A SYSTEM FOR SEPARATING EXPIRED FROM INSPIRED
AEROSOL DURING THE INHALATION EXPOSURE OF BEAGLE DOGS.

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A two-way valving system designed to separate expired from inspired air has been built as an integral part of the venturi used to measure a dog's respiration parameters during aerosol inhalation exposures. The exhaled air is collected in a 30-liter meteorological balloon, from which a cascade impactor sample can be drawn while the dog is being exposed. Figure 1 shows the complete valving system, including the fiberglass mask into which the dog fits (lower right) and a filter holder through which air from the balloon may be exhausted after completion of the exposure (upper right). Figure 2 shows the system installed in the dog exposure box. Three female beagles have each been exposed three times to ^{198}Au labelled gold aerosols ($T_{1/2} = 2.7$ days) using this system. Filter paper and cascade impactor samples were used to analyze the inhaled and exhaled aerosol. Total activity in the balloon air was added to activity deposited in the balloon and the exhaust plumbing to obtain the total exhaled activity. Activity retained in the dogs was assessed in a thorax counter 2, 8 and 15-16 days postexposure. All excreta were collected and analyzed for this period, enabling estimates to be made of both total initial deposition (activity retained + activity excreted) and probably alveolar deposition of inhaled gold.

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The results, expressed as a percentage of the measured inhaled activity (total initial deposition + total exhaled activity), are presented in Table 1. A calculated inhaled activity value close to 100% indicates a good balance of materials between the inhaled and exhaled aerosols. The values in the table show that the system used for the third exposure (Figures 1 and 2) gives satisfactory results, though some leakage of air past the dog mask for #1029 caused her inhaled activity to be underestimated.

Both inhaled and exhaled aerosols were log-normally distributed. Exhaled aerosol size distribution results are given only for the third exposure, since the system used for the earlier exposures did not permit samples of the exhaled air to be taken until the end of the exposure, allowing differential deposition of aerosols of different size in the balloon to render the cascade impactor sample results meaningless. An interesting feature of the third exposure data is that there is no significant difference between the AMADs obtained for the inspired and the expired aerosol. However, the GSDs increased to between 1.93 to 1.98 (from 1.65 and 1.71). This meant that the CMD of the aerosols decreased from the range 0.13-0.14 μm in the inspired aerosol to 0.09-0.10 μm in the expired aerosol.

The utility of this system for separating expired from inspired air during inhalation exposures has been demonstrated. The additional information yielded, namely the total initial deposition of inhaled material, the activity exhaled and the relative size distributions of the inhaled and exhaled aerosols, is considerable and the system can be recommended for incorporation in our other dog inhalation exposure chambers.

TABLE 1
EXRT #157DKC

DIRECT DETERMINATION OF TOTAL INITIAL DEPOSITION OF INHALED
¹⁹⁸Au LABELLED GOLD AEROSOLS IN BEAGLE DOGS BY SEPARATION OF
EXPIRED FROM INSPIRED AIR

NOTES: EXPOSURE 1 VALUES AT 1 DAY POST EXPOSURE, 2 AND 3 AT 2 DAYS
ALL VALUES ARE EXPRESSED AS A PERCENTAGE OF MEASURED INHALED ACTIVITY

			DOG # 928 F			DOG # 980 F			DOG # 1029 F		
			EXP.	EXP.	EXP.	EXP.	EXP.	EXP.	EXP.	EXP.	EXP.
			1	2	3	1	2	3	1	2	3
1	CALCULATED INHALED ACTIVITY (CONC. X VOL. INH.)		163	162	96.3	289	140	91.3	160	111	73.3
2	ACTIVITY RETAINED (THORAX COUNT POST EXPOSURE)		51.2	19.5	11.4	78.5	47.5	30.0	60.7	38.9	12.1
3	ACTIVITY EXCRETED (FECES + URINE UP TO THORAX COUNT).		3.4	25.7	54.3	15.0	11.7	37.6	14.5	14.5	51.5
4	TOTAL INITIAL DEPOSITION (2 + 3)		54.7	45.2	65.7	93.4	62.4	67.7	75.2	53.4	63.6
5	ACTIVITY EXHALED DURING EXPOSURE		45.3	54.8	34.3	6.6+	37.6	32.3	24.8	46.6	36.4
6	MEASURED INHALED ACTIVITY IN N.C.		319.3	784.7	3736	1163+	1845	3006	531.5	235.7	2952.
7	AMAD	INH.	0.879	0.940	1.540	0.851	1.083	1.677	1.114	1.214	1.699
	(μ m)	EXH.	-	-	1.647	-	-	1.657	-	-	1.708
8	GSD	INH.	2.251	1.949	1.747	2.241	1.778	1.785	2.286	1.742	1.756
		EXH.	-	-	1.978	-	-	1.931	-	-	1.934
9	CMD	INH.	0.025	0.001	0.130	0.025	0.084	0.133	0.030	0.102	0.142
	(μ m)	EXH.	-	-	0.088	-	-	0.098	-	-	0.100

† THESE VALUES ARE UNDER ESTIMATES, SINCE AN UNKNOWN QUANTITY OF AIR ESCAPED FROM THE BALLOON.