PCBs IN THE MILK OF GREY SEALS: PRELIMINARY RESULTS FROM A DETAILED UK STUDY

P.P.Pomeroy[1] and N.J.L.Green[2].

[1]Sea Mammal Research Unit
Madingley Road, Cambridge CB3 0ET, UK

[2]Institute of Environmental and Biological Sciences
Lancaster University, Lancaster LA1 4YQ, UK

ABSTRACT

Milk samples collected from tagged grey seals (Halichoerus grypus) at a single location in three consecutive weening seasons have been analysed for 28 individual CB congeners. Information from six individuals is summarised here. Considerable variation in CB concentrations with time from parturition was observed, although the congener pattern remained similar throughout. Results are comparable to previously documented figures for PCBs in the milk of grey seals from other colonies in Scotland and Canada. Congeners 138 & 153 dominated all samples; relative levels of congener 180 varied from one animal to another (18% to 90% of the congener 138 value).

INTRODUCTION

The last five years have seen a heightened interest in PCBs in marine mammals, following the suggested link between persistent organochlorine contaminants and increased susceptibility to disease (Brouwer et al. 1989) and reproductive failure (Reijnders 1986), notably in seals. Most of this interest has centred on the comparison of PCB concentrations in the blubbers of healthy and sick seals. Our study uses a tagged population of free-ranging grey seals which breed on the Isle of May, Scotland to investigate the impact of early exposure to PCBs on the development of the immune system of pups. Grey seals are particularly suitable subjects for this work because they return to breed in the same places; females stay with their pups throughout the 17 days of lactation and do not feed. The quantities of PCBs transferred by the female to her pup is determined largely by her overall PCB burden. This paper presents results of PCB concentrations in milk samples from six individual grey seals at the Isle of May, collected in three consecutive seasons (1990-92). Up to three samples were taken each season.

RESULTS

Samples (ca. 1g) were soxhlet extracted with hexane for 16 hours. Extracts were digested with c.H_2SO_4, cleaned by silica and alumina chromatography, before analysis by HRGC-ECD (Hewlett Packard 5890 with 50m HP Ultra 2 column).

A total of 42 samples from six animals were analysed for 28 individual CB congeners selected from the list suggested by Jones (1988) as being pertinent to studies of PCB in biota. A detailed analysis of the full data set will be published elsewhere. Each sample was dominated by CB 153 and CB 138, and together with CBs 101, 149, 188, 187, 180 and 170 made up >80% of the total. In essence this congener pattern is consistent with that observed for other marine mammals (Bacon et al. 1992). CB 52 was the only congener of <5 chlorination present to a significant extent, having values between 0.5-1 times that of CB 101.

Figure 1 shows the results for the eight dominant congeners in a typical animal in 1992. In this figure results of three samples taken from the same animal during the same weening period are presented. They differ only in the time of sampling from parturition (2d, 10d, and 18d). The mid-period drop (typically of ca.20%) and subsequent increase (typically to ca.135% of the original value) was observed for all congeners, in all seals and for each of the three years. Figure 2 emphasises the uniformity of the variation by normalising the Week 1 value to 100% and plotting Week 2 and Week 3 values relative to it. The columns represent means calculated from all samples.

Figure 1
The general congener pattern as shown by one animal. Note the decline in concentrations of all congeners for the middle part and even more dramatic increase during the later part of the weening period.

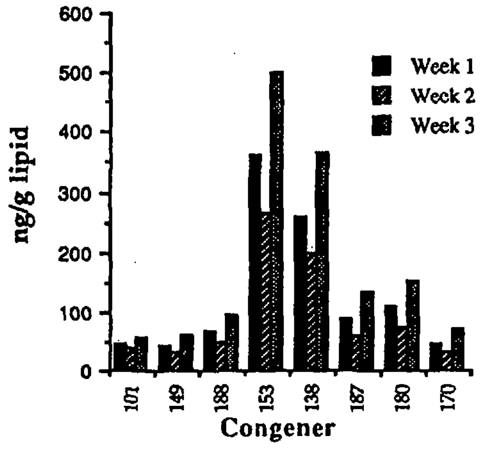
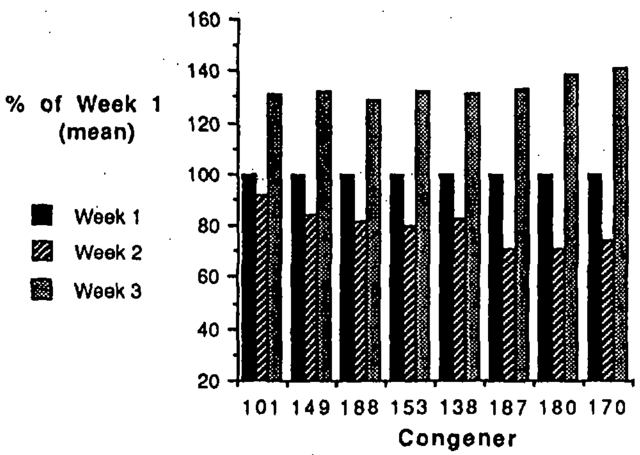


Figure 2
The variation of PCB concentration (lipid basis) through the lactation period. The concentrations of individual congeners found in samples from week 2 of the lactation periods were calculated as a percentage of the normalised concentrations from the corresponding Week 1 samples. The striped columns represent the means of all such percentages. Concentrations of congeners in Week 3 samples were treated similarly and the means are represented by the grey columns.



The lipid content of the milk increased during the course of lactation (Figure 3). Similar changes in milk composition have been documented in other studies of pinnipeds (eg. Bryden 1968, Baker et al. 1990, Reidman and Ortiz 1979). Figure 4 shows that when account is taken of this variation, the total quantity of PCB received by a pup in each feed of milk increases dramatically towards the end of lactation. Since this is also the time when the pup's immune system is beginning to develop, this could have a profound effect on its subsequent resistance to disease.

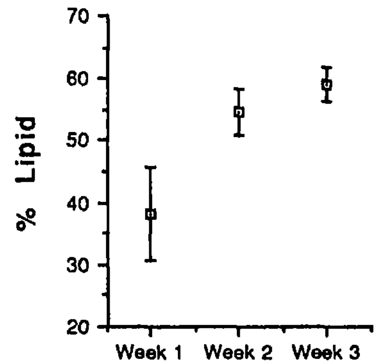


Figure 3
Mean lipid contents of milk samples taken during the first (n=14), second (n=15), and third (n=13) weeks of lactation for six seals. Error bars show one standard deviation either side of the mean.

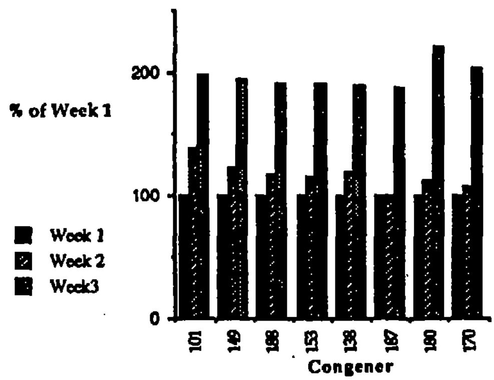


Figure 4
Demonstrates the variation of PCB concentration (whole milk basis) through the lactation period. Normalised data are shown as for Figure 2.

Levels of CB 153 in milk samples at the beginning of lactation ranged from 0.3µg/g to 1.3µg/g lipid. There are limited data which can be compared directly to these results, since most work on PCBs in grey seals has been reported as ΣPCB in blubber, and what constitutes "ΣPCB" varies considerably. However, Schweigert and Knöppler (1990) recorded a mean concentration of 0.34µg/g lipid of CB 153 in the milk of grey seals from Sable Island, Canada. The mean concentration of CB 153 in milk samples from seven grey seals on North Rona, off the northwest coast of Scotland, was 0.60µg/g lipid (SMRU unpublished data).

CONCLUSION

The transfer of PCBs from maternal blubber to milk is clearly not a straight forward process. The examination of PCBs in the blubber and blood of both mothers and pups will constitute the next stage of this project. It is anticipated that this future work will provide a clearer understanding of the mechanisms and extent of transfer of PCBs from mother seals to their offspring. These results also show the need to take into account the time of sampling with respect to parturition when quoting data for PCBs in seal milk.

ACKNOWLEDGEMENTS

This work has been funded by the Natural Environment Research Council, UK and Rechem *International Limited*.

PCB

REFERENCES

Bacon C E, Jarman W M, Costa D P, 1992. Organochlorine and Polychlorinated Biphenyl Levels in Pinniped Milk from the Arctic, the Antarctic, California and Australia. Chemosphere. 24: 779-792.

Baker J R 1990. Grey seal (hlichoerus grypus) milk composition and its variation over lactation. Brit. Vet. J. 146: 233-8.

Brouwer A, Reijnders P J H, Koeman J H, 1989. Polychlorinated biphenyl (PCB)-contaminated fish induces vitamin A and thyroid hormone deficiency in the common seal (Phoca vitulina). Aquat. Toxicol. 15:99-106.

Bryden M M, 1968. Lactation and suckling in relation to early growth of the southern elephant seal, Mirounga leonina (L.). Austral. J. Zool. 16: 739-747.

Jones K C, 1988. Determination of PCB in Human Foodstuffs and Tissues: Suggestions for a selective congener approach. Sci. Tot. Environ. 68: 141-159.

Reidman M and Ortiz C L, 1979. Changes in milk composition during lactation in the northen elephant seal. Phys. Zool. 52: 240-9.

Reijnders P J H, 1986. Reproductive failure in common seals feeding on fish from polluted coastal waters. Nature (Lond.) 324: 456-7.

Schweigert F J and Knöppler H O, 1990. Polychlorierte biphenyle im Depotfett von Kegelrobben (Halichoerus grypus) und deren Transfer vom Muttertier mit der Milch zum Säugling. Arch. Lebensmittelhygiene 41: 79-89.