
 - SA burnt meat after 4 h
 - SCD burnt meat was not observed
- **The principal characteristics of burnt meat in cultured yellowtail observed at the early postmortem period were:**
 - ↑ L*, b*, expressible water, lactic acid contents, and the intercellular space
 - ↓ ATP, pH, breaking strength and Mf (Ca²⁺ and Mg²⁺) - ATPases activities
- **Low temperatures and a non exhausting slaughter method could prevent the burnt meat problem in cultured yellowtail**

General Conclusions

- The yellowtail **burnt meat model** system was developed as a **research tool** and it can be used to get deeper information on this problem
- For yellowtail, an effective spinal cord destruction as slaughter method followed by an immediate specific selected storage is recommended
- Fish handling is **determinant** for meat quality, more importantly in species for which the final market is raw consumption as sashimi

*Thank
you!*

