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Respiratory Metabolism of the Germinating Castor Bean.

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Many studies of the respiratory metabolism and energy changes in fatty seeds have been made, but none of them completely accounts for the relationships between oxygen absorption and carbon dioxide production observed at different stages of the germination. The present is the first of 3 studies now in progress in this laboratory to secure additional light on the significance of the low respiratory quotients reported by Godlewski[1], Gerber[2], and Ermakov and Ivanov[3].

The castor bean has been chosen for special study because of the nearly total absence of carbohydrate at the beginning of germination. Measurements of the respiratory exchange have been made in many stages from the first appearance of the radicle to a total length of the hypocotyl of approximately 10 cm. Stages up to 30-40 mm. length can be measured conveniently in the ordinary Brodie-Warburg respirometer. Stages beyond this have been studied over periods of 2 to 8 days on moist paper in tightly stoppered bottles covered with opaque paper and kept in the dark. Low quotients are obtained as soon as the growth of the radicle gets well started (length of 1 to 4 mm.).

Attention is directed to only 2 significant results. 1. The wide difference between the R. Q. of the endosperm and that of the young plant inclusive of the cotyledons, which in the castor bean are easily stripped out of the endosperm, and 2. that this difference seems to

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1 Godlewski, E., *Pringsheim's Jahrb. f. Wis. Botanik,* 1882, **13**, 491.

2 Gerber, C., *Actes 1st Cong. Internatl. Bot.*, Paris, 1900, 59-101.

3 Ermakov, I. A., and Ivanov, N., *Biochem. Z.*, 1931, **231**, 79.

be due more to the lower CO_2 output of the endosperm than to the larger O_2 absorption. These contrasts are illustrated by the accompanying table, where the O_2 and CO_2 are expressed in cu. mm. per hour per 100 mg. of the whole germinating seed, endosperm alone, and young plant alone, respectively.

TABLE I.

Respiratory Metabolism of Germinating Seed, Endosperm Alone, and New Plant Alone, Calculated to Unit Time and Weight.

No.	Part	Moist wt. mg.	Cu. mm. CO_2/ hr./100 mg.	Cu. mm. O_2/ hr./100 mg.	R. Q.
36	Germinating Seed	911	52.6	133.4	0.394
36	Endosperm	575	53.0	140.9	0.378
36	Young Plant	144	139.0	180.0	0.776
37	Germinating Seed	1047	47.6	104.6	0.454
37	Endosperm	601	53.2	111.1	0.468
37	Young Plant	194	141.5	170.5	0.829

The R. Q. of the young plant when first separated from the endosperm is between 0.9 and 1.0, but it rapidly declines and in the second or third hour reaches the levels shown in the table, probably because of the rapid consumption of sugar. The R. Q.'s obtained by confining from 6 to 24 germinating seeds continuously in darkened, closed bottles for 2 to 8 days from beginning of germination, range from 0.47 to 0.57. These quotients are quite too low to be accounted for by the conversion of glycerol alone to carbohydrate. A possible interpretation is that sugar is formed in the endosperm under the influence of the cotyledons, not only from glycerol but also from the ricinoleic acid, and is transported to the young plant where a part of it is oxidized and a part transformed into cellulose. However, this conclusion cannot be drawn securely until it is known what part in the total process is played by the organic acid discovered by Green.[4]

[4] Green, J. R., *Proc. Roy. Soc.*, 1890, **48**, 370.