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Changes in Blood Glucose level induced by Sodium Dodecylbenzene Sulfonate (SDBS) in Rats

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With 2 tables and 4 figures

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The linear alkylbenzene sulfonate is considered to be harmless to the organism according to results described by *Buehler* (1) and by other data reported. These investigations are mainly concerned with changes in body weight, hematological parameters and reproduction data, respectively. Few data are, however, available in the literature dealing with metabolic alterations induced by detergents. According to our previous experiments (2) the glucose tolerance was impaired in male rats fed SDBS (0,25 g/kg body weight) for 4 weeks. Following a single oral loading of detergent the time course of the blood glucose curve was similar to that being observed after glucose loading.

In the present study fasting blood glucose levels and glucose tolerance curves were investigated in rats fed SDBS for 3 months.

Methods

From the stock of our institute 40 male and 50 female albino rats with an average weight of 160 g and 180 g, were fed SDBS in a daily dose of 0,25 g/kg body weight mixed into their diet for 3 months. At the end of the third month the animals were divided into 4–4 groups, and the blood glucose was estimated. The animals were treated as follows:

Group I	Distilled water	1 ml/100 g body weight
Group II	Glucose	0,610 g/ml/100 g body weight
Group III	SDBS	0,094 g/ml/100 g body weight
Group IV	Glucose	0,610 g/ml/100 g body weight
	and SDBS	0,094 g/ml/100 g body weight.

All solutions were administered by a gastric tube.

In each group the number of animals was 10, except the female group IV (20 rats).

The diets were given to the animals in a semi-solid form.

The food consumption was the same in each group.

The animals were fasted for 18 hours. Fasting blood glucose levels and levels after loading were measured in the blood samples withdrawn from the tail every 30 minutes over 180 minutes. Blood glucose level was determined according to the orthotoluidine method described by *Bakos* (3).

Statistical analyses were done by *Student's* t-test.

Results

At the end of the 3rd month the average weight of the male rats was 350 g, while that of females 250 g. No differences were observed in the rate of growth between experimental and control groups.

*) The skilful technical assistance of Mrs. H. Asbóth is highly acknowledged.

The effect of a single large dose of detergent given by tube on the blood glucose levels in detergent pretreated and control male and female rats is illustrated in table 1. Due to the effect exerted by the detergent the blood glucose level was increased related to that of the controls treated with distilled water.

Table 2 represents the data obtained in detergent pretreated and control rats following glucose loading. No difference could be found between the two groups of male rats. In females the blood glucose level was significantly higher in the 30th minute and significantly lower in the 90th and 120th minutes as related to the controls.

The time courses of blood glucose levels after glucose and detergent and glucose loading, respectively, are shown in the figures:

Fig. 1 illustrates the data of male control groups. As a result of combined glucose + detergent loading at the 30th and 60th minute higher, from the 120th minute lower blood glucose levels were measured related to levels obtained after a simple glucose loading.

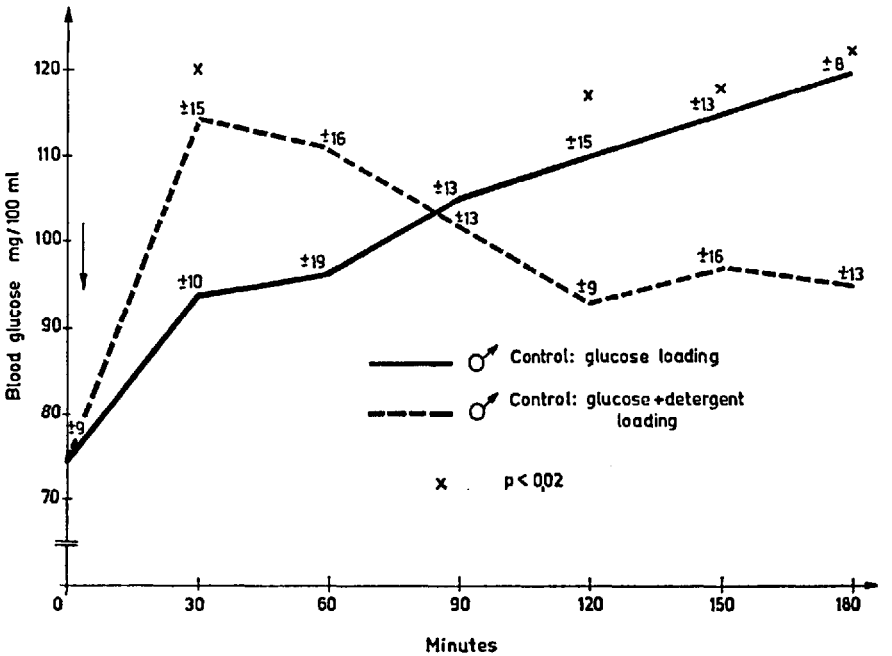

Fig. 1. Effect of glucose and glucose and detergent loading on the blood glucose levels in the control male rats.

Fig. 2 shows the results of detergent pretreated male animals. The time courses of blood glucose levels are similar to those of the controls. In one case, in the 30th minute, however, a high individual value of over 150 mg per cent was obtained due to the effect of detergent and glucose administration.

Fig. 3 illustrates the curves of female controls, indicating individual values. Due to the effect of the two kinds of loadings the levels of blood

Table 1. Acute effect of detergent on the levels of blood glucose in detergent treated and control rats

Sex	Group	Dose of detergent	0′	30′	60′	90′	120′	150′	180′
♂	Detergent pretreated	94 mg/100 g body weight	77 ± 10	81 ± 10	111 ± 27	101 ± 23	102 ± 17	94 ± 16	94 ± 17
		0	77 ± 10	73 ± 7	75 ± 10[3])	69 ± 6[3])	71 ± 12[3])	68 ± 11[3])	65 ± 10[3])
	Control	94 mg/100 g body weight	74 ± 9	82 ± 9	90 ± 14	91 ± 15	94 ± 13	86 ± 14	83 ± 14
		0	74 ± 9	81 ± 10	72 ± 10[1])	70 ± 13[1])	72 ± 10[1])	70 ± 13[1])	66 ± 11[1])
♀	Detergent pretreated	94 mg/100 g body weight	78 ± 10	103 ± 26	108 ± 24	98 ± 19	96 ± 29	97 ± 35	96 ± 28
		0	78 ± 10	74 ± 12[2])	73 ± 10[3])	72 ± 8[3])	70 ± 11[1])	71 ± 14	74 ± 11[1])
	Control	94 mg/100 g body weight	77 ± 7	97 ± 21	101 ± 17	102 ± 24	93 ± 20	86 ± 22	99 ± 21
		0	77 ± 7	76 ± 8[1])	80 ± 6[3])	76 ± 4[3])	74 ± 7[3])	75 ± 12	74 ± 8[3])

[1]) $p < 0,05$ [2]) $p < 0,02$ [3]) $p < 0,01$

Table 2. Effect of glucose loading on the levels of blood glucose in detergent treated and control rats

Sex	Group	Dose of glucose	0′	30′	60′	90′	120′	150′	180′
♂	Detergent pretreated	610 mg/100 g body weight	77 ± 10	97 ± 15	99 ± 11	101 ± 13	116 ± 19	116 ± 26	118 ± 17
	Control	610 mg/100 g body weight	74 ± 9	94 ± 10	96 ± 19	105 ± 13	110 ± 15	115 ± 13	120 ± 8
♀	Detergent pretreated	610 mg/100 g body weight	78 ± 10	128 ± 19	113 ± 13	106 ± 17	100 ± 13	105 ± 14	103 ± 19
	Control	610 mg/100 g body weight	77 ± 7	111 ± 14[1])	117 ± 11	123 ± 16[1])	111 ± 9[1])	108 ± 17	118 ± 16[2])

[1]) $p < 0,05$ [2]) $p < 0,1$

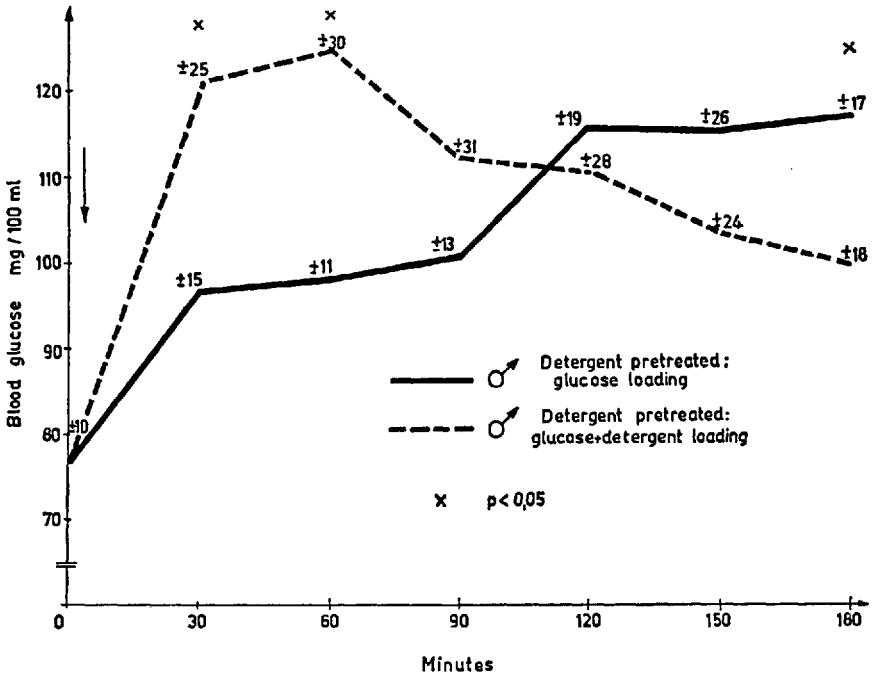

Fig. 2. Effect of glucose and glucose and detergent loading on the blood glucose levels in the detergent pretreated male rats.

glucose followed similar time courses. However, in the detergent and glucose treated group in the 30th minute one, in the 60th and 90th minute four, and in the 120th, 150th and 180th minute three values reach or exceed a blood glucose level of 150 per cent.

Fig. 4 shows the curves of female detergent pretreated animals; the individual values are also indicated. As a result of detergent and glucose treatment the levels of blood glucose are higher during the whole course of the investigation, and in the 30th minute eleven, in the 60th minute eight, in the 90th minute five, in the 120th minute three, in the 150th minute four, and in the 180th minute six values reach or exceed the value of 150 mg per cent. The average value even in the 150th minute exceeds the level of 130 mg per cent. Due to the effect of glucose loading the blood glucose level exceeded the value of 150 mg per cent only in two cases in the 30th minute.

Discussion

Both in our previous and in the present investigations rats were treated with SDBS of the same amount for 4 weeks or 3 months, respectively. The amounts of glucose or detergent loads calculated for body weight were also identical.

Due to the effect of a single oral detergent loading the levels of blood glucose were found elevated in both series of experiments. In this series the rate of elevation is more pronounced both in control or detergent

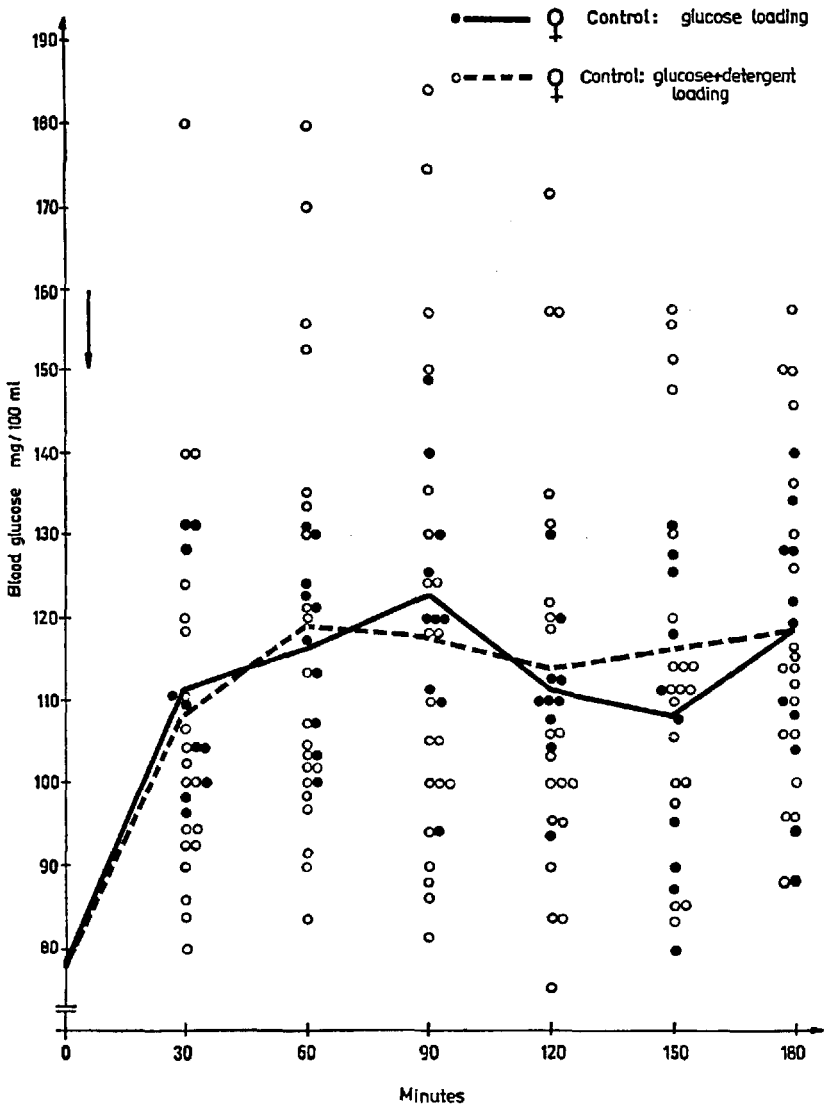

Fig. 3. Effect of glucose and glucose and detergent loading on the blood glucose levels in the control female rats.

pretreated animals than in that of our earlier experiment. Rats of higher age seem to react more sensitively to a single detergent challenge.

Due to the effect of glucose loading, blood glucose curves of male control and experimental rats followed the same time course, whereas in the experimental group of female rats blood glucose level reached its maximum in the 30th minute, while in the controls in the 90th minute.

Zsinka (4) has found impaired glucose tolerance in young offsprings of SDBS fed pregnant rats. *Budavári* (5) has reported increased glucose

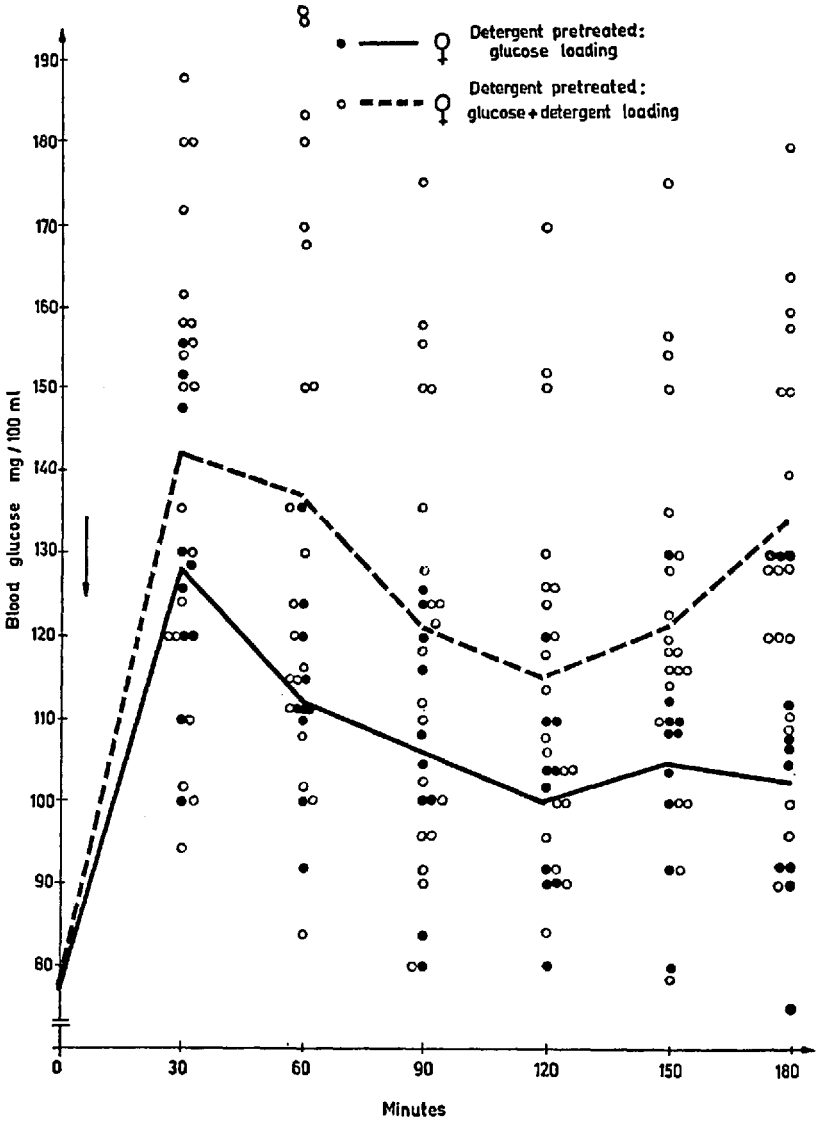

Fig. 4. Effect of glucose and glucose and detergent loading on the blood glucose levels in the detergent pretreated female rats.

sensitivity 12 days after the intravenous administrations of single doses of different kinds of surface active agents. In our previous experiments (2), we have found higher blood glucose levels than the controls after glucose loading in male rats fed SDBS for 4 weeks. According to our and other literary data glucose tolerance seems to depend on the length of the period of detergent feeding. It is of interest to investigate the length of the period of detergent exposition required for the development of maximal glucose sensitivity and also to decide when it ceases.

A difference was also found between the male and female animals concerning the reaction developed after a single detergent and glucose loading: Female animals appear to react more sensitively. As a result of combined detergent and glucose loading, individual levels of blood glucose over 150 mg per cent were measured several times in controls but even more often in detergent pretreated groups. The elevation of blood glucose levels may partially be a consequence of altered absorption. The decrease in cellular uptake of glucose is also suggested to be another possibility of a serious impairment in glucose tolerance. According to investigations made in erythrocytes in vitro (6, 7) Triton X-100 and Triton WR 1339 were shown to increase the hydratation of membrane proteins and decrease the glucose uptake. Glucose uptake of the isolated rat heart is significantly decreased when the perfusion medium contained 50 mg per cent of Na-cholate (8).

In some instances a single dose of epinephrine (5 μg/100 g body weight) was injected subcutaneously to control and detergent pretreated (for 3 months) female rats. The blood glucose curves of the two groups followed the same time courses, i.e. no increase in epinephrine sensitivity was observed in the experimental group either.

The results of these investigations suggest that the reactions developing in male and female animals due to the effect of detergent are not always the same. Glucose sensitivity is more pronounced in female rats. It is of particular interest that in female animals due to the effect of a combined glucose and detergent loading even in controls but more significantly in detergent pretreated rats high blood glucose levels were found.

Moncrieff (9) suggests that some individuals may develop idiosyncratic sensitivity to detergents. In every day life the possibility of the combined ingestion of detergents and carbohydrates could not be excluded.

Summary

Male and female rats were fed SDBS (0,25 g/kg body weight/day) for three months. At the end of the 3rd month both the control and experimental group was orally loaded with detergent, or glucose, or detergent and glucose.

Due to the effect of a single large dose of detergent loading both in the experimental and the control group the curves of blood glucose levels followed similar time course to the one observed after glucose loading.

After a glucose loading the blood glucose levels were higher in the 30th minute in the detergent pretreated female rats, whereas in the 90th minute they were lower as related to those of the controls.

The blood glucose levels were higher at the beginning and lower at the end of the experimential period in the detergent and glucose treated male group as compared to the levels of the glucose loaded males.

In female groups after glucose and detergent loading even in the controls, but particularly in the detergent pretreated group the levels of blood glucose exceeded the value of 150 mg per cent in several instances.

Zusammenfassung

Dodezylbenzolsulfonsaures Natrium wurde an männliche und weibliche weiße Ratten in einer Dosierung von 0,25 g/kg Körpergewicht täglich drei Monate lang verfüttert. Am Ende der Versuchsperiode wurden in den Kontroll- und Untersuchungsgruppen Belastungen mit Detergens bzw. Glucose und mit Detergens und Glucose durchgeführt.

Nach einer großen Einzeldose des Detergens konnte bei den Kontroll- und Untersuchungsgruppen ein ähnlicher Blutzuckerkurvenverlauf beobachtet werden.

Bei den mit Detergens vorbehandelten weiblichen Ratten waren die Blutzuckerwerte 30 Minuten nach der Glucosebelastung niedriger, 90 Minuten nach der Belastung höher als bei den Kontrolltieren.

Nach der Belastung mit Detergens und Glucose waren bei den männlichen Kontroll- und Versuchsgruppen im Vergleich zur Glucosebelastung anfangs höhere, später jedoch niedrigere Blutzuckerwerte zu verzeichnen.

Der kombinierten Belastung mit Detergens und Glucose folgend wurden bei den Kontrolltieren und noch eher bei den mit Detergens vorbehandelten weiblichen Ratten häufig Blutzuckerwerte über 150 mg% gemessen.

Literatur

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