

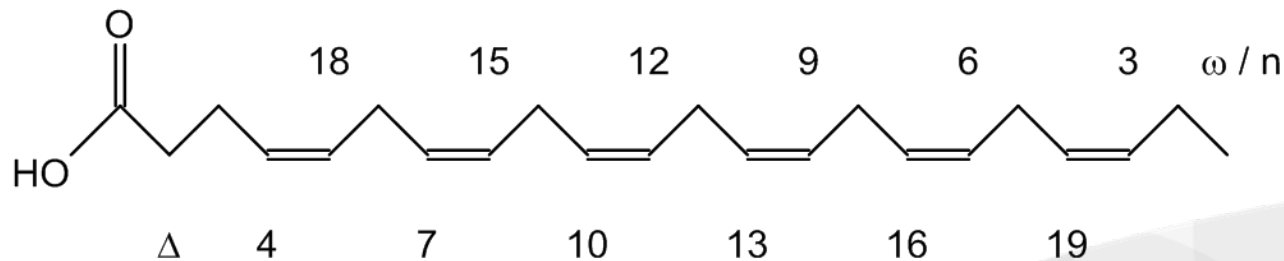
# Microbial production of docosahexaenoic acid

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# Docosahexaenoic acid (DHA; 22:6 n-3)

- DHA is an polyunsaturated fatty acid (PUFA)
- DHA is regarded essential for cognitive and visual development of fetuses and infants
- Low intake of n-3 PUFA (compared to n-6 PUFA) are linked to many diseases including cancer, cardiovascular diseases and mental illnesses
- DHA is most often found in marine fish and their oils
- Most of the DHA in fish originates from thraustochytrids (microalgae)



# Microbial production of docosahexaenoic acid (DHA; 22:6 n-3)

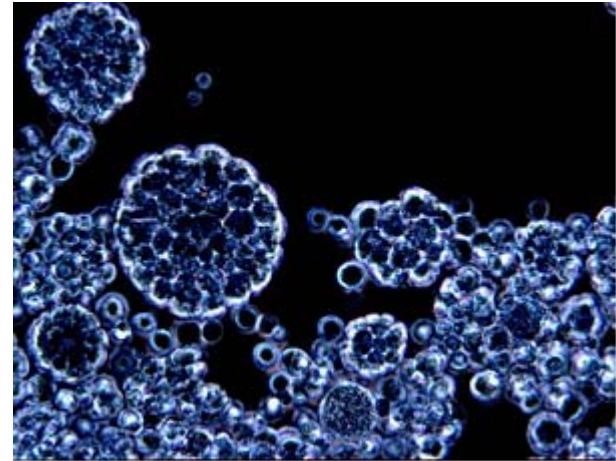
- Microbial oil is an alternative source of n-3 PUFA
  - Growth in aquaculture industry
  - Increasing trend for enrichment of infant formula and food products with DHA



Photo: Martek Biosciences Corporation

# Production of DHA by fermentation of marine thraustochytrids

- **Thraustochytrids are marine eukaryotic single-cell microorganisms**
- **Easy to cultivate industrially**
- **DHA-rich fat (up to 50 %) accounts for up to 60-70 % of cell dry weight**
- **The DHA-rich fat is approved for human consumption**
- **The DHA-rich fat is suited for fish feed, but currently more expensive than marine oils**
- **Our collection currently contains around 70 strains, some of which are high DHA-producers**



# Recommended intakes of n-3 fatty acids

- **Balanced dietary intake of n-3 and n-6 PUFA in a ratio 1:1 to 1:4 is recommended**
- **In general, about 1-2 % of the daily energy intake is recommended to come from n-3 PUFA and consumption of 1-2 fish meals per week (preferably oily fish) is advised**
- **ISSFAL: 0,5 g DHA + EPA (20:5 n-3) per day**
- **American Heart Association: 1 g DHA + EPA per day for persons with coronary heart disease**
- **The Perinatal Lipid Intake Working Group: Minimum 0.2 g DHA + EPA per day for pregnant and lactating women**
- **World Association of Perinatal Medicine Dietary Guidelines Working Group: 0.2-0.5% DHA of total fatty acids in infant formula**

# Actual versus recommended intake of n-3 fatty acids

- In many western countries the average fish intake is currently far below recommended intake
- n-3:n-6 up to 1:17

Population	EPA + DHA (g per day)	
	Men	Women
Japan	1-1.5	0.7-1.1
Norway	1	0.7
Spain	0.7	0.7
France	0.5	0.4
Germany	0.3	0.2
Australia	0.2	0.1
USA	0.2	0.2

# Actual versus recommended intake of n-3 fatty acids in Norway

- **Adults eat in average 65 g fish per day (~2 meals per week)**
  - Lean fish and fish products dominate (70%)
  - n-3 fatty acids constitute almost 1% of daily energy intake
  - n-3:n-6 ~1:5
- **50% of young women in childbearing age eat less than 50 g oily fish per week**
- **Children (9-13 years old) eat in average 25 g fish per day**



# Publications

- **Anita N. Jakobsen, Inga M. Aasen and Arne R. Strøm (2007). Endogenously synthesized (-)-*proto*-quercitol and glycine betaine are principal compatible solutes of *Schizochytrium* sp. strain S8 (ATCC 20889) and three new isolates of phylogenetically related thraustochytrids. *Appl. Environ. Microbiol.* 73:5848-5856.**
- **Anita N. Jakobsen, Inga M. Aasen, Kjell D. Josefsen and Arne R. Strøm (2008). Accumulation of docosahexaenoic acid-rich lipid in thraustochytrid *Aurantiochytrium* sp. strain T66: effects of N and P starvation and O<sub>2</sub> limitation. *Appl. Microbiol. Biotechnol.* 80:297-306**
- **Anita N. Jakobsen (2008). Compatible solutes and docosahexaenoic acid accumulation of thraustochytrids of the *Auranthiochytrium* group. Doctoral Thesis NTNU.**
- **Anita N Jakobsen (2009). n-3 fats: nutritional needs, sources and microbial production strategies. In Columbus, F. ed, *Industrial fermentation: Food processes, nutrient sources and production strategies*. Novapublisher. In Press.**