Acta vet. scand. 1963, 4, 92—96.

From the Department of Clinical Biochemistry and the Medical Department for Non-Ruminants, Royal Veterinary College, Stockholm, Sweden.

DISTRIBUTION OF SE^{75}-TAGGED SODIUM SELENITE IN PIGS WITH NUTRITIONAL MUSCULAR DYSTROPHY

By

Lars Ekman, Kerstin Orstadius and *Bertil Åberg*

Recently, *Orstadius & Åberg* (1961) published results obtained from healthy pigs which were given Se^{75}-tagged sodium selenite. This was done in order to elucidate possible health hazards with sodium selenite treatment of pigs with muscular dystrophy (MD). The values received did not point towards any health hazards for man with such a treatment. However, it is well known that during some diseases various substances are metabolized in a different way than during healthy conditions. Furthermore selenium uptake of muscles might be changed in MD. It was therefore decided to repeat the experiments with pigs having nutritional MD (and liver dystrophy (LD)). Furthermore, *Grant et al.* (1961) studied selenium distribution in pigs with activation analysis.

MATERIAL AND METHODS

Pigs: Ten healthy pigs weighing 16—25 kg. were used. The breed was the Swedish Land Breed and both females and castrated males were represented. The pigs were fed with heated cottonseed oil and heated mixed grain according to *Lindberg & Orstadius* (1961) and *Orstadius et al.* (1962); this diet provoked MD which in some pigs was combined with LD. The diseases were diagnosed clinically and by transaminase determinations *(Orstadius et al.,* 1959). Transaminase determinations (GOT and OCT)[1])

[1]) GOT = Glutamic-oxaloacetic transaminase. OCT = ornithine carbamyl transferase.

were performed on blood plasma by the methods of *Reitman & Frankel* (1957) and *Reichard* (1957).

Sodium selenite — Se^{75}: Se^{75}-tagged sodium selenite was obtained from Amersham, England. The specific activity was 200 mC per g. From this preparation 200 uC were administered intramuscularly as a single injection. This corresponds to 0.46 mg. of selenium and thus extra selenium as sodium selenite was added so as to ensure that the selenium dose always was 0.06 mg. per kg. body-weight.

Preparation of samples and radioactivity measurements: The pigs were slaughtered 1, 3, 8, 15 and 22 days respectively after selenite administration with the exception of pig no. 70/34 who died spontaneously between the 12th and 24th hour. Blood samples were taken every second day. Heparin was added. The organs were removed at slaughter. The radioactivity of the blood was measured on 2 ml. samples in a well scintillation crystal. Organs were wetashed according to *Ekman* (1961) and measurements were performed in the well crystal on 5 ml. samples. For the Se^{75}-standard, 0.04 uC of Se^{75}-tagged sodium selenite was prepared simultaneously with the samples injected.

The results of the radioactivity measurements were expressed as the percentage of dose administered per kg. body-weight that was found in one kg. of organ examined. Radioactivity in blood was expressed as the percentage of original dose per kg. body-weight found in one ml. of blood. This value was furthermore corrected for total body-weight of the pig at the time of blood sampling because of the increase in body-weight during the experiments.

RESULTS

Radioselenium in blood: Table I shows the percentage of the dose per kg. body-weight per ml. whole blood. The concentration curves for the pigs no. 70/17 and 70/20 gives a single exponential function corresponding to biological half lives of 18 and 24 days respectively. It is noteworthy that a single exponential course seems to be reached already after 24 hours.

Radioselenium in organs at slaughter: In Table II the contents of Se^{75} in the tissues examined are expressed as the percentage of original dose per kg. body-weight found in one kg. of organ examined.

Table I. Blood concentration (per cent of dose per kg. by body-weight per ml.).

Pig no.	Days after the administration of Se^{75}													
	1	2	3	5	7	8	9	12	14	15	16	19	21	22
70/6	0.095													
70/34	0.168													
70/10		0.058	0.051											
70/30		0.094	0.078											
70/12		0.090		0.074	0.059	0.063								
70/23		0.056		0.043	0.040	0.040								
70/14		0.112		0.094	0.068		0.066	0.058	0.053	0.050				
70/22		0.058		0.043	0.040		0.039	0.035	0.033	0.038				
70/17		0.101		0.078	0.070		0.072	0.086	0.055		0.051	0.050	0.044	0.042
70/20		0.050		0.044	0.042		0.054	0.043	0.035		0.033	0.030	0.029	0.028

Table II. Concentration of Se^{75} in certain tissues and plasma enzyme values at the time of killing.

Pig no.	Status of the pigs	μC of Se	Extra Carrier Se mg.	Route	Weight	Killed days after administration	GOT enzyme units	OCT enzyme units	Per cent of original dose per kg. body-weight per kg. of organ						
									Kidney	Liver	Heart	Tounge	Muscle	Fat	Skin
70/6	MD + LD	200	0.98	intra-muscular	22.4	1	214	6.1	83.6	27.2	9.42	6.08	3.05	1.43	2.08
70/34	MD + LD	„	0.86	„	20.2	1[1])	2500	107	93.9	*76.9*	*27.7*	7.35	*5.48*	2.08	3.93
70/10	MD	„	0.92	„	21.0	3	67	3.3	100.7	26.2	6.66	4.34	2.74	1.34	1.68
70/30	MD	„	0.98	„	21.8	3	380	2.2	106.0	26.9	7.02	4.83	2.12	0.86	2.40
70/12	Healthy	„	0.92	„	21.4	8	51	—	128.6	16.5	7.62	4.80	1.32	2.15	2.34
70/23	MD	„	0.86	„	20.3	8	114	2.2	86.1	9.32	5.43	4.43	1.74	1.37	1.48
70/14	Healthy	„	0.78	„	16.7	15	34.5	—	88.6	8.99	6.38	4.14	1.23	0.81	1.45
70/22	MD	„	0.86	„	20.2	15	87.5	1.7	62.3	7.29	4.18	3.71	1.40	0.77	1.38
70/17	MD	„	1.16	„	24.7	22	141	1.7	80.2	7.65	6.74	3.34	1.40	0.72	1.92
70/20	MD	„	0.86	„	20.0	22	156	1.7	57.3	5.31	4.61	3.58	1.28	2.02	1.36

[1]) This pig died 12—24 hours after receiving Se^{75}.

DISCUSSION

From the transaminase determinations it is obvious (*Orstadius et al.* 1959) that the pigs in the present investigation had MD (and in 2 cases LD, too) with the exception of pigs no. 70/12 and 70/14 which were healthy (Table II). Furthermore, the diagnosis were verified at postmortem examination (*Magnusson & Orstadius* 1962).

When the values of the present investigation are compared with those given by *Orstadius & Åberg* (1961) for healthy animals, it is evident that diseased animals do not concentrate more selenium in the muscles than healthy ones. The healthy pigs of the present investigation showed values comparable with the diseased ones.

Grant et al. (1961) concluded that only kidneys show a high concentration of selenium. This coincides with the present investigation as well as that of *Orstadius & Åberg* (1961). The conclusions of *Grant et al.* (1961) that selenium should only be used as an emergency and auxiliary solution because of hygienic points of view, are not favoured by the results here presented. However, it is obvious that care must be taken not to overfeed pigs with selenium salts, and furthermore that, at least during the 14 days before slaughter no selenium should be administered.

REFERENCES

Ekman, L.: Distribution and excretion of radio-cesium in goats, pigs and hens. Acta vet. scand. 1961, *2*, suppl. 4.

Grant, C. A., Thafvelin, B. and Christell, R.: Retention of Selenium by Pig Tissues. Acta pharm. toxicol. scand. 1961, *18*, 285—297.

Lindberg, P. and Orstadius K.: Production of muscular dystrophy in pigs by feeding cottonseed oil. Acta vet. scand. 1961, *2*, 226—235.

Magnusson, G. and Orstadius, K.: Relation between the plasma level of glutamic-oxaloacetic transaminase and the morphological status of skeletal muscle in pigs. In press.

Orstadius, K., Nordström, G. and Lannek, N.: Combined therapy with vitamin E and selenite in experimental nutritional muscular dystrophy of pigs. In press.

Orstadius, K., Wretlind, B., Lindberg, P., Nordström, G. and Lannek, N.: Plasma-transaminase and transferase activities in pigs affected with muscular and liver dystrophy. Zbl. Vet. Med. 1959, *6*, 971—980.

Orstadius, K. and Åberg, B.: Distribution of Se^{75}-tagged sodium selenite in pigs. Acta vet. scand. 1961, *2*, 60—67.

Reichard, H.: Determination of ornithine carbamyl transferase with microdiffusion technique. Scand. J. clin. Lab. Invest. 1957, *9*, 311—314.

Reitman, S. and Frankel, S.: A colorimetric method for the determination of serum glutamic oxalacetic and glutamic pyruvic transaminases. Amer. J. clin. Path. 1957, *28*, 56—63.

SUMMARY

Sodium-selenite-Se^{75} was given as an intramuscular injection to pigs fed on a dystrophogenic diet. An examination for radioactivity of organs at slaughter 1 to 22 days after administration showed that pigs affected with muscular (and liver) dystrophy did not concentrate more selenium in muscles and organs than do healthy animals.

ZUSAMMENFASSUNG

Verteilung von Se^{75}-gekennzeichnetem Natriumselenit bei Ferkeln mit diätbedingter Muskeldystrophie.

Den Ferkeln gehalten bei einer Muskeldystrophieerzeugender Diät, wurde intramuskulär eine Injektion Natriumselenit-Se^{75} gegeben. Die Feststellung des Radioselen-Gehaltes in Organen der geschlachteten Ferkeln nach 1 bis 22 Tage ergab, dass die Ferkeln mit einer Muskeldystrophie (und gleichzeitiger Leberdystrophie) nicht mehr Selen in der Muskulatur und den Organen konzentrierten als gesunde Tiere.

SAMMANFATTNING

Fördelning av Se^{75}-märkt natriumselenit hos grisar med utfodringsbetingad muskeldystrofi.

Natriumselenit-Se^{75} gavs som en intramuskulär injektion till grisar, som stod på en muskeldystrofiframkallande diet. En undersökning av radioselen-halten i grisarnas organ vid slakt 1—22 dagar senare visade att grisar med muskeldystrofi (och leverdystrofi) inte koncentrerade mera selen i muskulatur och organ än friska djur.

(Received September 26. 1962).