HEAVY METAL CONTENT IN CETACEANS STRANDED AT WEST AND NORTH COASTS OF SABAH, MALAYSIA

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ABSTRACT

A number of cetacean strandings has been reported in Sabah, Malaysia in the recent years. However, limited investigation has been done to further examine the phenomenon, hence leading to little understanding of the local cetaceans. Heavy metals, including methylmercury (MeHg) are globally-concerned pollutants. This is mainly due to their chemical properties and ability to interact with systemic enzymes, as well as their effects on cellular functions. When the body tolerance limit for heavy metal is exceeded, it can lead to dysfunction of body systems which subsequently reduce the cetaceans' fitness to survive. This inspired the current study which is the first attempt in Malaysia to examine and establish baseline concentrations of heavy metals in stranded cetaceans. Concentrations and distribution of Cd, Cr, As, Pb, Cu, Mn, Fe, Se, and Zn in the main organs (liver, kidney, heart, lung, muscle, melon, and blubber) of five cetaceans (two short-finned pilot whale, two finless porpoises and a spinner dolphin) stranded at the west and north coasts of Sabah in 2015 were examined. MeHg in the brains were also measured as it is a neurotoxin and behavioural teratogen which mainly targets the central nervous system. None of the heavy metals was found to exceed the tolerance limit in the five cetaceans. The calf, adolescent and adult cetaceans examined in this study exhibited different manners of heavy metal distribution due to their diet and age differences. However, similar pattern of distribution was observed regardless of species variation. Concentrations of Cu, Zn, Fe, and Mn in the liver and kidney were found to be not affected by species or age. Selective accumulation of Cd was found in the kidney of adolescent short-finned pilot whale and spinner dolphin (98.65 µg g-1 dwt and 35.04 µg g-1 dwt or 54.28% and 67.13% respectively). Meanwhile, As and Cd in the finless porpoise calf were significantly ($p<0.05$) higher in the muscle as compared to other tissues (3.52 µg g-1 dwt and 3.79 µg g-1 dwt) which could be due to redistribution of harmful heavy metals to protect the main organs from toxicity. Concentrations of MeHg in the brains of the four cetaceans were also examined. The MeHg concentration was found to be significantly higher ($p<0.05$) in the brain of the adult spinner dolphin (0.91 µg g-1 dwt) than in other younger cetaceans (0.27 – 0.35 µg g-1 dwt). Nonetheless, it was relatively low as compared to cetaceans stranded in the temperate regions. On the contrary, brain MeHg percentage was significantly lower ($p<0.05$) in the adult spinner dolphin but higher in other young cetaceans (62.92 – 72.09%). This finding was similar to those of other studies which stated that demethylation activity is more efficient in adult cetaceans. Since only five cetaceans were obtained in 2015, it is suggested that such investigation efforts should be continued to properly assess the hazard of heavy metals in Sabah waters.

ABSTRAK

KANDUNGAN LOGAM BERAT DALAM SETASEA YANG TERDAMPAR DI PANTAI BARAT DAN UTARA SABAH, MALAYSIA

Banyak kes mengenai setasea terdampar telah dilaporkan di Sabah, Malaysia sejak kebelakangan ini tetapi keadaan itu tidak dikaji dengan lebih mendalam lagi menyebabkan tiada pemahaman mengenai setasea tempatan. Logam berat dan metilmerkuri (MeHg) adalah bahan pencemar yang membimbangkan. Oleh sebab peranan biokimia dalam badan berupaya berinteraksi dengan enzim sistemik dan memberi kesan kepada fungsi sel, tahap toleransi yang berlebihan boleh membawa kepada disfungsi sistem badan dan kemudiannya mengurangkan kecergasan setasea untuk meneruskan kehidupan di laut. Hal ini menjadi inspirasi bagi kajian semasa yang merupakan percubaan pertama untuk mengkaji tahap pencemaran di dalam bangkai setasea yang terdampar di Sabah, dengan tujuan untuk mewujudkan maklumat asas yang berguna bagi kajian masa depan. Taburan Cd, Cr, As, Pb, Cu, Mn, Fe, Se, dan Zn dalam organ-organ utama (hati, buah pinggang, jantung, paru-paru, otot, melon, dan lapisan lemak) bagi lima ekor setasea (dua ekor paus-pilot sirip-pendek, dua ekor lumba-lumba tanpa sirip belakang, dan seekor lumba-lumba pemintal) yang terdampar di pantai barat dan utara Sabah pada tahun 2015 telah diperiksa. Kandungan MeHg dalam otak setasea tersebut juga diukur kerana MeHg adalah neurotoksin dan teratogen tingkah laku yang terutamanya mensasarkan sistem saraf pusat. Umumnya, tiada logam yang didapati melebihi tahap toleransi. Taburan logam dalam anak, remaja, dan dewasa setasea yang diperiksa mempamerkan kandungan yang berbeza. Keadaan ini adalah biasa bagi setasea memandangkan diet dan peringkat kematangan memainkan peranan utama. Corak taburan yang sama juga didapati tanpa mengira spesies. Spesies atau kematangan turut didapati tidak memberi kesan kepada kepekatan Cu, Zn, Fe dan Mn dalam hati dan buah pinggang. Cd ditemui terutamanya terkumpul di dalam buah pinggang remaja paus-pilot sirip-pendek dan lumba-lumba pemintal (masing-masing adalah 98.65 μg g^{-1} dwt dan 35.04 μg g^{-1} dwt atau 54.28% dan 67.13%). Kandungan As dan Cd dalam anak lumba-lumba tanpa sirip belakang adalah lebih tinggi dalam otot berbanding tisu lain (3.52 dan 3.79 μg g^{-1} dwt), mungkin disebabkan oleh taburan semula logam berbahaya untuk melindungi organ-organ utama dari keracunan. MeHg dalam empat otak setasea diperiksa. Walaupun kajian ini mendapati kepekatan MeHg dalam ikan lumba-lumba pemintal dewasa adalah lebih tinggi (0.91 μg g^{-1} dwt) berbanding spesies lain (0.27 – 0.35 μg g^{-1} dwt), kepekatan tersebut adalah rendah berbanding setasea yang terdampar di kawasan perairan sejuk. Walau bagaimanapun, peratusan MeHg adalah rendah dalam badan ikan lumba-lumba pemintal dewasa (54.22%) tetapi tinggi dalam remaja dan bayi (62.92 – 72.09%). Penemuan ini adalah serupa dengan kajian-kajian lain yang menyatakan bahawa setasea mempunyai keupayaan lebih cekap untuk menyah-metil MeHg dan disimpan sebagai selenide merkuri, bentuk yang kurang reaktif. Memandangkan hanya lima bangkai sahaja yang diperoleh pada tahun 2015, adalah dicadangkan agar kajian ini perlu diteruskan untuk menilai dengan tepat bahaya MeHg terhadap setasea di Sabah.