

## DIFFERENTIAL ROLE OF OVARIAN HORMONES FOR TASTE PREFERENCES IN RATS

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**Abstract:** The effects of estrogen (OVX-EB) and progesterone (OVX-P) administration to ovariectomized (OVX) rats on food and fluid intakes were studied in fifty five, animals grouped into three series. Animals in each series were given a choice of two fluids viz. tap water and either 5% glucose (5 G/W) or 12% glucose (12 G/W) or 1.5% Sodium chloride (S/W) by two bottle preference. Both hormones had a differential effect on the ingestion of the two concentrations of glucose while progesterone markedly increased the intake of Sodium Chloride. Could the putative role of the ovarian hormones be hedonic for glucose and homeostatic for salt ?

**Key words:** estrogen progesterone taste

### INTRODUCTION

Studies on taste preference between sexes in rats and hamsters have established that females consume greater quantities of sweet solutions than do their male counterparts (1,2,3,4) and it is presumed that the ovarian hormones influence the taste regulatory mechanisms (5,6). Estrogen and progesterone probably also affect salt appetite (7,8). Kreck et al (9) found that mature female rat drank more of salt solution than males and this behaviour was cyclical decreasing during proestrous and estrous. While estrogens are known to cause salt and water retention, large doses of progesterone produce natriuresis (10).

The present study was designed to provide additional information regarding the role of estrogen and progesterone in the intake of glucose and sodium chloride solutions and their preference.

### METHODS

Fifty five healthy regularly cycling Wistar strain female rats weighing 180-250 gms were housed in individual cages and given food (pellets) *ad libitum* but choice of two fluids by two bottle preference, one fluid being tap water common to all. The animals were grouped in three series. Besides water, the rats in Series A (n = 14) were given 5% glucose solution (5G/W), in Series B (n = 27) 12% glucose solution (12 G/W) and

in series C (n = 14) 1.5% Sodium Chloride solution (S/W). The body weight, food and fluid intakes were recorded daily.

After the initial control period of two weeks, all the rats in each of the three series were ovariectomized and subgrouped into ovariectomized (OVX); ovariectomized and estradiol benzoate replacement by daily injection of 2 µg subcutaneously (OVX-EB); ovariectomized and progesterone injection of 0.1 mg daily (OVX-P). Further two weeks of body weight food and fluid intakes noted after which the animals were sacrificed. The total calories consumed were those derived from glucose (5 Kcal/gm) and pellets (3.6 Kcal/gm) in both the glucose series.

The data collected was analysed for statistical significance between subgroups but intraseries using student's "t" test. The comparison was made between control and OVX animals and between OVX and OVX-EB or OVX-P in each of the series.

### RESULTS

Tables I, II and III present the analysed data on body weight, food intake, individual and total fluid intakes as well as total caloric intake by the rats in the various subgroups of each series. The salient observations are the differential effects of estrogen on 5% and 12% glucose ingestion. The intake of 1.5% sodium chloride is significantly more with progesterone. The food intake as expected, is least with estrogen in all the series.

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TABLE I: Showing the Mean  $\pm$ SD of body weight, food intake, and fluid intakes of the rats in 5% glucose series.

Series	Body weight (g)	Food intake (g)	5% glucose intake (ml)	Water intake (ml)	Total fluid intake (ml)	Caloric intake (Kcal)
Control (n = 14)	193.78 $\pm$ 12.44	9.57 $\pm$ 2.77	99.14 $\pm$ 13.25	9.14 $\pm$ 9.05	108.28	57.85
OVX (n = 6)	195.50 $\pm$ 12.22	10.33 $\pm$ 3.77	92.33 $\pm$ 11.97	4.33 $\pm$ 2.87	96.66	60.23
OVX-EB (n = 4)	191.25 $\pm$ 14.90	6.29 $\pm$ 1.86*	82.50 $\pm$ 11.90	6.25 $\pm$ 7.49	88.75	43.24
OVX-P (n = 4)	191.25 $\pm$ 6.87	8.50 $\pm$ 1.00	87.50 $\pm$ 14.43	6.25 $\pm$ 2.49	93.75	52.45

n= No. of animals; Level of significance\*; \*P<0.10, \*\*P<0.05, \*\*\*P<0.01

TABLE II: Showing the Mean $\pm$  SD of body weight, food intake, and fluid intakes of rats in 12% glucose series.

Series	Body weight (g)	Food intake (g)	12% glucose intake (ml)	Water intake (ml)	Total fluid intake (ml)	Caloric intake (Kcal)
Control (n = 27)	198.66 $\pm$ 18.78	6.07 $\pm$ 3.19	83.70 $\pm$ 15.35	6.25 $\pm$ 2.68	89.95	72.05
OVX (n = 9)	201.88 $\pm$ 25.16	10.66 $\pm$ 4.74**	55.55 $\pm$ 24.42***	14.11 $\pm$ 11.49	69.66	71.67
OVX-EB (n = 9)	191.77 $\pm$ 33.14	4.88 $\pm$ 1.45***	77.22 $\pm$ 18.21**	10.22 $\pm$ 9.87	87.44	63.86
OVX-P (n = 9)	180.00 $\pm$ 32.88	8.22 $\pm$ 2.57	68.88 $\pm$ 20.60	4.77 $\pm$ 8.00*	73.65	70.89

n= No. of animals; Level of significant\*, \*P<0.10, \*\*P<0.05, \*\*\*P<0.01

TABLE III: Showing the Mean $\pm$  SD of body weight, food intake, and fluid intakes of rats in 1.5% sodium chloride series.

Series	Body weight (g)	Food intake (g)	1.5% Sodium Chloride intake (ml)	Water intake (ml)	Total fluid intake (ml)	Caloric intake (Kcal)
Control (n = 14)	195.35 $\pm$ 15.16	12.14 $\pm$ 2.47	19.00 $\pm$ 16.00	25.21 $\pm$ 16.81	41.21	43.70
OVX (n = 6)	198.00 $\pm$ 14.87	13.66 $\pm$ 4.80	21.31 $\pm$ 7.84	23.57 $\pm$ 14.74	44.88	49.17
OVX-EB (n = 4)	186.25 $\pm$ 4.78	10.95 $\pm$ 1.97	22.75 $\pm$ 24.15	38.00 $\pm$ 6.78*	60.75	39.32
OVX-P (n = 4)	208.50 $\pm$ 8.69	13.25 $\pm$ 2.36	33.33 $\pm$ 10.48*	25.75 $\pm$ 4.34	59.00	47.65

n= No. of animals; Level of significance\* ; \*P<0.10, \*\*P<0.05, \*\*\*P<0.01

## DISCUSSION

Past observations made in the taste preference for glucose solutions have been varying and their interpretation at times conflicting as far as the intrasex comparisons in female rats. Gabric and Soljagic (11) reported that OVX rats drank more of 5% and less of 12% glucose solutions as compared to the control. These changes are attributed to the alterations in the level of gonadal hormones which through the hypothalamus are purported to have direct effect on taste preference (12) rather than an indirect effect mediated by hormone induced weight changes or their correlates (6,13). Kenney and Redick (14) made the same observations that OVX drank more of 5% glucose than the control

rats and OVX-EB decreased the intake from the OVX level which prompted them to deduce that the greater intake in OVX rats is related more to the nutritive value or postingestive consequences of the solution (providing calories) rather than to its taste. OVX rats are known to eat more and EB replacement reduces the food intake and the effect of the ovarian hormones could be on those mechanisms controlling food ingestion rather than any separate effects of the hormone on taste preference (15). In our study, we also noted a differential effect with the two concentrations of glucose. OVX had no effect on 5% glucose intake but reduced significantly the 12% glucose ingestion when compared to the control. The replacement of both estradiol (OVX-EB)

and progesterone (OVX-P) slightly decreased the 5% glucose but definitely increased the 12% glucose intake when compared to the OVX rats, although the total calories consumed by the OVX rats were more in both the series (5 G/W and 12 G/W) because of the higher food (pellets) consumption. It appears therefore that the ovarian hormones act conjointly rather than individually to promote taste preference for sweet solutions especially for 12% glucose and that the response is more hedonic than for energy balance.

The ingestion of sodium chloride in rats has been studied mostly during pregnancy or after adrenalectomy (ADX). Enhanced salt intake during pregnancy in rats was first observed by Barelare and Richter (16) and subsequently confirmed by others in rats and rabbits (17,18,19). The pattern of sodium preference during the estrous cycle shows an increase in the luteal phase and decrease during proestrous and estrous corresponding to the plasma progesterone concentration (7, 9, 20) and progesterone causes natriuresis by antagonizing the renal effects of aldosterone while enhancing its secretion (10). It would be plausible to suppose that the enhanced

sodium appetite with progesterone is a response to a deficit caused by its natriuretic effect and that in the estrous cycle, salt appetite joins the kidney and gut in producing coordinated changes in sodium balance (8). Our observations also concur in that OVX-EB rats decreased and OVX-P rats increased the salt intake. However what appears paradoxical is that estrogen is said to retain salt and water (10), but on our study the water intake in OVX-EB of saline series is significantly high and does not seem to fit in with the thirst and water balance mechanism.

To summarize, the ovarian hormones have a differential influence on the intake of 5% and 12% glucose solutions and this response appears to be hedonic rather than for energy balance whereas the effects on the intake of salt solution appears to be solely for sodium balance.

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