

解説 オーランチオキトリウム (*Aurantiochytrium*)について

文責：筑波バイオテック研究所
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筑波大学の渡邊 信さんが発見した(2010年12月15日報道)というオーランチオキトリウム(*Aurantiochytrium*)について多くの質問が寄せられるので、ここに説明をしておきます。

このオーランチオキトリウムはクロロフィルを持たない(つまり光合成をしない)微小な生物で、クロロフィルを持つ微細藻類とは大きく異なります。

オーランチオキトリウムはそれ自身では光合成ができないので、CO₂以外の炭素化合物(つまり他の植物が光合成によって得た有機炭素化合物)を代謝して増殖と油脂生産をおこないます。これはわれわれの身近に接している魚、家禽や、家畜(牛や豚など)が植物性の飼料を食べてタンパク質や脂肪を作るのと基本的には同じです(このような生物を専門的には従属栄養型の生物と言います)。海に生息するオーランチオキトリウムは海水中の有機炭素を食べて体内に油脂を蓄積します。これを魚が食べ魚の油脂となります。現在、魚の体内油脂はω-3油脂(DHA やビタミン E など)を含むので栄養食品や医薬品への応用が有望として注目されています(参考文献を参照してください)。

微小な生物に関しては従属栄養型の生物は独立栄養型(CO₂と水と光エネルギーを利用して炭水化物を生産する)の生物より成長が早いことを多くの研究者が認識しています。オーランチオキトリウムを利用して油脂生産を行なおうとすると、1KLの油を作るためには少なくともその2~3倍の餌(有機炭素源)が必要になります。これは畜産にたとえると、1kgの肉を得るのに約7kgの飼料を必要とすることと同じことです。

以下に、Webでも検索できる研究例を紹介いたします。これらの研究から以上の解説がさらに理解できることでしょう。

参考文献(スライド)

1. Omega-3 Polyunsaturated fatty acid production by microalgae *Aurantiochytrium mangrovei* Sk-02 as the effect of carbon sources and growth environments

発表者： Nutnicha Chodchoey Ph.D Candidate of Mahidol University, Thailand

出典：www.australianoilseeds.com/_data/assets/pdf_file/0010/7021/chodchoey,_nutnicha_00264.pdf

2. Commercial Production of DHA using Heterotrophic Microalgae

発表者： Yi-Min Chen et al

出典：

www.phyco.org.tw/caa/05-Commercial%20Production%20of%20DHA%20using%20heterotrophic%20microalgae%20.pdf

3. さらに詳しく理解したければ、以下の Google 学術文献リストを参考にしてください。

[... 18S rRNA gene phylogeny \(Thraustochytriaceae, Labyrinthulomycetes\): emendation for Schizochytrium and erection of **Aurantiochytrium** and Oblongichytrium gen. ...](#)

R Yokoyama... - Mycoscience, 2007 - Springer

Abstract The genus Schizochytrium sensu lato has been characterized by successive binary division of its vegetative cells. However, the molecular phylogeny strongly suggests that this genus is not a natural taxon, because the original and recorded strains that have been ...

[引用元 18 - 関連記事 - 全 6 バージョン](#)

[Accumulation of docosahexaenoic acid-rich lipid in thraustochytrid **Aurantiochytrium** sp. strain T66: effects of N and P starvation and O₂ limitation](#)

AN Jakobsen, IM Aasen, KD Josefsen... - Applied microbiology and ..., 2008 - Springer

Abstract **Aurantiochytrium** sp. strain T66 was grown in batch bioreactor cultures in a defined glutamate- and glycerol- containing growth medium. Exponentially growing cells had a lipid content of 13% (w/w) of dry weight. A fattening of cells fed excess glycerol occurred in the post- ...

[引用元 5 - 関連記事 - 全 5 バージョン](#)

[Improvement of a two-stage fermentation process for docosahexaenoic acid production by **Aurantiochytrium** limacinum SR21 applying statistical experimental designs ...](#)

SM Rosa, MA Soria, CG Vélez... - Bioresource technology, 2010 - Elsevier

Statistical screening experimental designs were applied to identify the significant culture variables for biomass production of **Aurantiochytrium** limacinum SR21 and their optimal levels were found using a combination of Artificial Neural Networks, genetic algorithms and graphical ...

[引用元 3 - 関連記事 - 全 4 バージョン](#)

[Optimization of culture conditions for growth and docosahexaenoic acid production by a marine thraustochytrid, **Aurantiochytrium** limacinum mh0186](#)

N Nagano, Y Taoka, D Honda... - Journal of oleo science, 2009 - J-STAGE

1 INTRODUCTION Long-chain polyunsaturated fatty acids such as arachi- donic acid (C₂₀:4n-6), eicosapentaenoic acid (C₂₀:5n-3) and docosa- hexaenoic acid (DHA, C₂₂:6n-3) are structural components of cell membrane and play important roles in biological func- ...

[引用元 3 - 関連記事 - 全 5 バージョン](#)

[Influences of culture temperature on the growth, lipid content and fatty acid composition of **Aurantiochytrium** sp. strain mh0186](#)

Y Taoka, N Nagano, Y Okita, H Izumida... - Marine ..., 2009 - Springer

Abstract The growth, lipid content, and fatty acid compo- sition of **Aurantiochytrium** sp. strain mh0186 at different temperatures were investigated. Strain mh0186 grew well at 15–30°C, but weakly at 10°C. The biomass at 15–30°C was significantly higher than at 10 and 35°C, and the ...

[引用元 2 - 関連記事 - 全 4 バージョン](#)

[Extracellular enzymes produced by marine eukaryotes, thraustochytrids](#)

Y Taoka, N Nagano, Y Okita, H IZUMIDA... - Bioscience, ..., 2009 - J-STAGE

... Extracellular enzymes produced by six strains of thraustochytrids, Thraustochytrium, Schizochytrium, and **Aurantiochytrium**, were investigated. ... Gelatinase activity was detected

in all strains, except for A. limacinum and **Aurantiochytrium** sp. ...

[引用元 3 - 関連記事 - 全 5 バージョン](#)

[The distribution of extracellular cellulase activity in marine eukaryotes, thraustochytrids](#)

N Nagano, S Matsui, T Kuramura, Y Taoka... - Marine Biotechnology - Springer

... On the other hand, cellulolytic enzyme activity was not detected in any strains belonging to the

genus **Aurantiochytrium**. Keywords Thraustochytrids . Cellulase activity

Aurantiochytrium

limacinum SR21 11.2 15.4 0 0 **Aurantiochytrium** limacinum mh0186 12.8 17.5 0 0 ...

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[Production of Lipids Containing High Levels of Docosahexaenoic Acid by a Newly Isolated Microalga, Aurantiochytrium sp. KRS101](#)

WK Hong, D Rairakhwada, PS Seo, SY Park... - Applied Biochemistry and ... - Springer

Abstract In the present study, a novel oleaginous Thraustochytrid containing a high content of docosahexaenoic acid (DHA) was isolated from a mangrove ecosystem in Malaysia. The strain

identified as an **Aurantiochytrium** sp. by 18S rRNA sequencing and named KRS101 used ...

[関連記事](#)

[Effects of Cold Shock Treatment on Total Lipid Content and Fatty Acid Composition of Aurantiochytrium limacinum strain mh0186](#)

Y Taoka, N Nagano, Y Okita, H Izumida... - Journal of Oleo ..., 2011 - J-STAGE

Journal of Oleo Science Copyright ©2011 by Japan Oil Chemists' Society J. Oleo Sci. 60, (5) 217-220 (2011) ... Effects of Cold Shock Treatment on Total Lipid ... Yousuke Taoka1, Naoki Nagano1, Yuji Okita2, Hitoshi Izumida2, Shinichi Sugimoto2 and Masahiro Hayashi1*

[Docosahexaenoic acid production and ultrastructure of the thraustochytrid Aurantiochytrium mangrovei MP2 under high glucose concentrations](#)

MKM Wong, CKM Tsui, DWT Au... - Mycoscience, 2008 - Springer

MKM Wong · CKM Tsui1 (*) · DWT Au · LLP Vrijmoed (*) Department of Biology and Chemistry, City University of Hong Kong, 83 Tat Chee Avenue, Kowloon Tong, Hong Kong Special Administrative Region, China Tel. +852-2788-9966; Fax +852-2788-9922 e-mail: ...

[関連記事 - 全 4 バージョン](#)

[Enhanced production of squalene in the thraustochytrid Aurantiochytrium mangrovei by medium optimization and treatment with terbinafine](#)

KW Fan, T Aki, F Chen... - World Journal of Microbiology and ..., 2010 - Springer

Abstract Squalene is an effective chemopreventive agent in reducing the incident of coronary heart disease and cancer. It is also a strong antioxidant used extensively in the food and cosmetic

industries. Microbial sources of squalene are being explored in recent years. The ...

[関連記事 - 全 6 バージョン](#)

[Differentiation in Fatty Acid Profiles of Pigmented and Nonpigmented **Aurantiochytrium** Isolated from Hong Kong Mangroves](#)

KW Fan, Y Jiang, LT Ho... - Journal of agricultural and food ..., 2009 - ACS Publications

Twenty-five thraustochytrids that belong to the genus **Aurantiochytrium** were isolated from subtropical mangroves in Hong Kong. Although they have similar morphological and physiological characteristics, they have different colors on a yeast extract–glucose agar plate, which ...

[関連記事 - 全 4 バージョン](#)

[Production of Lipids Containing High Levels of Docosahexaenoic Acid by a Newly Isolated Microalga, **Aurantiochytrium** sp. KRS101.](#)

WK Hong, D Rairakhwada, PS Seo... - Applied biochemistry ..., 2011 - ncbi.nlm.nih.gov

In the present study, a novel oleaginous Thraustochytrid containing a high content of docosahexaenoic acid (DHA) was isolated from a mangrove ecosystem in Malaysia. The strain identified as an

Aurantiochytrium sp. by 18S rRNA sequencing and named KRS101 used various carbon ...

[Optimization of nitrogen source for enhanced production of squalene from thraustochytrid **Aurantiochytrium** sp.](#)

G Chen, KW Fan, FP Lu, Q Li, T Aki, F Chen... - New biotechnology, 2010 - Elsevier

Nitrogen (N) sources, the critical medium component, were optimized for squalene production by microalga **Aurantiochytrium** sp. in heterotrophic cultures. In screening experiments monosodium glutamate, yeast extract and tryptone were found to enhance cell growth and squalene ...

[関連記事 - 全 3 バージョン](#)

[\[PDF\] Compatible solutes and docosahexaenoic acid accumulation of thraustochytrids of the **Aurantiochytrium** group](#)

[diva-portal.org](#) の [\[PDF\]](#)AN Jakobsen - 2008 - ntnu.diva-portal.org

... Compatible solutes and docosahexaenoic acid accumulation of thraustochytrids of the **Aurantiochytrium** group Thesis for the degree of doktor ingeniør Trondheim, June 2008 ... Printed by Tapir Uttrykk Page 3. **Aurantiochytrium** sp. strain T66 in liquid medium Page 4. Page 5. ii ...

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[Modification of Lipid Composition by Genetic Engineering in Oleaginous Marine Microorganism, Thraustochytrid](#)

T Aki, H Iwasaka, H Adachi, M Nanko, H Kawasaki... - 2010 - Wiley Online Library

... We have isolated a number of thraustochytrid strains from coastal areas in Japan and Thailand and identified most of those belonging to the genera Thraustochytrium, Schizochytrium, or **Aurantiochytrium** (Huang et al., 2003; Yongmanitchai and Ward, 1989). ...

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[\[PDF\] Modules attached](#)

[ictvonline.org](#) の [\[PDF\]](#) Y Takao, D Honda, K Nagasaki, K Mise... - [ictvonline.org](#)

... **Aurantiochytrium** single-stranded RNA virus ... (2007)]. As a result of this taxonomy rearrangement,

the genus Schizochytrium was divided into three genera: genus **Aurantiochytrium**, genus Oblongichytrium and genus Schizochytrium (Yokoyama & Honda, 2007). ...

[関連記事](#) - [HTMLバージョン](#) - [全 4 バージョン](#)

[Fluorescence in situ hybridization using 18S rRNA-targeted probe for specific detection of thraustochytrids \(Labyrinthulomycetes\)](#)

Y TAKAO, Y TOMARU, K NAGASAKI... - *Plankton and Benthos ...*, 2007 - J-STAGE

... Key words: **Aurantiochytrium**, Decomposer, FISH method, Schizochytrium, Thraustochytrium

Plankton Benthos Res 2(2): 91–97, 2007 ... Taxon Strain Original locality Reactivity**

Thraustochytriaceae **Aurantiochytrium** sp. NIBH N1-27* Nakaminato Harbor, Ibaragi, Japan ...

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[Screening and characterization of squalene-producing thraustochytrids from Hong Kong mangroves](#)

Q Li, GQ Chen, KW Fan, FP Lu... - *Journal of agricultural ...*, 2009 - ACS Publications

... The cell dry weight ranged from 5.49 to 15.62 g/L and squalene content from 0.02 to 0.18 mg/g at 72 h. The highest squalene-producing strain, BR-MP4-A1 was identified as a new strain

of **Aurantiochytrium** species through sequence comparison of the 18S rRNA gene. ...

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[\[PDF\] Fluorescence in situ hybridization using 18S rRNA-targeted probe for specific detection of thraustochytrids \(Labyrinthulomycetes\)](#)

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... Key words: **Aurantiochytrium**, Decomposer, FISH method, Schizochytrium, Thraustochytrium

Plankton Benthos Res 2(2): 91–97, 2007 ... Taxon Strain Original locality Reactivity**

Thraustochytriaceae **Aurantiochytrium** sp. NIBH N1-27* Nakaminato Harbor, Ibaragi, Japan ...

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[Use of an antifungal drug, amphotericin B for isolation of thraustochytrids](#)

Y Taoka, N Nagano, Y Okita, H Izumida... - *Journal of bioscience ...*, 2010 - Elsevier

... Key words: Amphotericin B; Thraustochytrids; **Aurantiochytrium**; Colony isolation; Fungi. Article

Outline. References. ... Based on these results, we believed AMPH is a suitable antifungal drug

for the isolation of thraustochytrids, especially genus **Aurantiochytrium** strains. ...

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[Inhibitory effects of microalgal extracts on the formation of advanced glycation endproducts](#)

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Z Sun, X Peng, J Liu, KW Fan, M Wang... - Food Chemistry, 2010 - Elsevier

... (FACHB 283) and *Synechocystis* sp. (FACHB 27184), cultured in the BG-11 medium (Allen, 1968);

the red alga *Rhodella violacea* (UTEX 2427), cultured in the Brody & Emerson medium (Pekarkova, Hindak, & Smarda, 1988); the Chromista **Aurantiochytrium** sp. ...

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[Isolation and Characterization of Taiwanese Heterotrophic Microalgae: Screening of Strains for Docosahexaenoic Acid \(DHA\) Production](#)

HL Yang, CK Lu, SF Chen, YM Chen... - Marine Biotechnology, 2010 - Springer

... GC/MS analysis discerned seven distinctive fatty acid profiles of these strains, with the production of eicosapentaenoic acid (C20:5n-3) ranging from 0.02 to 2.61 mg L⁻¹, and DHA ranging from 0.8 to 18.0 mg L⁻¹. An **Aurantiochytrium** strain BL10 with high DHA production ...

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[Fatty acid composition and squalene content of the marine microalga *Schizochytrium mangrovei*](#)

Y Jiang, KW Fan, RTY Wong... - Journal of agricultural and ..., 2004 - ACS Publications

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[Taxonomic rearrangement of the genus *Ulkenia* sensu lato based on morphology, chemotaxonomical characteristics, and 18S rRNA gene phylogeny \(...](#)

R Yokoyama, B Salleh... - Mycoscience, 2007 - Springer

... Therefore, we proposed that species of the genus *Schizochytrium* were separated into three distinct genera, that is, *Schizochytrium* sensu stricto and two new genera, **Aurantiochytrium** R. Yokoy. .2004 **Aurantiochytrium** limacinum NIBH SR21T AB022107 Honda et al. 1999 ...

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[Lipid characterization of mangrove thraustochytrid-*Schizochytrium mangrovei*](#)

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[\[PDF\] Squashed ball-like dsDNA virus infecting a marine fungoid protist *Sicyoidochytrium minutum* \(Thraustochytriaceae, Labyrinthulomycetes\)](#)

[int-res.com](#) の [\[PDF\]](#) Y Takao, K Nagasaki... - Aquatic microbial ecology, 2007 - int-res.com

... 103 Taxon Strains Isolation locality Sensitivity to SmDNAV Kingdom Chromista

Thraustochytriaceae **Aurantiochytrium** sp. NIBH N1-27a Nakaminato Harbor, Ibaragi, Japan

-

Aurantiochytrium limacinum NIBH SR-21 (IFO 32693)a Colonia, Yap Island, Micronesia – ...

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[Development of a stepwise aeration control strategy for efficient docosahexaenoic acid production by *Schizochytrium* sp.](#)

LJ Ren, XJ Ji, H Huang, L Qu, Y Feng... - Applied microbiology ..., 2010 - Springer

... Jakobsen et al. (2008) studied the effect of oxygen limitation on DHA-rich lipid accumulation in

Aurantiochytrium sp. T66, which was also a genus of Schizochytrium. ... SR21 (Yaguchi et al. 1997) and is much higher than 93 mg/L h by using **Aurantiochytrium** sp. T66. ...

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L Qu, XJ Ji, LJ Ren, ZK Nie, Y Feng... - Letters in applied ... - Wiley Online Library

... 2008). Jakobsen et al. (2008) found that the lipid content of **Aurantiochytrium** sp. ... 2006), and 117 mg l⁻¹ h⁻¹ for strain 12B, (Perveen et al. 2006) and much higher than 93 mg l⁻¹ h⁻¹ by using **Aurantiochytrium** sp. T66 (Jakobsen et al. 2008). ...

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... 2003, Lang et al. 2004), AsRNAV (**Aurantiochytrium** single-stranded RNA virus: previously

designated as Schizochytrium single-stranded RNA virus [SssRNAV]) infecting a fungoid

protist **Aurantiochytrium** sp. (Takao et al. 2005, Takao et al. ...

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[\[PDF\] Novel uncultivated labyrinthulomycetes revealed by 18 S rDNA sequences from seawater and sediment samples](#)

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... Abbreviations of species names: Aplan, Aplanochytrium; Aurant, **Aurantiochytrium**; Botry, Botryochytrium; Japon, Japonochytrium; La, Labyrinthula; Loides, Labyrinthuloides; Oblong, Oblong-ichytrium; Pariet, Parietichytrium; Schiz, Schizochytrium; Sicyoid, Sicyoidochytrium; Th ...

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[Isolation and characterization of a single-stranded RNA virus infecting the bloom-forming diatom Chaetoceros socialis](#)

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... RNA polymerase (RdRp) domain from a genome sequence of CtenRNAV is highly similar to

RsRNAV but less similar to other marine stramenopile organism viruses (16): Schizochytrium single-stranded RNA virus (SssRNAV) infecting a fungoid protist **Aurantiochytrium** sp. ...

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F Mantzouridou, E Naziri... - Journal of agricultural and ..., 2009 - ACS Publications

... Pseudomonas (11), the algae Euglena (12), and the marine microorganisms

Pseudozyma sp. JCC207 and **Aurantiochytrium** sp. BR-MP4-A1 (13, 14) were used.

In the present study, taking into account food safety requirements for ...

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... 2011 Mar 22. [Epub ahead of print] PubMed PMID: 21424856. 5: Hong WK, Rairakhwada D, Seo PS, Park SY, Hur BK, Kim CH, Seo JW. Production of Lipids Containing High Levels of Docosahexaenoic Acid by a Newly Isolated Microalga, **Aurantiochytrium** sp. KRS101. ...

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[Increase of EPA in Thraustochytrids through Expression of a Fatty Acid {Delta} 5 Desaturase Gene Driven by the Thraustochytrid Ubiquitin Promoter](#)

[T Kobayashi, K Sakaguchi, T Matsuda... - Applied and ..., 2011 - Am Soc Microbiol](#)

... 8 ubiquitin promoter. The gene was functionally expressed in **Aurantiochytrium** 9 ... 26 In this study,

a fatty acid A5 desaturase isolated from Thraustochytrium aureum 27 ATCC 34304 was expressed in **Aurantiochytrium** limacinum mh0186 (18, 19) using an 28 ...

[Docosahexaenoic acid \(C22: 6n-3, DHA\) and astaxanthin production by Thraustochytriidae sp. AS4-A1 a native strain with high similitude to Ulkenia sp.: Evaluation of ...](#)

[B Quilodr n, I Hinzpeter, E Hormazabal... - Enzyme and Microbial ..., 2010 - Elsevier](#)

... carotenoids (astaxanthin, zeaxanthin, cantaxanthin, β -carotene, echinenone and phenicoxanthin)[5], [6], [7], [8] and [9]. Thraustochytrids comprise species belonging to the genera, Althornia, Diplophrys, Japonochytrium, Thraustochytrium, **Aurantiochytrium** (formerly known as ...

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[\[PDF\] AQUATIC VIRAL ECOLOGY](#)

[aslo.org の \[PDF\]K Nagasaki... - 2010 - 222.aslo.org](#)

... Mastigophorea) (reported as Bodo sp.) Mimivirus Acanthamoeba polyphaga

(Acanthamoebidae) 750 dsDNA, 1.2 Mb Viral lysate SssRNAV **Aurantiochytrium** sp. ...

(**Aurantiochytrium** sp.) can grow well on agar plate (Y. Takao pers. ...

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[Increasing evidence for the important role of Labyrinthulomycetes in marine ecosystems](#)

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... from fallen mangrove leaves at Goa, India. This species has now been renamed **Aurantiochytrium**

mangrovei (Raghuk.) R. Yokoy. et D. Honda. ... R. Yokoy. et D. Honda. Schizochytrium S. Goldst.

et Belsky **Aurantiochytrium** R. Yokoy. et D. Honda Oblongichytrium R. Yokoy. ...

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[Y Kumon, Y Kamisaka, N Tomita, K KIMURA... - Bioscience, ..., 2008 - J-STAGE](#)

... ment of the genus *Schizochytrium* sensu lato based on morphology, chemotaxonomic characteristics, and 18S rRNA gene phylogeny (Thraustochytriaceae, Labyrinthulomycetes): emendation for *Schizochytrium* and erection of **Aurantiochytrium** and *Oblongichytrium* gen. ...

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[Adjusting culture conditions to isolate thraustochytrids from temperate and cold environments in southern Argentina](#)

SM Rosa, MA Galvagno... - *Mycoscience* - Springer

... The well-studied SR21 strain of **Aurantiochytrium** (formerly *Schizochytrium*) *limacinum* (D. Honda & Yokochi) R. Yokoy. & D. Honda was included for contrast, while several local strains were excluded because of plausible species redundancy (BAFC cult. ...

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[\[PDF\] Novel uncultivated labyrinthulomycetes revealed by 18 S rDNA sequences from seawater and sediment samples](#)

[int-res.com](#) の [\[PDF\]](#) E Collado-Mercado, JAC Radway... - *Aquatic Microbial Ecology*, 2010 - [int-res.com](#)

... Abbreviations of species names: Aplan, *Aplanochytrium*; Aurant, **Aurantiochytrium**; Botry, *Botryochytrium*; Japon, *Japonochytrium*; La, *Labyrinthula*; Loides, *Labyrinthuloides*; Oblong, *Oblongichytrium*; Pariet, *Parietichytrium*; Schiz, *Schizochytrium*; Sicyoid, *Sicyoidochytrium*; Th ...

[引用元 2 - 関連記事 - 全 4 バージョン](#)

[Isolation and characterization of a single-stranded RNA virus infecting the bloom-forming diatom *Chaetoceros socialis*](#)

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RsRNAV but less similar to other marine stramenopile organism viruses (16): *Schizochytrium* single-stranded RNA virus (SssRNAV) infecting a fungoid protist **Aurantiochytrium** sp. ...

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[5], [6], [7], [8] and [9]. Thraustochytrids comprise species belonging to the genera, Althornia, Diplophrys, Japonochytrium, Thraustochytrium, **Aurantiochytrium** (formerly known as ...

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... Mastigophorea) (reported as Bodo sp.) Mimivirus Acanthamoeba polyphaga

(Acanthamoebidae) 750 dsDNA, 1.2 Mb Viral lysate SssRNAV **Aurantiochytrium** sp. ...

(**Aurantiochytrium** sp.) can grow well on agar plate (Y. Takao pers. ...

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... a stramenopile comprises transferring a foreign gene into the stramenopile which is a microorganism belonging to the class Labyrinthula, more specifically, to a genus Labyrinthula, Altonia, Aplanochytrium, Schizochytrium, **Aurantiochytrium**, Thraustochytrium, Ulkenia, etc. ...

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The
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