

ORGANOCHLORINE PESTICIDES AND POLYCHLORINATED BIPHENYLS IN GRASS AND YAK SAMPLES FROM A HIGH ALTITUDE PRAIRIE IN QINGHAI-TIBET PLATEAU

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Introduction

Information on global distribution, mass balance, environmental processes and fate of POPs can be obtained from study on POPs distribution in the background areas¹. In highland pastures, there are no agricultural and industrial activities, OCPs and PCBs in milk and yak meat is mainly from atmospheric precipitation of POPs into surface water, grass, and soils. Mass balances of POPs such as PCBs, PCDD/Fs, and PBDEs in cows and grass have been reported to understand the role of the physico-chemical properties of these compounds playing in their transfer and accumulation from feeds to cow muscle tissues and milk²⁻⁶. Little study on OCPs in highland cows has been reported⁶. Yak meat and milk is the main foodstuff for highland residents in central Asia and high plateau regions of the western China. Consumption of these food may be an important exposure route for the local residents to intake POPs. Therefore, understanding of POPs' accumulation from grass to yak meat and milk are important for evaluation of the effect of POPs' long-range transport (LRT) and precipitation on highland pasture residents. In China, only PCBs in butter samples in Lasha, Tibetan have been reported⁷.

Our research area was chosen to be Ruoergai (Zoige) highland wetland located in the eastern edge of the Qinghai-Tibetan Plateau. The altitude of Ruoergai highland is 3500 m in average, with livestock grazing as the main human activities. This study reports the results from a detailed field study conducted to investigate and quantify the OCPs and PCBs levels in grass, yak meat and milk, and to assessment of health risk of local residents' exposure of POPs via uptake of yak meat and milk.

Materials and methods

(1) Grass

Grass samples were mainly *Kobresia* and *Polygonum*. Grass samples were wrapped in clean aluminum foil, stored in sealable plastic bags, and stored at -18 °C until extraction.

(2) Yak muscle tissue, liver, and milk

Yak muscle tissue and liver were purchased from local farmers and yak milk samples were collected in five different farms (Heihe Farm, Tangke, Huahu Lake, Banyou, and National Reserve Area of Ruoergai Wetland). The samples were preserved in refrigerator at -18 °C and transported in ice box to laboratory. The yak samples were minced and homogenized before going through the clean-up procedure.

The extraction and cleanup procedure and HRGC-HRMS analysis for OCPs and PCBs were similar to Ref.8.

Results and discussions

1. OCPs and PCBs in grass in Ruoergai high plateau

The total concentrations of HCHs, DDTs, PCBs in grass samples were in the range of 0.82-2.45, 1.6-6.0, 0.71-2.04 ng g⁻¹ dw, with the means 1.38, 2.88, 1.18 ng g⁻¹ dw, respectively (Fig. 1). HCB, DDE, and PCB28 were most predominant isomers. In the six indicator PCB congeners, PCB28 and 52 are the predominant congeners.

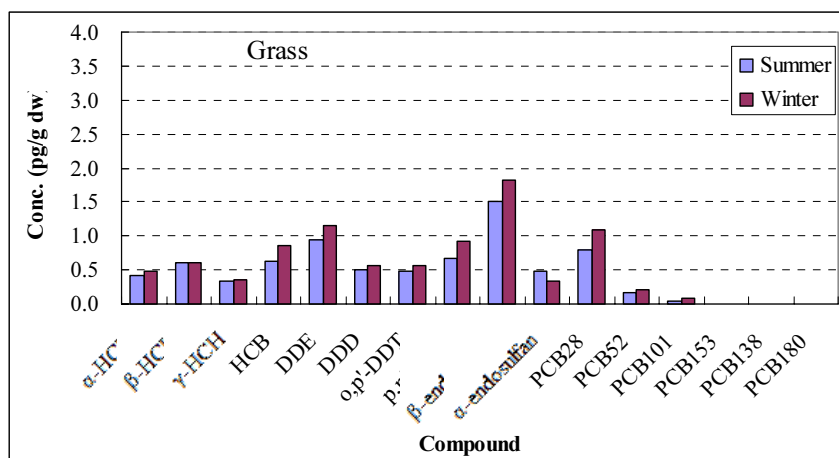


Fig. 1 POP isomer concentrations in grass samples in Ruergai in summer and winter of 2011

POPs concentrations in vegetations are related with their physico-chemical properties⁹. The isomer composition in grass was quite different from that in soils and surface waters (Fig.2). Endosulfan concentrations in the grass were higher than in soils, especially α -endosulfan.

2. OCPs and PCBs in yak samples and health risk assessment

Our results for yak samples (Fig. 3) indicated that the compounds finally accumulated most in yak were β -HCH, γ -HCH, DDE, and α -HCH. HCHs were significantly enriched in yak muscle tissues and liver, but DDTs were basically not accumulated. PCB 28 and 52 were predominant in the PCBs in yak samples. It should be noted that β -HCH was relatively enriched in yak milk, being 4~10 times higher than the other compounds. PCB153, 138, and 180 only accumulated in yak milk. However, the POPs in the yak milk are at the level of pictogram whereas in yak muscle tissues are at nanogram level. Therefore, yak muscle tissue (beef) should be the most concerned yak food-stuff which may pose health risk to human being.

The health risk to the local residents due to intake of OCPs and PCBs via dietary of yak meat and milk can be assessed. The consumption amount of yak meat and milk were based on a survey to the local peoples' dietary habit. The body weight was taken as 60 kg. The assessment results are shown in Table 1. It can be seen that the daily intake of HCHs, DDTs, and PCBs were well less than the Health Canada's ADI, therefore it is safe for the local people to consume the yak meat and milk.

Table 1 Assessment of health risks intake of OCPs and PCBs via dietary of yak meat and milk in Ruergai

Item	Unit	HCB	Σ HCHs	Σ DDTs	Σ PCBs
Yak muscle tissue	ng g ⁻¹ fw	0.7	1.6	0.6	0.346
Yak milk	pg L ⁻¹	58.2	248.7	42.6	24.0
ADI (Health Canada)	μg/person/day	17.0	18.0	1200.0	60.0
Yak muscle tissue consumption	g fw/day	200	200	200	200
Yak milk consumption	L/day	0.5	0.5	0.5	0.5
Average body weight	kg	60	60	60	60
Daily intake via yak tissue	ng	137.25	327	110.5	66.5
Daily intake via milk	pg	0.0291	0.1244	0.0213	0.0120
HR		0.0081	0.0182	0.0001	0.0011

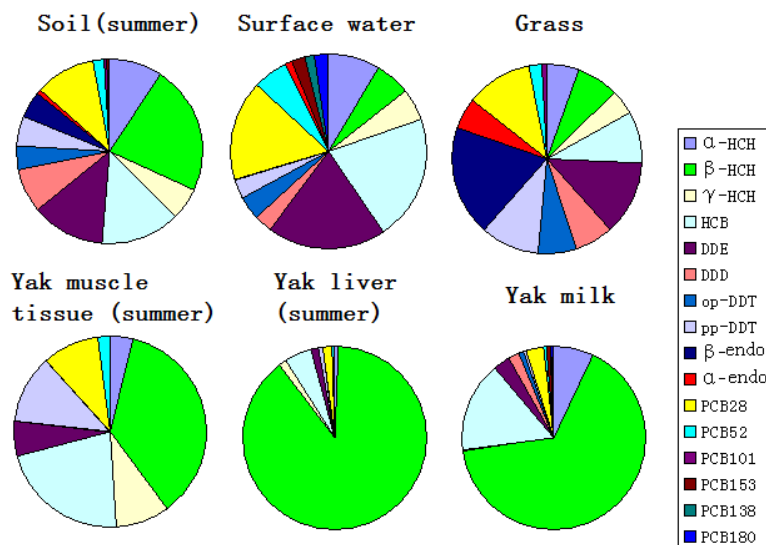


Fig. 2 Relative abundances of isomers of POPs in different media from Ruoergai High Plateau

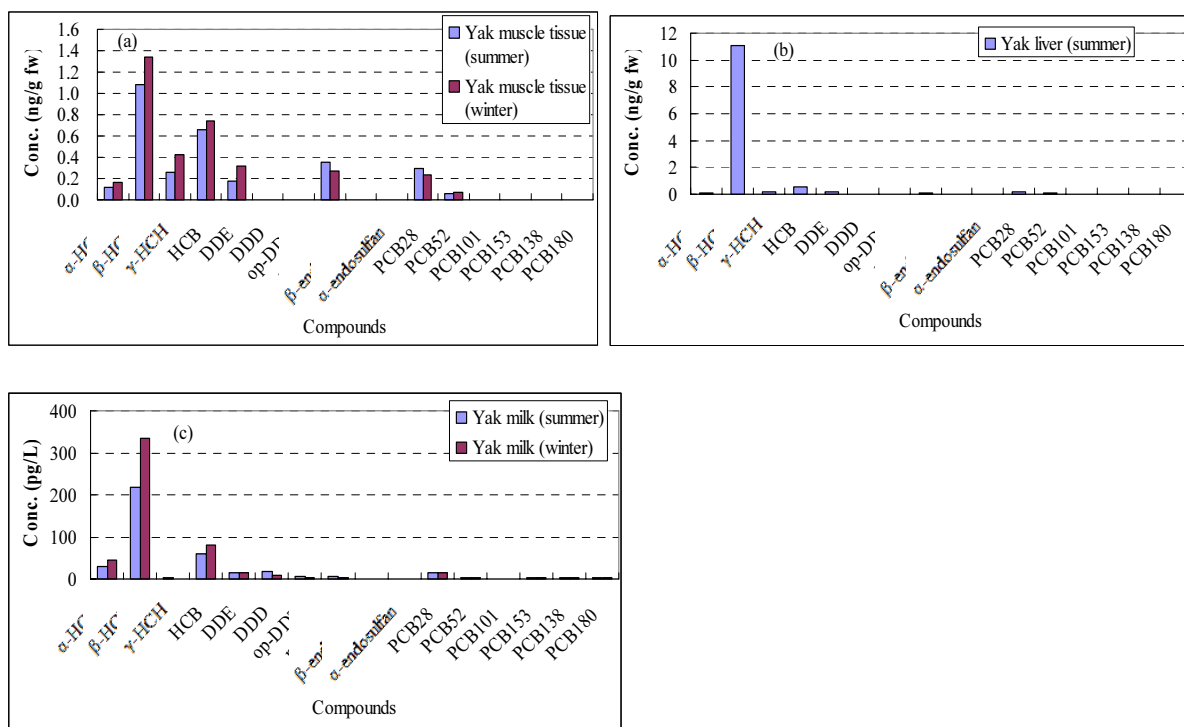


Fig. 3 Concentrations of OCPs and PCBs in (a) yak muscle tissue, (b) liver, and (c) milk samples

Conclusions

The compounds finally accumulated most in yak were β -HCH, γ -HCH, DDE, and α -HCH. HCHs were significantly enriched in yak muscle tissues and liver, but DDTs were basically not accumulated. PCB 28 and 52 were predominant in the PCBs in yak samples. β -HCH was relatively enriched in yak milk, being 4~10 times higher than the other compounds. PCB153, 138, and 180 only accumulated in yak milk. Health risk is assessed for local people's intake of OCPs and PCBs via dietary of yak meat and milk. The daily intake of HCHs, DDTs,

and PCBs were well less than the Health Canada's ADI, therefore it is safe for the local people to consume the yak meat and milk.

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