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Penetration of polydimethylsiloxanes (PDMS) to nervous tissue of rats

RAPID COMMUNICATION

Summary — Penetration of various forms of PDMS from alimentary tract of rats to their blood, urine and brain has been described. The groups or rats were supplied with PDMS either with food or directly to the stomach (tables 1 and 2). Possibility of organism penetration (espescially nervous tissue) with PDMS using lymphatic path has been proposed.
Key words: polydimethylsiloxanes, penetration from alimentary tract, nervous tissue

Our to-date research on the absorption of polydimethylsiloxanes (PDMS) by oral supplying and their further distribution in tissues [1—5] aimed above all at the verification of the views on the lack of absorbability of PDMS from the alimentary tract [6], and led to an approximate description of the pharmacokinetics of PDMS in rats.

The detectable quantities of PDMS in blood of the rats appear already after 1 hour, reaching the maximum value usually after 5 hours, and subsequently they drop to non-measurable values. The phenomenon of the elimination of PDMS from blood is accompanied by the accumulation of compounds in animal internal organs, among others in the brain (already after 24 hours), kidneys, and spleen. The excretion takes place mainly with excrements, and slightly less intensively through kidneys [2].

Further research also examined to what degree both linear PDMS and cyclic PDMS (cPDMS) may be absorbed from various matrices. The research was conducted using a group of 3-month rats of the Wistar strain, weighing 150—200 g. One group of animals (10 rats) was fed with granulated LSM maintenance feed (Feed Manufacturing Plant, Motycz, Poland) containing 5% PDMS and cPDMS [1—3]. The experiment was conducted for 12 days, the animals were sacrificed after 1, 5 and 24 hours, and after 24 hours on the 12th day after the final dose getting. Whenever it was possible, whole blood and organs were taken for tests.

In the case of the other groups of animals, the materials for tests — blood and brain were taken after 5 and 24 hours and on the 7th day after 24 hours after the final dose of the preparation getting. The urine taken for analysis was 24-hour average urine of two animals.

A group of 12 experimental animals was fed with "Esputicon" (drops, Pharma Synteza, Poznań, Poland) or "Espumisan 40" (emulsion, Berlin-Chemie AG, Germany) directly to the stomach by means of a stomach tube. The doses of the medicines were calculated according to the manufacturers' instructions, taking into account the weight of the animals. The third group of rats was fed with "Silol OM-1000" (Chemical Plant Organika-Sarzyna, Nowa Sarzyna, Poland) directly to the stomach by means of a stomach tube, whereas the fourth group of 6 rats was given daily, directly to the stomach by means of a stomach tube, 1 cm^3 of silicone oil "Silol OM-300" (Chemical Plant Organika-Sarzyna, Nowa Sarzyna, Poland), *i.e.* silicones of the viscosities applied in the manufacture of medicines. Table 1 presents the results of the determined contents of PDMS in rats organisms.

The results of the analysis of the ^1H NMR spectra of the extracts from the micronised brains as well as blood samples demonstrated that apart from the signals of PDMS (δ 0,2 ppm), there were quite frequent signals lying below δ 0,1 ppm. These signals may indicate the *in vivo* biodegradation process and the appearance of the products of this process — that is oligomeric forms of PDMS — in the organism [7].

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Table 1. Mean amounts of PDMS in the brain, blood, and urine of animals tested

Number of rats observed, n	Mean amounts of PDMS in n-element sample, [μg] ± SD (min.; max.)			NOTES
	blood	urine	brain	
12	1,4 ± 3,8 (0; 13,8)	0,0	2,6 ± 4,3 (0; 22)	"Esputicon"; "Espumisan" [b]
10	1,1 ± 0,8 (0; 3,9)	1,9 ± 1,7 (0; 7,3)	5,2 ± 5,9 (4,6; 18,6)	OM-1000 [a), b)]
6	150 ± 91 (20; 230)	3,1 ± 2,5 (0,4; 5,8)	5,1 ± 5,8 (0; 20,3)	OM-300 [a), b)]
4	156 ± 139 (45; 360)	—	0,0	cPDMS [a)]
9	0,0	0,0	0,0	Control group (3 animals in each experiment)

[a)] Directly to a stomach through stomach tube
[b)] Samples taken after 5 hrs; 24 hrs and 7 days — after 24 hrs from last dose supplying

Table 2. Frequency of the detection of PDMS or products of its biodegradation in the tissues of animals tested

Number of rats observed	Number of animals in which PDMS or biodegradation products were detected and marked				Notes
	blood	urine	brain	generally	
10	7	10	7	10	Fed with 5% PDMS added
12	9	0	5	10	"Espumisan"; "Esputicon"
10	3	6	6	7	Silicone oil OM-1000 [a)]
6	0	4	4	6	Silicone oil OM-300 [a)]
9	0	0	0	0	Control group

[a)] Directly to a stomach through stomach tube

The relatively high frequency of the detection of PDMS supplied in various matrices in the brain (Table 2) suggests the penetration of this type of compounds to the nervous tissue. In order to confirm these analytical observations, the Chair of Anatomy of the Medical University in Gdańsk did histochemical tests, which demonstrated that cerebral leptomeninges and white matter of the animals tested were particularly strongly saturated with silicones. This may be evidence for a lymphatic (lipophilic) mechanism of PDMS distribution in the organisms of rats [8].

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