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## On the Effect of Oxidizable Substance upon the Gaseous Metabolism of the Castrated Male or Female Animals.

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# On the Effect of Oxidizable Substance upon the Gaseous Metabolism of the Castrated Male or Female Animals.\*

Hironori Hudino

## Abstract

1) The gaseous metabolism of guinea pigs (male and female) decreases to a certain extent after the removal of sexual glands, but it increases temporarily through the administration of the extract (of testis or ovary), up to the normal value as before the operation. 2) The testis extract has a little influence on increasing the gaseous metabolism of the ovariectomised guinea pigs and it is also temporary. 3) The oxidizable substances cause the gaseous metabolism of ovariectomised guinea pigs to increase markedly. 4) The gaseous metabolism of the castrated male is increased under the administration of the oxidizable substance of certain plant juices and the ratio of increase is proportional to the quantity of the oxidizable substance given, and the more, if the testis extract be added together. 5) The gaseous metabolism of the castrated animals fed with the basal diet free from vitamin C tends to diminish again. This diminished gaseous metabolism is only restored to the former level or more by the administration of vitamin C.

From the Institute of Physiology, Okayama Medical College  
(Director: Prof. Dr. S. Oinuma).

**On the Effect of Oxidizable Substance upon the Gaseous  
Metabolism of the Castrated Male or  
Female Animals.**

By

**Hironori Hudino.**

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**Introduction.**

It was demonstrated by the researches of many workers such as *A. Laewy* and *P. F. Richter* (1899 - 1902)<sup>1)</sup>, *H. Luethje* (1902)<sup>2)</sup>, *H. Bailey* (1921)<sup>3)</sup>, *T. C. Aub* (1922)<sup>4)</sup>, *V. Korenchevsky* (1925)<sup>5)</sup>, *E. P. Bugbee* and *A. Simond* (1926)<sup>6)</sup> that the metabolic rate of animals decreases to a certain extent after castration. *Laewy* and *Richter*<sup>1)</sup> observed it especially in respect to the gaseous metabolism. On the other hand *L. Ptasek*<sup>7)</sup> demonstrated that animals (dogs) have showed a decreased metabolism after the removal of their testes and regain their normal value as before the removal of testis by the administration of testis extract. But concerning the working mechanism of testis extract on the oxidization in the body of animals, no precise explanations have been offered so far as the author is aware.

In recent years it was reported that a considerable amount of oxidizable substance was contained in the testis extract<sup>8)</sup>, and it may be considered that the oxidization in the body of animals is much due to the oxidization of this oxidizable substance itself. Consequently a question is raised whether the influencing mechanism of the extract on the oxidization in animal organism is due to direct stimulation of the oxidization system or due to the oxidization of oxidizable substance itself contained in the testis extract.

The author carried out the present investigation to decide the problem above described, by accepting to begin with the assumption, that the action of the testis extract is due to the oxidizable substance contained in it, and pursued the question whether the testis extract

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has any influencing effect on the gaseous metabolism of animals or not.

In the paper of *A. M. Hemmington* (1934)<sup>9)</sup> many examples are described in detail, to show that the metabolism of ovariectomized animals is decreased and that after an application of ovary preparation it shows a temporary increase. But concerning the action of the testis extract on the gaseous metabolism of ovariectomized animals no references can be found. The author investigated the action of oxidizable substance in certain plant juices on the gaseous metabolism of male castrated or female castrated animals. Moreover in order to ascertain the interrelation between the action of testis extract and that of oxidizable substance of plant juice, the author studied the effect of these two substances together on the gaseous metabolism of animal when given at the healthy state as well as when they were affected by scurvy.

## Experimental.

### I. Methods used:

As the experimental animals, guinea pigs were used which had been fed for several days since buying from a dealer under constant meals and environment, and adapted in these conditions. The animals were usually fed with 'okara'—(the residue of bean after 'tofu' is made) and other vegetables; but those which were destined to become scorbutic were fed with the basal diet free from vitamin C after the formula of *Schermann Göthlin*<sup>10)</sup>, modified a little in our laboratory as follows: 75 parts of oat powder and flour mixed in equal volume, 25 parts of skimmed milk powder (*Darigold*) heated for two hours at 120°C to which 1 part of cod liver oil and 1 part of sodium chloride were added.

When fed with this diet under proper treatment with water, guinea pigs reveal the symptoms of scurvy after about two weeks. The testis extract was freshly prepared from the testis of male guinea pigs and the ovary extract was prepared from the ovary of cows. The oxidizable substance of plant juice, was prepared from the lotus rhizome and platan leaves by crushing and centrifuging and the clear upper portions were used. The quantity of the oxidizable substance was measured from the degree of light intensity emitted by the oxidization test which has been adopted in our laboratory. The testes or ovaries were totally extirpated on both sides, in such a manner, that in the former easily from the scrotum, and in the latter, through the paravertebral incision under the arc of ribs, the operation was performed. As for the determination of gaseous metabolism, the *Haldane's* apparatus<sup>11)</sup> was adopted. The details in regard to the directions for the use of this apparatus are described in the papers of many workers and especially those matters which demand special attention were carried out according to the instructions given in the paper of Prof. *Oinuma*<sup>12)</sup>. In order to avoid the influence of food, the gaseous metabolism test was

carried out when the animals were hungry, and the animals were kept in the respiration chamber for one hour, under the constant temperature. Body temperature of animals during experiment was kept unchanged. The values of oxygen intake and carbon dioxide output are expressed per one hour (h) as well as per one kilogram of body weight (kg), and per one square meter of body surface ( $M^2$ ) which was calculated according to *Meeh's* formula:  $S = K \sqrt[3]{G^2}$  where the constant K for guinea pigs 8.9, S the body surface in  $cm^2$  and G the body weight in kilograms.

## II. Results.

The following eight cases were investigated and obtained the results noted below:

1) The effect of the testis extract on the gaseous metabolism of the castrated male guinea pigs. (Table 1.)

The castrated male had showed a decrease in oxygen intake of about 51 per cent and in carbon dioxide output of about 47 per cent

Table 1.

### I. Normal value before castration.

Date	Temperature of laboratory C°	Temperature of animal C°	Body weight of animal g	Body surface of animal cm <sup>2</sup>	Carbon dioxide output		Oxygen intake		Resp. quot.	Remarks
					per kg, h g	per M <sup>2</sup> , h g	per kg, h g	per M <sup>2</sup> , h g		
18/8	30.0	39.5	489		1.490		1.246		0.8602	
„	31.0	39.5	485		1.521		1.213		0.9110	
„	31.5	39.5	480		1.503		1.234		0.8808	
Mean value			484	549	1.504	13.26	1.231	10.88	0.8840	

### II. Value after castration (20/8 operation).

20/9	26.2	39.0	501	561	0.795	7.12	0.675	6.03	0.8556	30th day
Compared with I					-47.14 %	-46.30 %	-45.16 %	-44.57 %		
25/9	22.8	39.0	490		0.816		0.612		0.9696	35th day
„	24.4	39.1	488		0.778		0.573		0.9870	„ „
Mean value			489	552	0.797	7.07	0.592	5.25	0.9783	
Compared with I					-47.00 %	-46.68 %	-51.90 %	-51.74 %		—decrease

III. After the administration of testis extract 3 cc.  
(Ca. one hour before regist).

Date	Temperature of laboratory	Temperature of animal	Body weight of animal g	Body surface of animal cm <sup>2</sup>	Carbon dioxide output		Oxygen intake		Resp. quot.	Remarks
	°C	°C			per kg, h	per M <sup>2</sup> , h	per kg, h	per M <sup>2</sup> , h		
					g	g	g	g		
26/9	20.6	38.7	491		1.138		0.997		0.8311	
„	23.0	38.4	483		1.615		1.366		0.8595	
„	24.0	38.5	481		1.954		1.496		0.9494	
„	24.1	38.6	480		1.708		1.458		0.8519	
Mean value			483	548	1.604	14.16	1.329	11.74	0.8729	
Compared with I					+101.25%	+100.28%	+124.49%	+123.61%		+increase

IV. After the cessation of the administration  
of the extract.

27/9	24.5	38.4	463	533	1.295	11.25	1.036	9.00	0.9999	
Compared with III					-19.26%	-20.62%	-22.04%	-23.33%		
28/9	24.1	38.5	461	532	0.867	7.51	0.780	6.78	0.8080	
Compared with III					-45.94%	-46.96%	-41.30%	-42.25%		
29/9	24.6	38.3	477	543	0.796	7.00	0.713	6.27	0.8128	
Compared with III					-50.37%	-50.56%	-46.35%	-46.59%		-decrease

as compared with the value before castration. However, through the administration of the testis extract it showed a increase, nearly up to the value before castration, in oxygen intake of about 124 per cent and in carbon dioxide output of about 101 per cent. This effect of the testis extract seems temporary, because after cessation of supplying with it, there appeared again a decrease in oxygen intake of about 46 per cent and in carbon dioxide output of about 50 per cent.

2) The effect of ovary extract on the gaseous metabolism of the ovariectomized guinea pigs. (Table 2.)

Table 2.  
I. Value after ovariectomy.

Date	Temperature of laboratory C°	Temperature of animal C°	Body weight of animal g	Body surface of animal cm <sup>2</sup>	Carbon dioxide output		Oxygen intake		Resp. quot.	Remarks
					per kg, h	per M <sup>2</sup> , h	per kg, h	per M <sup>2</sup> , h		
					g	g	g	g		
10/7	32.0	39.4	369	457	1.289	10.41	1.037	8.40	0.9038	19th day
13/7	26.0	38.5	387	473	1.119	9.15	0.938	7.69	0.8675	22th "

II. After the administration of ovary extract 3 cc twice a day, since 19/7,

21/7	29.0	39.6	388		1.572		1.314		0.8698	3th day
"	30.5	38.5	379		1.311		1.047		0.9109	" "
24/7	27.5	39.0	371		1.347		1.159		0.8287	6th day
"	28.0	39.0	367		1.297		1.025		0.9206	" "
Mean value			376	464	1.382	11.16	1.136	9.25	0.8825	
Compared with I					+23.50 %	+21.97 %	+21.11 %	+22.86 %		+increase

III. After the cessation of the administration of the extract, since 25/7.

28/7	29.0	39.3	353		1.085		0.886		0.8866	4th day
30/7	29.0	39.3	339		1.081		0.786		1.0069	6th "
Mean value			346	438	1.038	8.52	0.836	6.61		
Compared with II					-21.63 %	-23.65 %	-26.40 %	-28.55 %		-increase

In the same way as shown in the former case, the ovary extract also increased the gaseous metabolic rate (oxygen intake about 21 per cent, carbon dioxide output 23 per cent) of the ovariectomized, which had been decreased remarkably after the ovariectomy. And this effect is also temporary because it showed a decrease in oxygen intake of about 26 per cent, in carbon dioxide output of about 21 per cent after the cessation of giving it.

3) The effect of the testis extract on the gaseous metabolism of ovariectomized guinea pigs. (Table 3.)

The administration of the testis extract increased the gaseous metabolism (oxygen intake about 13 per cent, carbon dioxide output about 14 per cent) of the ovariectomized, which had been decreased after ovariectomy (oxygen intake about 51 per cent, carbon dioxide

Table 3.

## I. Normal value before ovariectomy.

Date	Temperature of laboratory C°	Temperature of animal C°	Body weight of animal g	Body surface of animal cm <sup>2</sup>	Carbon dioxide output		Oxygen intake		Resp. quot.	Remarks
					per kg, h	per M <sub>2</sub> , h	per kg, h	per M <sup>2</sup> , h		
					g	g	g	g		
25/9	24.0	37.0	317		2.018		1.703		0.8619	
"	24.2	37.2	315		1.968		1.651		0.8671	
"	24.4	36.8	312		1.923		1.794		0.7792	
Mean value			314	411	1.969	15.0	1.716	13.1	0.8360	

## II. Value after ovariectomy.

4/10	22.0	37.5	316		0.946		0.854		0.8888	11th day
"	21.9	37.5	316		0.853		0.759		0.8484	" "
"	21.6	37.5	315		0.952		0.888		0.7792	" "
Mean value			315.5	412	0.917	7.2	0.834	6.4	0.8388	
Compared with I					-53.42 %	-52.00 %	-51.39 %	-51.14 %		-decrease

## III. After the administration of testis extract 3 cc.

6/10	16.9	36.5	305		1.114		1.016		0.7971	
"	17.0	36.5	305		1.000		0.900		0.8888	
"	17.0	36.8	302		1.025		0.924		0.8072	
Mean value			304	405	1.046	7.8	0.946	7.0	0.8310	
Compared with II					+14.06 %	+8.30 %	+13.42 %	+9.03 %		+increase

## IV. After the cessation of the administration of the extract.

8//0	20.6	36.8	304		0.902		0.805		0.8072	
"	21.0	36.8	300		0.911		0.840		0.7890	
Mean value			302	400	0.906	6.8	0.822	6.2	0.7981	
Compared with III					-13.38 %	-12.82 %	-13.10 %	-11.42 %		-decrease

output about 53 per cent). The effect is temporary because the cessation of the administration returned the gaseous metabolic rate to its former level or lower.

4) The effect of lotus rhizome juice on the gaseous metabolism of the castrated female guinea pigs. (Table 4.)



Table 4.  
I. Normal value.

Date	Temperature of laboratory C°	Temperature of animal C°	Body weight of animal g	Body surface of animal cm <sup>2</sup>	Carbon dioxide output		Oxygen intake		Resp. quot.	Remarks
					per kg, h g	per M <sup>2</sup> , h g	per kg, h g	per M <sup>2</sup> , h g		
14/6	24.5	38.7	404	487	1.443	11.97	1.178	9.56	0.8974	

II. Value after ovariectomy (17/6 operation).

2/7	32.0	39.8	413	494	1.646	13.77	1.452	12.15	0.8242	15th day
Compared with I					+14.06 %	+15.05 %	+18.99 %	+27.09 %		
10/7	32.0	38.9	434	512	1.036	8.80	0.768	6.50	0.9729	22th "
Compared with I					-26.32 %	-26.49 %	-34.81 %	-32.00 %		
13/7	27.3	38.8	448	522	0.982	8.42	0.811	6.95	0.8815	25th "
Compared with I					-31.94 %	-29.69 %	-31.15 %	-27.30 %		-decrease

III. After the administration of lotus rhizome juice 3 cc daily since 18/7.

20/7	31.5	39.3	489		1.200		0.951		0.9227	3th day
"	31.5	39.2	475		1.052		1.000		0.7655	" "
Mean value (A)			482	550	1.129	9.92	0.975	8.55	0.8441	
Compared with the last value of II					+14.97 %	+17.81 %	+20.22 %	+23.03 %		+increase
23/7	30.0	39.5	474		1.561		1.276		0.8895	6th "
"	31.0	39.5	469		1.407		1.194		0.8571	" "
25/7	28.0	39.1	446		1.403		1.292		0.7904	8th "
Mean value (B)			463	533	1.457	12.66	1.245	10.88	0.8456	
Compared with the last value of II					+48.37 %	+50.35 %	+53.51 %	+56.55 %		

IV. After the cessation of the administration of the juice (25/7).

28/7	30.0	39.5	437		0.716		0.442		1.1323	4th day
30/7	29.0	39.5	428		0.778		0.679		0.8467	6th "
Mean value			432	508	0.747	6.38	0.560	4.71		
Compared with (B) of III					-48.73 %	-49.59 %	-55.02 %	-56.70 %		

The castrated female which had diminished the gaseous metabolic rate of about 31 per cent after castration, showed a remarkable increase in oxygen intake of about 53 per cent and in carbon dioxide output of about 48 per cent through the addition of lotus rhizome

juice (3 cc daily) to the diet, and it was gradually decreased without the administration of it; namely oxygen intake about 55 per cent, carbon dioxide output about 48 per cent.

5) The effect of lotus rhizome juice on the gaseous metabolism of the castrated male guinea pigs. (Table 5.)

Table 5.

## I. Normal value before operation.

Date	Temperature of laboratory C°	Temperature of animal C°	Body weight of animal g	Body surface of animal cm <sup>2</sup>	Carbon dioxide output		Oxygen intake		Resp. quot.	Remarks
					per kg, h	per M <sup>2</sup> , h	per kg, h	per M <sup>2</sup> , h		
					g	g	g	g		
19/6	24.0	38.9	470		1.782		1.357		0.9552	
24/6	24.0	38.8	455		1.692		1.472		0.8358	
Mean value			462	533	1.737	15.08	1.414	12.27	0.8955	

## II. Value after the removal of testis (25/6 operation).

11/7	30.7	39.3	414		1.166		1.038		0.8169	17th day
"	31.5	39.6	399		1.127		1.027		0.7982	" "
14/7	25.0	38.1	419		1.169		0.954		0.8909	20th "
"	26.3	38.0	404		0.955		0.792		0.8772	" "
15/7	27.4	38.4	429		1.125		0.942		0.9417	21th "
Mean value			413	494	1.108	9.29	0.950	7.81	0.8649	
Compared with I					-36.22 %	-38.39 %	-32.81 %	-36.34 %		-decrease

## III. Value after the administration of lotus rhizome juice 3 cc daily since 27/7.

29/7	29.5	40.0	411		1.158		1.021		0.8242	5th day
31/7	29.0	39.0	409		1.426		1.198		0.8653	7th "
1/8	30.0	39.5	411		1.216		0.973		0.9091	8th "
Mean value			410	429	1.270	10.54	1.064	8.88	0.8662	
Compared with II					+14.62 %	+13.45 %	+12.00 %	+13.70 %		+increase

## IV. Value after the cessation of the administration of the juice, since 2/8.

3/8	31.0	39.5	403		1.032		0.868		0.8644	2nd day
7/8	31.5	39.8	408		1.019		0.938		0.8737	6th "
Mean value			405	488	1.025	8.52	0.903	7.50	0.8690	
Compared with III					-19.45 %	-19.16 %	-15.13 %	-20.60 %		-decrease

The castrated male, the oxygen intake of which had diminished (about 32 per cent) and the carbon dioxide output (about 36 per cent) after castration, showed a remarkable increase in oxygen intake of about 12 per cent and in carbon dioxide output about 14 per cent through the addition of lotus rhizome juice (3 cc daily) to the diet. As in the former case, this was gradually decreased after the cessation of giving the juice, and finally a decrease in oxygen intake of about 15 per cent and in carbon dioxide output of about 19 per cent.

6) The effect of platan leaves juice on the gaseous metabolism of the castrated male guinea pigs. (Table 6.)

Table 6.

## I. Value after the removal of testis.

Date	Temperature of laboratory		Body weight of animal g	Body surface of animal cm <sup>2</sup>	Carbon dioxide output		Oxygen intake		Resp. quot.	Remarks
	C°	C°			per kg, h	per M <sup>2</sup> , h	per kg, h	per M <sup>2</sup> , h		
					g	g	g	g		
8/9	25.5	39.0	391		1.125		0.869		0.9411	
"	27.0	39.0	389		1.114		0.831		0.9749	
"	24.0	39.0	412		1.116		0.873		0.9292	
Mean value			397	481	1.118	9.23	0.857	7.08	0.9484	

## II. Value after the administration of platan leaves juice 3 cc. daily since 9/9.

11/9	26.5	39.2	448		1.328		1.199		0.8054	3rd day
16/9	25.5	39.3	435		1.862		1.173		0.9585	8th "
"	27.5	39.3	429		1.503		1.188		0.9199	" "
Mean value			437	512	1.584	13.35	1.187	10.80	0.8946	
Compared with I					+41.68 %	+44.63 %	+38.50 %	+52.54 %		+increase

## III. After the cessation of the administration of the juice 17/9.

19/9	24.0	39.0	399		1.353		0.977		1.0060	3rd day
"	25.0	39.0	398		1.406		1.055		0.9696	" "
Mean value			398	481	1.379	11.43	1.016	8.41	0.9878	
Compared with II					-12.94 %	-14.38 %	-14.40 %	-22.12 %		-decrease

The gaseous metabolic rate of the castrated male which had decreased as in all the former cases, showed a remarkable increase

in oxygen intake of about 38 per cent and in carbon dioxide output of about 41 per cent through the addition of 3 cc of platan leaves juice daily to the diet. It showed again a decrease of about from 12 to 14 per cent after the discontinuing the addition of that juice.

7) The effect of testis extract and lotus rhizome juice, given at the same time, on the gaseous metabolism of the castrated male guinea pigs. (Table 7.)

In this case when the testis extract with lotus rhizome juice (each 3 cc) were administered together at the same time, the gaseous metabolism of the castrated male, which had showed a decrease in the gaseous metabolic rate of about 11 or 13 per cent after castration was more markedly increased (oxygen intake about 93 per cent, carbon dioxide output about 59 per cent) than when it was given separately as shown in the former cases. Then as 6 cc of lotus rhizome juice was added, it increased still more, namely in oxygen intake about 133 per cent, in carbon dioxide output 104 per cent. Thus, the more the lotus rhizome juice added, the rate of metabolism increased until 8 cc of lotus rhizome juice being added, and the rate of increase in oxygen intake amounted to about 154 per cent, in carbon dioxide output to about 125 per cent. After the cessation of giving these

Table 7.

## I. Normal value.

Date	Temperature of laboratory		Body weight of animal g	Body surface of animal cm <sup>2</sup>	Carbon dioxide output		Oxygen intake		Resp. quot.	Remarks
	C°	C°			per kg, h	per M <sup>2</sup> , h	per kg, h	per M <sup>2</sup> , h		
12/9	25.5	39.0	540		1.065		0.944		0.8199	
"	26.5	39.0	534		1.141		0.862		0.9644	
"	26.2	39.0	531		1.074		0.791		0.9870	
Mean value			535	587	1.093	9.96	0.866	7.88	0.9237	

## II. After the removal of testis (13/9 operation).

27/9	22.5	39.5	429		0.931		0.699		0.9696	14th day
"	24.0	39.4	428		0.981		0.747		0.9545	" "
"	24.5	39.4	430		0.976		0.790		0.8983	" "
Mean value			429	508	0.962	8.12	0.745	6.88	0.9408	
Compared with I					-11.98 %	-18.48 %	-13.97 %	-12.69 %		-decrease

III. After the administration of testis extract and lotus rhizome juice.

Date	Temperature of laboratory C°	Temperature of animal C°	Body weight of animal g	Body surface of animal cm <sup>2</sup>	Carbon dioxide output		Oxygen intake		Resp. quot.	Remarks
					per kg, h	per M <sup>2</sup> , h	per kg, h	per M <sup>2</sup> , h		
					g	g	g	g		
28/9	25.6	38.8	444		1.576		1.531		0.7486	testis extract 3cc lot. rhizome juice 3cc
..	25.3	38.8	443		1.489		1.354		0.8000	
Mean value			443.5	518	1.533	13.12	1.443	12.35	0.7743	
Compared with II					+ 59.35 %	+ 61.57 %	+ 93.69 %	+ 79.50 %		+ increase
29/9	23.7	38.9	453		2.075		1.920		0.7857	testis extract 3cc lot. rhizome juice 6cc
..	24.5	39.0	450		1.866		1.555		0.8727	
Mean value			451	523	1.971	17.01	1.373	15.00	0.8292	
Compared with II					+ 104.88 %	+ 109.48 %	+ 133.15 %	+ 118.02 %		
30/9	25.2	38.8	400		2.181		1.841		0.8619	testis extract 3cc lot. rhizome juice 8cc
..	25.7	38.8	439		2.167		1.958		0.8051	
Mean value			439.5	514	2.174	18.38	1.899	16.05	0.8335	
Compared with II					+ 125.98 %	+ 126.35 %	+ 154.89 %	+ 133.28 %		

IV. After the cessation of the extract and the juice.

1/10	24.6	38.5	457		1.487		1.225		0.8831	1st day
..	24.2	38.5	451		1.374		1.064		0.7393	" "
Mean value			454	525	1.430	12.38	1.144	9.90	0.9112	
Compared with the last value of III					- 34.22 %	- 32.65 %	- 39.75 %	- 38.51 %		
2/10	21.0	38.7	440		1.340		1.181		0.8391	2nd day
..	21.0	38.6	440		1.409		1.136		0.9018	" "
Mean value			440	514	1.374	11.86	1.158	9.90	0.8704	
Compared with the last value of III					- 36.79 %	- 35.48 %	- 39.02 %	- 38.51 %		
5/10	18.6	38.2	432		1.064		0.925		0.8363	5th day
8/10	21.0	38.3	395		1.113		0.911		0.8888	8th "
Mean value			414	494	1.088	9.19	0.918	8.29	0.8625	
Compared with the last value of III					- 49.95 %	- 50.00 %	- 51.65 %	- 48.34 %		

substances, the gaseous metabolism of the animal began to decrease day by day and finally went down to the value as represented in Table 7.

8) The effect of lotus rhizome juice or testis extract on the gaseous metabolism of scurvy. (Table 8.)

Table 8.  
I. Normal value.

Date	Temperature of laboratory C°	Temperature of animal C°	Body weight of animal g	Body surface of animal cm <sup>2</sup>	Carbon dioxide output		Oxygen intake		Resp. quot.	Remarks
					per kg, h	per M <sup>2</sup> , h	per kg, h	per M <sup>2</sup> , h		
					g	g	g	g		
12/9	25.5	39.0	540		1.065		0.944		0.8199	
"	26.5	39.0	534		1.141		0.862		0.9644	
"	26.2	39.0	531		1.074		0.791		0.9870	
Mean value			535	588	1.093	9.95	0.866	7.89	0.9237	

II. After the removal of testis (13/9 operation).

29/9	25.5	39.2	501		0.918		0.758		0.8803	14th day
"	26.0	39.3	498		0.964		0.762		0.9186	" "
Mean value			499	562	0.942	8.37	0.760	6.78	0.8994	
Compared with I					-13.81 %	-15.88 %	-12.24 %	-14.06 %		-decrease

III. After the feeding with the basal diet free from vitamin C, since 28/9.

10/10	22.5	36.7	390		0.923		0.794		0.8440	
"	23.0	36.8	389		0.971		0.750		0.9527	
"	23.3	36.6	388		0.927		0.721		0.9350	
Mean value			389	474	0.942	7.71	0.722	5.48	0.9106	
Compared with II					0.00 %	-7.88 %	-5.000 %	-19.18 %		-decrease

IV. After addition of lotus rhizome juice 3 cc daily to basal diet since 10/10.

13/10	21.0	36.5	338		1.183		1.094		0.7862	
"	22.0	36.5	336		1.160		1.011		0.8342	
Mean value			337	432	1.172	6.14	1.052	8.21	0.8102	
Compared with III					+24.41 %	+18.54 %	+45.69 %	+49.82 %		+increase

V. After addition of lotus rhizome juice and testis extract (each 3 cc) to the basal diet.

15/10	22.5	35.5	298		1.308		1.074		0.8636	
"	22.5	35.6	298		1.140		0.973		0.8526	
Mean value			298	397	1.224	9.06	1.023	7.68	0.8581	
Compared with III					+29.91 %	+17.49 %	+41.64 %	+40.14 %		+increase

Guinea pigs with diminished oxygen consumption after castration had been fed with the diet free from vitamin C above described. On the 13th day from the commencement of this feeding, it showed a slight diminution, namely, on the average, in oxygen intake of about 5 per cent per one kilogram of body weight, 19 per cent per one square meter of body surface and in carbon dioxide output of about 0 per cent per one kg of body weight, 7 per cent per one M<sup>2</sup> of body surface. Even under such conditions, if lotus rhizome juice alone or testis extract with it be added to its diet, the gaseous metabolism seems to increase, namely in oxygen intake about 45 - 41 per cent per one kg of body weight and in carbon dioxide output about 24 - 29 per cent per one kg of body weight. But especially in the case here described, the diminution was observed also in the body weight and the general condition of animals was very much weakened.

### Discussions.

From the results above obtained, the following considerations may be made.

With respect to the decrease in the gaseous metabolic rate after the castration (male and female) and the recovery through the administration of the extract of testis or ovary, as recorded in table 1 and 2, coincide with the results of many previous workers. Moreover, from table 3 it can be assumed that the testis extract has a little influence on increasing the oxygen intake and carbon dioxide output of the castrated female. Then comparing table 1 with table 3, the increase in oxygen consumption due to the administration of the testis extract, is more pronounced in the castrated male than in the castrated female. Judging from this fact, it seems that, in the former case, not only the oxidizable substance, contained in the testis extract, is oxidized, but also that it has a stimulating action on the oxidization system of the animal body, while in the latter case, only the oxidizable substance contained in the testis extract is oxidized and it has no further stimulating effect on the oxidization system. As a matter of fact the results given in table 4, show that the administration of oxidizable substance itself causes a marked increase in the oxygen consumption of the castrated female. These facts suggest an important rôle of the testis extract on the oxidization system of animal organism, to be compared with the results of *F. Verzár* and *Á. V. Arvay*<sup>14)</sup> who reported that ovary preparation caused an increase in the metabolism of the ovariectomized animals,

but not the castrated male. Such a presumption may be recognized more easily from the following results.

As represented in table 5 and 6, the oxidizable substance contained in certain plant juices causes an increase in the oxygen consumption of the castrated male, and from table 7, this fact is more remarkable when it was given together with the testis extract at the same time in stimulating the oxidization system of the animal organism; and it is clear that the oxygen consumption is increased more in proportion to the quantity of the oxidizable substance given. The similar effect of the testis extract and lotus rhizome juice was observed in the case of scurvy which had manifested a less oxygen consumption as shown in table 8.

Speaking generally, the effect of testis extract on increasing the oxidization in the body of animals lies chiefly in the stimulation of the cell-oxidization, besides a little content of oxidizable substance added, and the more of the oxidizable substance is given, the effect becomes more pronounced.

### Summary.

1) The gaseous metabolism of guinea pigs (male and female) decreases to a certain extent after the removal of sexual glands, but it increases temporarily through the administration of the extract (of testis or ovary), up to the normal value as before the operation.

2) The testis extract has a little influence on increasing the gaseous metabolism of the ovariectomised guinea pigs and it is also temporary.

3) The oxidizable substances cause the gaseous metabolism of ovariectomised guinea pigs to increase markedly.

4) The gaseous metabolism of the castrated male is increased under the administration of the oxidizable substance of certain plant juices and the ratio of increase is proportional to the quantity of the oxidizable substance given, and the more, if the testis extract be added together.

5) The gaseous metabolism of the castrated animals fed with the basal diet free from vitamin C tends to diminish again. This diminished gaseous metabolism is only restored to the former level or more by the administration of vitamin C.

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