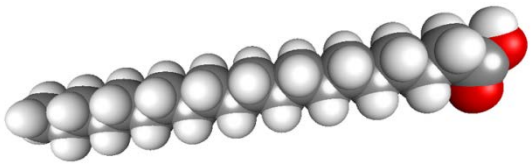
生物策略格式

KJC, 2019/10/21

類別	生物策略 (Strategy)
生物策略 STRATEGY	海獸脂吸熱 (Blubber absorbs heat)
生物系統 LIVING SYSTEM	寬吻海豚 *Tursiops truncates* (Bottlenose dolphin)
功能類別 FUNCTIONS	#獲取、吸收、或過濾能量 #分配能量 #儲存能量 #Capture, absorb, or filter energy #Distribute energy #Store energy
作用機制標題	寬吻海豚的海獸脂通過作為相變材料以吸熱 (The blubber of the bottlenose dolphin absorbs heat by acting as a phase change material)
生物系統/作用機制示意圖	  

作用機制摘要說明 (SUMMARY OF FUNCTIONING MECHANISMS)

文獻引用 (REFERENCES)

「有實質的證據支持外皮的歸類，特別是 (大西洋寬吻海豚) 海獸脂，可當作一種相變材料。第一，海獸脂中的脂肪酸大多屬於相變材料，而且熔點都在哺乳類的體溫範圍內 (Sari, 2003; Sari and Kaygusuz, 2001; Sari et al., 2003; Suppes et al., 2003)。Suppes et al. (2003) 將棕櫚酸 (C16:0)、硬脂酸 (18:0)、油酸 (C18:1)、亞油酸 (C18:2)、亞麻酸 (C18:3)和花生酸 (C20:0)等脂肪酸都歸類為極佳的變相材料。鯨豚類的海獸脂中，則包含所有這些脂肪酸 (Koopman et al., 1996)。這些脂肪酸的混合物形成了熔點介在 29°C~38°C（包含哺乳類的體溫範圍）的相變材料 (Suppes et al., 2003)。第二，這些脂肪酸的潛熱值通常都高於 180 $J \cdot g^{-1}$，符合此材料需有相對較大的潛熱穩定狀態之條件 (Suppes et al., 2003)。第三，由於海獸脂組織中脂肪細胞的抑制，以及脂肪細胞的高度結構性，可避免海獸脂中脂肪酸產生分層現象。最後，已知鯨豚類對於附肢以及身體外圍的血管擁有良好的控制能力 (Elsner et al., 1974; Kvadsheim and Folkow, 1997; Ling, 1974; Meagher et al., 2002; Pabst et al., 1999b;

Scholander and Schevill, 1955)。將溫熱血液分流至海獸脂層，可使得間歇性熱負荷到達海獸脂，隨後則是血管收縮期。未來的研究需要釐清海獸脂的潛在相變性質之特性，以及探討有關此性質的可能功能。」(Dunkin et al., 2005: 1479)

"There is substantial evidence to support the classification of the integument, and specifically the blubber layer [of the Atlantic bottlenose dolphin], as a phase change material. First, many of the fatty acids found in blubber are classified as phase change materials and have melting points in the range of mammalian body temperatures (Sari, 2003; Sari and Kaygusuz, 2001; Sari et al., 2003; Suppes et al., 2003). Suppes et al. (2003) classified palmitic (C16:0), steric (18:0), oleic (C18:1), linoleic (C18:2), linolenic (C18:3) and arachidic (C20:0) fatty acids as excellent phase change materials. All of these fatty acids have been identified in cetacean blubber (Koopman et al., 1996). Mixtures of these fatty acids yield phase change materials with melting points between 29°C and 38°C (Suppes et al., 2003), which include the range of mammalian body temperatures. Second, these fatty acids also satisfy the requirement that the material has a relatively large latent heat plateau, with latent heat values generally greater than 180 $J \cdot g^{-1}$ (Suppes et al., 2003). Third, their stratification in blubber may be prevented by their containment in adipocytes as well as the highly structured nature of adipocytes in the blubber tissue. Finally, cetaceans are known to have fine vascular control to their appendages and to the periphery of their body (Elsner et al., 1974; Kvadsheim and Folkow, 1997; Ling, 1974; Meagher et al., 2002; Pabst et al., 1999b; Scholander and Schevill, 1955). Intermittent heat loads could be applied to the blubber through shunting of warm blood to the blubber layer, followed by periods of vasoconstriction. Future studies are needed to fully characterize blubber's potential phase change properties as well as investigate the possible functions that may be associated with such a property." (Dunkin et al., 2005: 1479)

參考文獻清單與連結 (REFERENCE LIST)

R. C. Dunkin. (2005). The ontogenetic changes in the thermal properties of blubber from Atlantic bottlenose dolphin *Tursiops truncates*. *Journal of Experimental Biology* 208: 1469-1480. (https://jeb.biologists.org/content/208/8/1469)

Nikolić, R., M. Marinović-Cincović, S. Gadžurić, and I. J. Zsigrai. (2002). New materials for solar thermal storage—solid/liquid transitions in fatty acid esters. *Solar Energy Materials and Solar Cells* 79: 285-292. (https://doi.org/10.1016/S0927-0248(02)00412-9)

延伸閱讀:

生物系統延伸資訊連結 (LEARN MORE ABOUT THE LIVING SYSTEM/S)

https://en.wikipedia.org/wiki/Tursiops_truncatus

文章貢獻/編修者與日期:

劉展廷翻譯 (2019/04/28)；朱天愛編修 (2019/12/19)；吳晧編修 (2020/01/04)； 譚國鎏編修 (2020/05/26)；紀凱容編修 (2020/11/26)；施習德編修 (2020/12/25)
AskNature 原文連結
https://asknature.org/strategy/blubber-absorbs-heat/