

in goldfish brain, pituitary, and skin in response to background color

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Background

In teleost fish, body color varies in response to changes in background color. The color is lighter in a white background than in a black background. Melanin-concentrating hormone (MCH) produced in hypothalami and agouti signaling protein (ASP) in skins turn body color pale by aggregating pigments, while melanocyte-stimulating hormone (MSH) encoded on a proopiomelanocortin (POMC) gene disperses pigments.

In the present study, we investigated the effects of a black or white background on expression levels of the genes for the hormonal peptides and corresponding receptors by real time RT-PCR in goldfish (*Carassius auratus*).

Materials and methods

- Goldfish were reared in black or white tank for 3 weeks.
- Total RNA was prepared from hypothalamus, pituitary gland and dorsal/ventral skin.
- Quantitative RT-PCR with TaqMan probe was used to estimate mRNA level.

Results

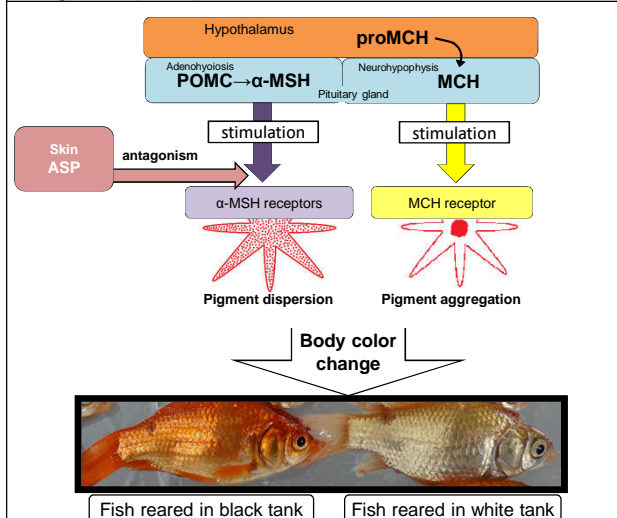
Summary

Relationships between background color and expression of the genes for hormonal peptides and those for corresponding receptors

Hormone genes			Receptor genes				
Tissue	Hormone	Background color		Tissue	receptor	Background color	
		Black	White			Black	White
Brain	MCH 1a	+	++	Dorsal skin	MC1R	++	+
Pituitary gland	POMC-a	++	+		MC5R	++	+
Skin	ASP	+	+	MCHR-2	++	+	
				MC1R	+	+	
Ventral skin				MC5R	++	+	
				MCHR-2	++	+	

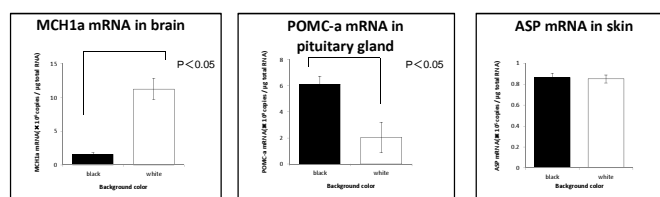
Background color modulates gene expression of both hormones and receptors.

Schematic diagram of hypothalamus-pituitary-skin axis in fish (upper) and body color of goldfish reared in black or white background (lower).



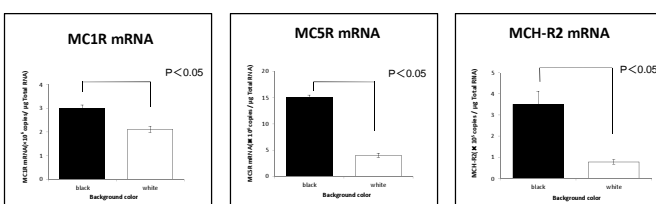
Results

Effects of background color on the mRNA levels of MCH1a, POMC-a, and ASP



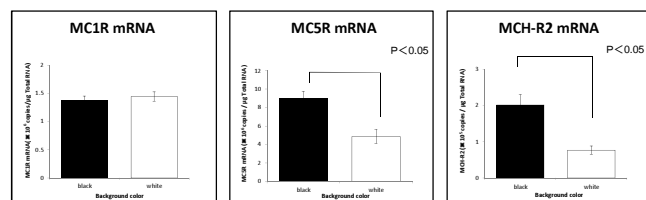
In brain, the levels of MCH1a mRNA in the goldfish reared in white tank were higher than those reared in black tank. In pituitary, the levels of POMC-a mRNA in the goldfish reared in black tank were higher than those reared in white tank. No difference was observed in ASP mRNA levels in the ventral skin between the fish reared in black and white tank.

Effects of background color on the mRNA levels of some receptors in the dorsal skins



In the dorsal skins, the levels of MC1R, MC5R and MCH-R2 mRNAs of the goldfish reared in black tank were higher than those reared in white tank.

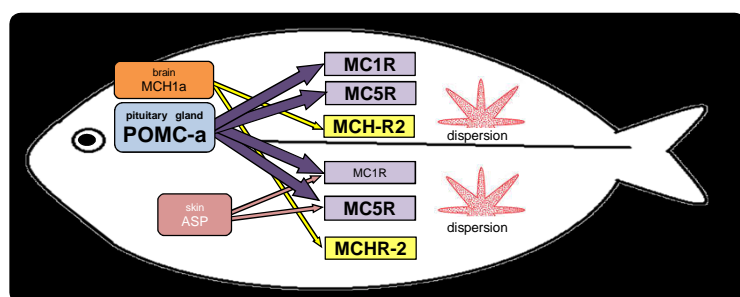
Effects of background color on the mRNA levels of some receptors in the ventral skins



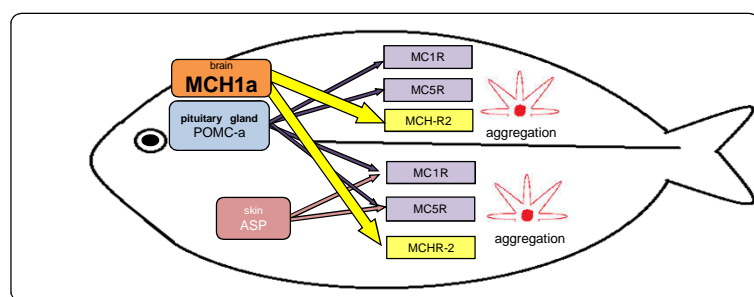
In the ventral skins, the levels of MC5R and MCH-R2 mRNAs of the goldfish reared in black tank were higher than those reared in white tank. No difference was observed for MC1R mRNA levels.

Discussions

Activities of hormones and receptors deduced from those mRNA levels in the goldfish reared in black and white background



In the goldfish reared in black background, the expression of the genes for POMC-a and MCRs were higher than those reared in white background, suggesting that increased activities of α -MSH and its receptors may contribute to darker skin color.



In the goldfish reared in white background, the expression levels of the genes for each receptors and POMC-a were generally lower than those in black background, while the expression level of MCH gene was high. It is, therefore, conceivable that decreased activities of α -MSH and its receptor and increased activity of MCH caused lighter skin color.