The effect of aqueous extract of banana peel on sexual behavior in male rats

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ABSTRACT

To study the effect of aqueous banana peel (either green or yellow) extract on the sexual behavior, 50 male adult rats divided into 5 equal groups as the following: the control group administrated orally with 0.2 ml normal saline/ kg, the second group administrated orally with aqueous extract of green yellow banana peel (400 mg/kg), the third group administrated orally with aqueous extract of green yellow banana peel (200 mg/kg), the fourth group administrated orally with extract of yellow banana peel (400 mg/kg) and the fifth group administrated orally with extract of yellow banana peel (200 mg/kg) . All treatments were done for 28 days. The experiment was performed at the night time in a dim red florescent lamp. Fifty bilateral overiectomized female rats were used as a mating stimulus, the ovariectomy was done two weeks before the experiment . To be sexually receptive, the females were received single subcutaneous injections of 10µg estradiol benzoate and 1mg progesterone before pairing by 52 hours and 4 hours respectively. The parameters of male sexual behavior were recorded. In comparison to control the extract treatment either of green or yellow in all doses resulted in increase in mount latency (ML), intromission latency (IL) and ejaculation latency (EL) while it decrease the mounts frequency(MF) ,intromission frequency (IF) ejaculation frequency (EF) and ejaculatory interval (PEI). Also, the extract increased estrogen levels while it decrease testosterone level. It could be concluded that aqueous extract of either green or yellow banana peel resulted in impairment of sexual behavior in male rats and further studies may be conducted on the mode of action and phytochemical screening.

Key word: *banana peel, sexual behavior, male rat, testosterone*

1.INTRODUCTION

Sexual behavior of the male involves a complex pattern of somatomotor and genital responses, educed, directed and maintained by internal and external signals. It comprises precopulatory and copulatory behaviors that permit the male to discover and define a partner, determine her prospect mating suitability and excite a receptive response [1-2].

Reproductive ability of the male was found to be insufficient in no less of less than 50%of infertile couples [3]. Main factors that lower the eventuality of the conception in the female mate are extremely iatrogenic, immunological, endocrine or congenital cause. Ejaculatory and sexual dysfunction, oligospermia are additional responsible for failure to conceive in many cases [3]. The extent of sexual insufficiency in human males has led to the development of a number of available treatments. These options may be with serious side effects and expensive. Many patients rummage for a product of natural origin having wide safety margin, quick starting action and minimum side effects [4-5]. Nowadays, plants and herbal products which have valuable therapeutic action both in traditional and modern medicine attract the attention of the scientists.

Banana is one of the most important subtropical and tropical fruit, it is cultivated with both large and small scale in about 130 countries all over the world [6]. Its tree like herb, different parts of the tree (leaves, the root, the juice of the corn, fruit and peel) have a number of beneficial pharmacological effects [7], have antibiotic and antifungal properties [8] and used for treatment broken bones, bruises [9], retention of urine, gonorrhea, goiter and as laxative, anticancer, antiulcer and heart disease [10], moreover, banana fruits consumption could alleviate some reproductive disorders and improve some reproductive functions in human males [11and 12] The flower as astringent [13], the root used in folk medicine as aphrodisiac and anthelmintic [13], root infusion also, used to suppress convulsion, venereal disease, vomiting and anemia [13], enhanced sperm metabolism [14]. Moreover, the root extract found to be enhance the synthetic and normal secretory functions of the rat testes through stimulating testosterone production and increasing the bioavailabilty of androgen to the testes [15]. Furthermore the stem juices used for dissolving of urinary stone and inhibiting the urinary stone formation [9].

Banana peel protects the banana fruits and it accounts about 30-40% of the total weight of fresh banana and it contains high quantities of phosphorous and nitrogen and used as fertilizer in some countries while it discarded as waste products in many countries and this makes an environmental problem [16], it has antibiotic and antifungal properties it is used for treating many different skin diseases like skin irritants and allergies, relieve hangovers, treat warts; aids in toxifications and as diuretics. It can also supply nutritional products, it is rich with minerals such as magnesium, phosphorus, calcium and potassium, the pulp is poor than the banana peel in phytochemical compounds [17-18]

Both yellow and green banana peels extracts exhibits antidepressant-like effects and can be used to treat depression and the extract of yellow banana peel could treat depression with less effects in comparison to green banana peel extract [19]**.** The quantitative analysis of banana peel extract reveals the presence of tryptophan amino acid. The tryptophan is the precursor for serotonin formation and the serotonin plays an important role in the mood and human sexuality[20].

However, there is no published data about the effect of banana peel on sexual behavior. Therefore, the present study was carried out to investigate the effect of aqueous extract of banana peel on the sexual behavior in male rats

2. MATERIALAS AND METHODS

2.1 BANANA PEEL EXTRACTION:

The green peel of banana with a vestige of yellow phase extracted by using the fresh banana fruit's peel, every 600 g peel heated for 2 min at 80^{o} C in one liter of distilled water. Then, using an electric blender the peel homogenized twice at room temperature with 70% acetone [21]. After that it centrifuged for 10 min at 6000 rpm. Then, the acetone extracts filtered and concentrated at 50° C to 300 ml which allowed to dry at 50°C.The same procedures used for extraction of yellow banana peel.

2.2 ANIMALS

In this study a total of 120 rats made up of equal number of mature female and male Wister rats, 4 months old, weighting 200 - 210 grams were used. The animals were selected from King Faisal University Experimental Station at Al-Ahsa, Kingdom of Saudi Arabia, they housed in clean glass cages (4 rats per cage) at Laboratory of Physiology Department. The maintenance and handling of the animals were done accordance to King Faisal University's guidance from the Ethical Committee for Research on Laboratory Animals. The animals were accommodated in well ventilated controlled environment (temperature,20-24ºC and relative humidity 65% and a 12 hrs light – dark cycle). The animals were allowed free access to water and food ad libitum. The chemical composition of standard rat pellets was presented in table 1. The experiment was performed at the night time in a dim red florescent lamp.

TABLE 1. CHEMICAL ANALYSIS OF RAT DIET

Item	Moisture	ME kcal/gm	Crude protein	Crude fat	Crude fiber	Ash	Calcium	Phosphorus	Starch
Level in the diet, %	12	4.15	22	5	4	6	1	0.74	28

2.3. MALE RATS GROUPING

Fifty male rats were grouped randomly into the following 5 groups (10 rats each); the control group administrated orally with 0.2 ml normal saline/ kg, the second and third groups administrated orally with aqueous extract of green banana peel [400 and 200 mg/kg respectively ,19], the fourth and the fifth group administrated orally with aqueous extract of green banana peel(400 and 200mg/kg respectively), the fifth group administrated orally with aqueous extract of yellow banana peel at a dose of 400mg/kg. All treatments were done for 28 days. The banana peel extract was freshly dissolved in normal saline before administration every day.

2.4. ESTRUS FEMALE

Fifty bilateral overiectomized female rats were used as a mating stimulus, the ovariectomy was done two weeks before the experiment via lumber incisions. To be sexually receptive, the females were received single subcutaneous injections of 10µg estradiol benzoate and 1mg progesterone before pairing by 52 hours and 4 hours respectively [22]. Before being placed with a single male, the female were tested for receptivity. The females in estrus manifested high degree of lordosis response and proceptivity.

2.5. SEXUAL BEHAVIOR

A Plexiglas monitoring cage (0.3mX0.5mX0.3m) in the middle of it there is a mesh plate, was put on a metal box with an oblique mirror inside it. Three hour after each administration of the extract, the male rat was placed in the observation cage. After 10 minutes, and at the other side of the cage, a sexually receptive estrus female rat was introduced (anticipatory stage). Ten minutes after introduction of the females, the mesh plate was taken away for half an hour (consummatory phase). From the cage side the proceptive and precopulatory sexual behaviors of a male with female was noticed, also the parameters of the sexual behavior were noticed for 30 minutes through video Panasonic camera.

Male rats which could not start intromission within the first quarter of an hour was rejected and substituted with another one.

According to the basic and standard transaction, the next sexual parameters of the male were listed or estimated for the monitory period. 1-The elapsed period from female introduction till the mount was recorded as mount latency (ML). 2- The elapsed period from the female introduction till intromission recorded as intromission latency (IL). 3- The elapsed period from the intromission till ejaculation was recorded as ejaculation latency (EL). 4- The mounts number in a series recorded as mounts frequency (MF). 5- Intromissions number in a series recorded as intromission frequency (IF). 6- The number of times there was expulsion of semen by the male after penetration of vagina recognized by harmonious contraction of the posterior abdomen recorded as ejaculation frequency (EF). 7- The elapsed from the ejaculation till initiation of a new series as recognized by the next intromission recorded as post ejaculatory interval (PEI). Other estimated parameters of sexual behavioral of the male include: 1- Index of libido % = (number mated /number paired) x100. 2- mounted % = (number mounted /number paired) x100. 3- intromitted % = number of rats that intromitted/number paired) x100. 4- ejaculated % = (number of rats that ejaculated/number of paired)x100. 5-copulatory efficiency= (number of intromissions/number of mounts) x100. Iterocopulatory efficiency = average time between intromissions {23-26].

2.6. ADVERSE EFFECT

The treated rats were kept an eye on for any symptoms of toxicity (tremors, writhing, squinted eyes, salivation , ptosis ,convulsions, lachrymation) stress (fur erection), behavior changes (climbing, non-genital self-grooming, spontaneous movements in the cage, face cleaning) and diarrhea. Moreover, water and food intake were noted.

2.7. COLLECTION OF SERUM SAMPLES

After estimation of the parameters of the sexual behavior and at the end of the experimental period. All male rats were anaesthetized with xylazine and ketamine and individual blood samples were collected by heart puncture, serum were separated and stored at -20ºC for hormonal assay.

2.8. HORMONAL ASSAY

Testosterone and estradiol were assayed in the serum by ELISA technique using rat specific kits supplied by BioVendor (Gunma, Japan) according to the manufacture guide of each kit.

2.9. STATISTICAL ANALYSIS

The data obtained statistically analyzed [27]. The means ± standard errors calculated and tested for significance using analysis of variance procedures of the statistical analysis system computer package SAS .

3. RESULTS

There was no effect of various doses (400 or 200 mg/kg b.wt) of aqueous green or yellow banana peel extracts on body weight (table 2).

The effect of chronic administration of aqueous extracts of green or yellow banana peel at various doses on sexual behavior parameters are presented in tables (3 and 4). Oral administration of various doses of aqueous extracts of green or yellow banana peel altered all studied parameters. The maximum effect was noticed in male rats administrated 400mk/kg of aqueous extracts of green banana peel where it resulted in increase in ML, IL, EL, MF and decrease in IF. EF and PEI ($P \leq 0.05$). Computed indexes decreased in rats treated with various doses of aqueous green or yellow banana peel extracts except at dose 200mg/kg of yellow banana peel extract where it was not differ than that of control (table4).

The orientation of the treated males toward female was decreased and displayed less frequent and vigorous anogenital sniffing and mounting on females when compared to control rats. The orientation towards self (genital grooming) was less than that of control, and the orientation toward the environment (raring and exploration and climbing on the cage wall) was decreased in treated rats.

Table (2) showed that serum testosterone level decreased in treated rats with aqueous extract of green or yellow banana peel when compared to the value of control rats. The estrogen levels in the serum increased in all treated rats in comparison to control one. The most effective dose for both hormones was 400 mg/kg green banana peel aqueous extract.

There were no mortality, clinical signs of toxicity , adverse effect or stress or changes in appearance and general behavior. The water and food intake in both treated rats and control one were similar all over the experimental period.

TABLE2. EFFECT OF AQUEOUS EXTRACT OF BANANA PEEL EXTRACT ON MALE RAT BODY WEIGHT AND SERUM TESTOSTERONE AND ESTROGEN LEVELS.

Item	control	G.P.E		Y.P.E	
		400mg/kg	200	400	200
Initial body weight (g)	208.40±1.77	207.20±1.85	209.00±1.35	208.80±0.10	208.40±1.93
Final body weight (g)	228.10±2.52	224.20±2.00	224.60±1.49	226.80±2.54	227.90±1.98
Testosterone	2.94 ± 0.05^{a}	1.27 ± 0.04^{b}	1.63 ± 0.03^{c}	1.81 ± 0.05^{d}	$1.1.96\pm0.04^{e}$
Estrogen	8.27 ± 0.58^{a}	15.05 ± 0.25^{b}	12.62 ± 0.21^{c}	11.55 ± 0.18^{d}	10.50 ± 0.57^{e}

-G.P.E= aqueous extract of green banana peel - G.Y.E= aqueous extract of green banana peel

-*Mean ± SE

-Means having different superscript are significantly different from each other ($P \leq 0.05$)

TABLE3. EFFECT OF AQUEOUS EXTRACT OF BANANA PEEL EXTRACT ON MALE RAT SEXUAL BEHAVIOR

Item Behavior*	Control	G.B.E		Y.P.E	
		400mg/kg	200mg/kg	400mg/kg	200mg/kg
ML(sec)	101.60±2.73[a]	235.8±3.00[b]	149.50±2.90[c]	176.90±2.38[d]	129.60±2.09[e]
IL	176.90±2.89[a]	283.50±2.32[b]	242.50±2.35[c]	263.70±2.25[d]	216.00±2.53[e]
EL(Sec)	240.90±3.33[a]	363.50±1.68[b]	294.50±10.68[c]	358.10±5.3[b]	283.80±2.0[c]
MF	11.50±0.65[a]	28.90±0.86[b]	19.60±0.70[c]	24.10±0.59[d]	17.50±0.87[c]
IF	20.00±0.96[a]	7.80±0.42[b]	14.70±0.37[c]	10.10±0.43[d]	17.80±0.49[e]
EF	13.40±0.45[a]	3.30±0.33[b]	6.70±0.65[c]	4.80±0.47[b]	8.70±0.65[d]
PEI(Sec)	13.80±0.55[a]	3.40±0.34[b]	6.805±0.39[c]	5.30±0.56[d]	8.10±0.38[e]

G.P.E= aqueous extract of green banana peel G.Y.E= aqueous extract of green banana peel

*Mean ± SE

Means having different superscript are significantly different from each other (P≤0.05)

ML= mount latency. - IL= intromission latency. - EL=Ejaculation latency

MF= mounts frequency - IF = intromission frequency. - EF = ejaculation frequency PEI = ejaculatory interval

TABLE4. EFFECT OF AQUEOUS EXTRACT OF BANANA PEEL EXTRACT ON COMPUTED MALE RAT SEXUAL BEHAVIOR

Behavior	control	G.B.E		Y.P.E	
		400mg/kg	200mg/kg	400mg/kg	200mg/kg
Index libido%	100	70	90	70	100
%mounted	100	70	90	90	100
%intromitted	100	60	90	80	100
%ejaculated	100	40	60	80	100
Copulatory efficiency%	100	85.4	88.7	90	100

4. DISCUSSION

Sexual behavior of the male involves a complex pattern of somatomotor and genital responses, educed, directed and maintained by internal and external signals. It comprises precopulatory and copulatory behaviors that permit the male to discover and define a partner, determine her prospect mating suitability and excite a receptive response [1-2].

Administration of aqueous extract of either green or yellow banana peel at dose 400mg or 200/kg b.wt to male rats resulted in increase in ML, IL, EL, MF and decrease in IF. EF and PEI in comparison to control. This could be attributed to the presence of tryptophan amino acid**.** The tryptophan is the precursor for serotonin formation and the serotonin plays an important role in the mood and human sexuality [20]. It have been found that ripe banana peel contains about 150 µg /gm serotonin [28]. In another study, it was found that serotonin content in banana peel in the range of 47-93 µg /gm [20]. The peel has much higher tryptophan than the banana fruit **[29]**which may explain the effectiveness of banana peel either juiced or steeped in hot water in treatment depression. Both yellow and green

banana peel extracts exhibit antidepressant-like effects and can be used to treat depression and the extract of yellow banana peel could treat depression with less effects in comparison to green banana peel extract[19]. Researchers have found that banana peel can help individual sleep directly when consumed since it is extremely high in tryptophan. The peels can lessen depressive episodes through elevating the levels of serotonin produced in the body. It has been suggested that eating two peels for three consecutive days can elevate the circulating serotonin in the body. In comparison, antidepressive synthetic drugs as Prozac work by the same mechanism, through increasing the serotonin level in the brain [30].

The different components of sexual behavior regulated by serotonin in different areas of the brain [31]. In lateral hypothalamus, increase of serotonin extracellularly at post ejaculatory intervals reduces copulation in male rats. Moreover, increase serotonin level in preoptic area, amygdala and nucleus accumbens increases intromission frequency and ejaculatory latancy. However, a reduction in the serotonin concentration in the median and dorsal raphe nuclei resulted in a decrease in ejaculation threshold [32]. Selective serotonin reuptake inhibitors (SSRI) resulted in sexual dysfunction (decrease both libido and sexual arousal) and anorgasmia [33].

Chronic treatment with SSRI resulted in decrease in erectile response [34]. The parameters of sexual behaviors of male mice were impaired after SSRIs treatment. SSRIs caused reduction in mounts duration with intromission which indicate a decrease in copulatory behavior and interrupted facilitation of sex behavior [35].

The pharmacological elevation of cerebral level serotonin concentration cause decrease in HCG level, which leads to decrease secretion of gonadotrophin hormones (LH and FSH) which essential for steroidogenesis [36-38]. In the present study there was a decrease in testosterone level in groups treated with aqueous extract of either green or yellow banana peel at dose 400mg or 200/kg b.wt which may be attributed to decrease in gonadotropin secretion or may be due to its aromatization into estrogen since there was an increase in the levels of estradiol in these groups. The impairment in the sexual behavior in the present study could be attributed also to the decrease in the testosterone level. Castration caused suppression of sexual behavior which restored by subsequent testosterone treatment **[39].**

5. CONCLUSION

It could be concluded from the present study that aqueous extract of either green or yellow banana peel resulted in impairment of sexual behavior in male rats and further studies may be conducted on the mode of action and phytochemical screening.

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