THE EFFECT OF LIGHT ON THE RESPIRATION OF SPERMATOZOA

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Received June 26, 1961

Starting with the work of Warburg (1915) numerous studies have been carried out on the respiration of spermatozoa (Mann, 1954; Rothschild, 1956). Although many factors have been studied that influence respiration of sperm, such as substrates, inhibitors and physical handling, apparently the effect of incidental room light has been overlooked. The present report is concerned with the initiation of respiration of spermatozoa by light.

The first experiments were conducted with rabbit sperm obtained by artificial vagina. Semen was diluted with an equal volume of Krebs-Ringers phosphate (K-R-P) solution ($CaCl_2$ omitted) and centrifuged 8 min. at 102 r.c.f. This washing and centrifugation was repeated once. The heavy sperm suspensions were then added to ordinary clear Warburg flasks or to flasks coated with a heavy layer of black paint. The flasks contained K-R-P solution, 5 mg of streptomycin and KOH in the center cup. In experiment 1, Table 1, the sensitivity of sperm activation by light was not fully appreciated and the sperm were collected and centrifuged in rooms with considerable daylight. Even so, exposure to light during the Warburg experiment more than doubled the rate of respiration. In subsequent experiments extreme precautions were taken to protect the sperm from light. All glass-

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ware was painted black, semen was collected with least possible light exposure and the centrifuging and washing carried out in total darkness. Consequently, as shown in Table 1, in experiments 2 to 5 respiration in the dark approached zero. In experiment 3 a portion of the sperm suspension was incubated in the dark for 6 hr with K-R-P plus glucose before adding to Warburg flasks.

Table 1

Respiration of Rabbit Sperm

Experiment	Oxygen Uptake	
	In Dark	In Light
1	5.7*	13.1
2	2.5	11.5
3 (fresh)	0.9	7.4
3 (incubated - 6 hrs)	1.1	7.2
4	3.1	16.6
5	1.0	9.0

* μl of $O_2/10^8$ sperm/hr

The question immediately came to mind, if light initiates respiration of sperm, do sperm attain the ability to respire under normal conditions of reproduction? To answer this question, washed spermatozoa protected from light were incubated 6 hr in ligated uterus of an estrous rabbit. The sperm were recovered in the dark, centrifuged and added to dark Warburg flasks. As shown in Figure 1 in utero incubation stimulated a greater rate of respiration than that caused by the present method of light exposure. Two controls were used, sperm incubated at 38°C for 6 hr in vitro and freshly ejaculated sperm. Exposure to light stimulated respiration of both of these.

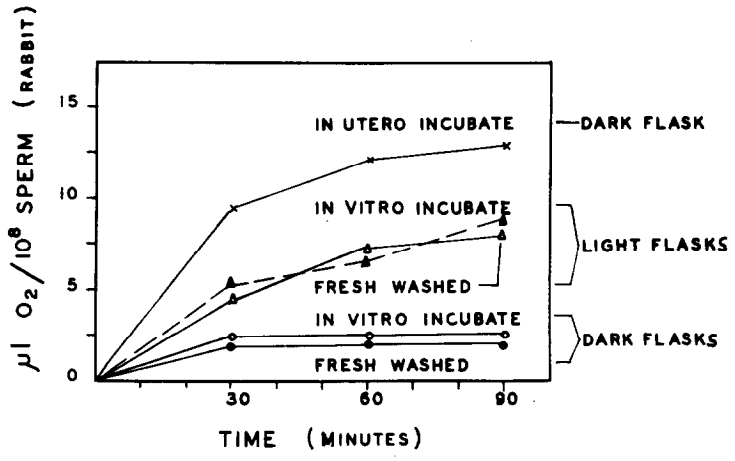

Figure 1. Stimulation of respiration of rabbit sperm by in utero incubation and light.

The respiration of rooster and human sperm was also markedly stimulated by light as indicated by the results in Table 2.

Table 2

Stimulation of Human and Rooster Sperm by Light

		Oxygen Uptake	
Experiment	Species	In Dark	In Light
6	Chicken	1.9*	6.8
7	Chicken	0	7.2
8	Human	4.5	12.6

* $\mu l\ O_2/10^8$ sperm/hr

Previous reports on effect of light on sperm have described deleterious effects. Sperm subjected to ultra-violet or X-ray radiation showed little change in motility or metabolism but rapidly lost ability to fertilize ova (Mann, 1954, p. 58-60). Norman, et al., (1960) and Norman and Goldberg (1959) found that

several hours exposure to white light or wave lengths of 430 mμ and 550 mμ eliminated motility and respiration of bovine sperm. Irradiation of sperm of the purple sea urchin by 435 mμ light delayed egg cleavage upon subsequent fertilization (Wells and Giese, 1950).

Investigations are in progress on the activation spectrum and the mechanism of the stimulation of respiration of sperm by light.

ACKNOWLEDGEMENT

We are pleased to acknowledge the financial support of The Population Council, Rockefeller Institute, and the encouragement of Dr. Warren O. Nelson, Medical Director.

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