THE ACTION OF SELENIUM SALTS ON RED BLOOD CORPUSCLES

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While investigating the action of selenium salts, it was noticed that there was produced a marked effect on the red blood corpuscles, and as the action appeared to be an haemolytic one, this work was undertaken to investigate its action.

As was shown in the paper referred to, the soluble salts are reduced in the body by some reducing substance, in this case probably glucose, and the insoluble amorphous selenium becomes deposited in the cells, and can be demonstrated as a golden-brown deposit in the cells. Part of the selenium is excreted as soluble salts by the kidneys, part is excreted by the bile and large intestine, and part as methyl-selenide is excreted in the breath.

In these experiments rats were used. Owing to the extreme ease with which sodium selenite is reduced, all doses were given hypodermically and were freshly-prepared. Blood films were prepared in the usual way, dried without heating and stained with Leishmann's stain. Each film being prepared and stained in the same manner.

The first rat was given 0.3 cubic centimetre of 0.125 per cent. solution of sodium selenite. The blood was examined and found to be normal.

Very shortly afterwards there appeared an increase in lymphocytes; the polymorphonuclear leucocytes remained normal, so that there appeared twice as many lymphocytes as other leucocytes. The red blood cells, at the same time, had developed a cloudy white centre (fig. 1).

This was followed by the almost complete disappearance of leucocytes and the development of the cloudy centres described above into vacuoles. Some have one central vacuole of varied shape, while others have several small ones, and it is probable, as will be seen later, that most of these vacuoles are at first central and gradually move towards the periphery (fig. 2).

The rat was now evidently very ill; it was left till next day to see if the blood cells would recover. Next day its blood was normal again.

It was again given an hypodermic injection, and the blood again went through the same changes, namely increase of lymphocytes, development of a cloudy white centre in many of the red blood corpuscles, disappearance of leucocytes, and vacuolation of many of the red blood cells. It was given another hypodermic injection of the same amount.

The vacuolation became more marked, the vacuoles increasing in number and working towards the periphery. In one or two instances the vacuole was seen opening into the blood stream, and occasional corpuscles were seen that had extruded the vacuole (fig. 3).

The movement of the vacuoles to the periphery appeared to be accelerated, a large number of red cells having numbers of vacuoles all round the periphery of the cell (fig. 4).

The films now commenced to stain very badly. Many of the red blood cells, as will be seen in fig. 5, showed the extrusion of buds all round the periphery.

The next films stained hardly at all, indeed, it was difficult to see that any staining had been attempted. The rat was now extremely ill. The next few films showed little difference from fig. 5, but an hour later there was a distinct improvement: the films commenced to take the stain again, the red blood cells began to lose their vacuoles, and the rat was evidently recovering. Large numbers of polymorphonuclear leucocytes and lymphocytes were present. An hour later, except for occasional red blood cells with vacuoles, the blood appeared normal, and next day the blood was normal.

This recovery is interesting, for if this is a condition of haemolysis, as will be shown in the next experiment, the quick recovery must be due to the re-absorption of haemoglobin into the red blood cells that are not too injured to recover. For it is evident, that when the conditions that cause the haemolysis are removed, the red blood cells are able to prevent any further loss, and also to make good the loss which they have previously gone through.

These experiments were repeated with the same results. A second rat was given 0.6 cubic centimetre of 0.125 per cent. solution of sodium selenite hypodermically; the time from the injection to the death of the animal was about two hours.

The blood when first examined was normal. It was seen to go through the same changes as the previous one, the increase of lymphocytes with the white filmy centres in many of the red blood cells, followed by the presence of vacuoles which moved to the edge of the cells and were extruded. The polymorphonuclear leucocytes became scarce, and were swollen, and in some cases disintegrated. The film stained badly and, finally, the corpuscles would not take the stain at all.

The rat now developed profound dyspnoea, convulsions appeared and death very quickly followed.

The blood was removed from the animal and was found to have undergone haemolysis.

No haemolysis was produced by sodium selenite in test-tube experiments.

CONCLUSIONS

Although sodium selenite does not produce haemolysis outside the body, yet it has that effect when injected hypodermically into the tissues of the animal.

The cause of this haemolysis is obscure. Sodium selenite is reduced to selenium in the portal circulation, chiefly in the spleen and liver unless a very large dose is given, in which case it floods the whole system and selenium is found in all the organs; but in the doses given in the previous experiments the reduction took place in the spleen and liver. This is confirmed by the fact that only a proportion of the red cells undergo these changes. In a film one part will be found almost entirely changed, another portion almost entirely normal, while a third portion will show clumps of changed cells and clumps of normal ones, just as one would expect if the portal red blood cells alone became changed and then became mixed with the normal systemic blood. The only other factor which might have some action is the remarkable disappearance of glycogen and sugar which the soluble selenium salts cause, but what effect this would produce it is impossible to say.

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FIG. 1

FIG. 2

FIG. 3

FIG. 4

FIG. 5

FIG. 6