RESEARCH ARTICLE

Sokoto Journal of Veterinary Sciences

(P-ISSN 1595-093X: E-ISSN 2315-6201)

http://dx.doi.org/10.4314/sokjvs.v17i1.5

Atoigwe-Ogeyemhe *et al*./*Sokoto Journal of Veterinary Sciences*, **17**(1): 38 - 48.

Assessment of mating profile of male Wistar rats administered single and pooled extracts of *Phoenix dactylifera* and *Cocos nucifera*

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Publication History:
Received: 22-11- 2018
Accepted: 16-01-2019

Abstract

Phoenix dactylifera (date) and Cocos nucifera (coconut) are edible and medicinal crops consumed in Africa to stimulate male sexual performances. Incidence of sexual incompetence, erectile dysfunction, premature ejaculation and reduced libido are on the rise. *C*onsequently, the effect of a pooled extract on mating profiles to determine the sexual performance efficiency in male Wistar rats was investigated. Fifty-two first filial (FI) generation in-bred healthy male Wistar rats were randomly selected and grouped into A to M (n=4) per cage. Group (A) received distilled water and served as the control, while group B, C, D and E received 250, 500, 750 and 1,000mg/kg of the date extract. Graded doses as described earlier were also administered to Group F, G, H and I (coconut milk) and J, K, l and M (mix extract) as oral single daily doses for 60 days. Rats adapted to the sanitized animal room condition for 14 days and adequately provided pelletized rat feed and water *ad libitum*. The crops were purchased from the open market and processed using maceration apparatus and spray drying process for the date and coconut extract extractions, and were pooled in equal proportion. Mating profiles were assessed by monitoring the activities of each rat in a rectangular Plexiglas surveillance chamber (52 x 45 x 38 cm) on 20th, 40th and 60th days of the treatments by observing in a sound-attenuated room after introducing an equivalent number of female rats (n=52). The mating parameters either decreased or increased in a dose-dependent manner; without traces of weakness or reduced penile reflexes and a higher significance in the combination ($P \leq 0.025$) than date ($P \leq 0.045$) and coconut ($P \geq 0.05$) extracts. We conclude that *P. dactylifera* and *C. nucifera* mix has lasting potentials on mating profile in male Wistar rats.

Keywords: *Cocos nucifera*, Mating profile, *Phoenix dactylifera*, Sexual arousal, Libido, Sex enhancer

Introduction

Herbal therapy remains an important aspect in the day to day management of sexual predicaments and as such plants with aphrodisiac properties are being utilized in the management or treatment of sexual dysfunction and to improve sex lives in traditional folklore (Prakash *et al.,* 2015). Male sexual behavior consists of a complex pattern of genital responses, which when initiated, is maintained and directed by signals within and outside the body (Abedi *et al.,* 2014). The complex patterns include mating and pre-mating behavior that allows the male to sense, trace a mate, and assess her potential mating suitability

thereby stimulating a receptive reaction (Abedi *et al.,* 2014). Mating abnormality is characterized by a range of sexual problems, which pose a serious health condition being that a significant number of men are affected with the estimated value cutting across different countries (Prakash *et al.,* 2015). Incidence of poor sexual performance, loss of vigour and vitality, poor libido amongst others may be on the rise due to varying factors like environmental pollution, work pressure, lifestyle and social, economic and chemical affluent endangering the society (Odigie & Osula, 2014; Atoigwe-Ogeyemhe *et al.,* 2016). In a mature adult male, response to sexuality begins with a hot sexual desire to erection, viable intromission, then to orgasm and ends in ejaculation (Neelesh *et al.,* 2013). Ability to formulate a safe traditional therapy to combat this rising menace, which often leads to erectile dysfunction (ED), will go a long way in alleviating the plight of the victims. Plants by-product have been used over time to treat ailments relating to infertility, low sperm count and poor libido in men (Atoigwe-Ogeyemhe *et al.,* 2016). We tried to redesign something that may be used quickly and with less financial implications compared to the orthodox medicine. Mating profile differs across species ranges from lower animals to the very large mammals. Series of parameters are investigated in the build-up to assessing mating behavioural changes in an animal and are translational in man. Mount latency, mount frequency, intromission frequency, ejaculatory latency, post-ejaculatory interval, ejaculation frequency, intromission latency, inter-intromission interval and sometimes intromission ratio have been reported (Obiandu *et al.,* 2018). *Phoenix dactylifera and Cocos nucifera* have been reported to stimulate male sexual performances. *Phoenix dactylifera* (family *Arecaceae*) known as the date fruit in English (debino in Igbo, dabino in Hausa and eso anobi in Yoruba), is cultivated in the hot and dry climate regions of Africa as a potential food source (Abedi *et al*., 2014). Previous information suggests that the crop possess active medicinal values including treatment of loss of sexual motivation and the ability to perform sexually (Baliga *et al.,* 2011). On the other hand, *Cocos nucifera* (family Arecaceae) often called coconut in English (aki oyibo in Igbo, kwakwa in Hausa and agbon in Yoruba), contains the edible part, which is the endosperm tissue from which the milk is derived and has been reported to act as an aphrodisiac in folks medicine (Prakash *et al*., 2015). Sexual abnormality may present in different ways, like erectile dysfunction, inability for a man to conduct more than one round of sex, poor sexual performance, premature ejaculation and orgasmic disorders. Varying treatment plans have been proposed to forestall the consequences of infertility that may be faced by sufferers apart from the social and emotional breakdown. Atoigwe-Ogeyemhe *et al.* (2018); reported that the incidence of sexual abnormalities are on the rise and thus, require a faster approach, which is cost effective and without side effects in order to provide relief to sufferers. Individual studies on aphrodisiac potentials of *P. dactylifera* and *C. nucifera* crops have been reported (Baliga *et al*., 2011; Prakash *et al*., 2015). The mixed extract is yet to be investigated as several available studies reported the different parts of the plants. It may therefore, be assumed that the combined effect may be more effective than the individual plant. Scientifically, it may not always be true; as one or two active ingredients from any of the component plant may be acting as an antagonist to the overall function of the product. Therefore, the effects of *P. dactylifera and C. nucifera* mix extract in an equivalent quantity on mating profile in rats, which is a determinant of sexual performance, were investigated.

Materials and Methods

Ethical approval

This study was carried out in-line with the laid down rules regarding the maintenance and use of animals for experimentation (NRC, 2011). Approval was obtained from the University of Nigeria, Research and Ethics Committee at College of Medicine, Ituku-ozalla, Enugu, with protocol number (COMREC 032/02/2017) prior to the commencement of the research.

Experimental animals

Fifty-two first filial (F1) generation in-bred healthy male Wistar rats were randomly selected and grouped into A to M (n=4) per cage. The rats with an average weight of 197.6 ± 0.4g were obtained from the animal facility of University of Nigeria Teaching Hospital and kept in plastic cages with wood-dust as quilts. They were placed in a well aerated room with optimal temperature (25 ± 5°C) and humidity (45-50%) in a reversed 12 hours light/ dark cycle. The animals adapted to the controlled animal house for 14 days and were fed with pelletized rat feed and water provided adequately.

Plant preparation and extraction

Phoenix dactylifera (date palm fruit) and *Cocos nucifera* (coconut milk) were procured as commercial products from new Benin market in

Benin City, Nigeria. The crops were identified and authenticated by a trained botanist in the Department of Plant Biology and Biotechnology, University of Benin, Nigeria. Voucher numbers UBH_P420 and UBH_C418 were assigned and samples deposited at the herbarium section.

Phoenix dactylifera: Twenty-eight (28) pieces of date palm fruit (*P. dactylifera*) were opened and the fleshy parts weighing 82.6g was oven dried at 50°C and grounded using an electric blender (Kenwood 1.6L, BL480 Prestons, Australia) for 5 minutes. Grounding was repeated on the coarse and rough blend until a fine uniform powder was achieved. It was soaked in maceration apparatus (*Sam teck* Extrakions Technik GmbH, Austria) at 37° – 40°C with 1L of water for 24 hours. The macerate was filtered, allowed to settle, decanted, and then oven dried at 50°C to obtain a brownish paste used as the extract for experiment I.

Cocos nucifera: A fully developed coconut fruit (*Cocos nucifera*) was used. Method described by Nwangwa & Aloamaka (2011) was modified and used for the extraction. Coconut mesocarp was pealed-off while the nuts were removed. The water content was discarded and the palm fruits were grated. The fruit was then grated using a stainless steel grater to obtain the shredded coconut, which was uniformly blended using an electric blender as described earlier with 750 mL of water. It was then heated to 65°C and the residues filtered using a Buchner funnel and Whatman No.1 filter paper to obtain a solution. The milk was boiled for 20 minutes while the curd was scooped to remove the coconut oil. The coconut milk was later cooled to room temperature and was passed through the spray drying process (TP-S30 Mini Spray Dryer, SiccaDania, China) to obtain a hardened shell of skimmed coconut milk powder (Naik *et al.,* 2012). The powdered milk was stored at room temperature but was reconstituted before administration according to body weight of rats in experiment II.

Combined extract

We measured 6.25g of the individual extract (*P. dactylifera* and *C. nucifera*) and were mixed in equal proportion. The pooled extract was used to prepare the stock, which was administered to animals in experiment III.

Experimental design

Acute toxicity testing to determine the LD_{50} of each crop was conducted in a preliminary study from which the doses for the present study were extrapolated. The control received distilled water only while the treated groups received different concentration of the graded dose (250, 500, 750 and 1000 mg/kg) of *P. dactylifera, C. nucifera* and the mix. The extract was administered as a single daily dose by oral intubation. The study was divided into three phases (Experiment I to III) representing extract of *Phoenix dactylifera, Cocos nucifera* and the combined extract. Mating profile of male rats (n=4) was assessed by monitoring the activity of each rat according to the specified sexuality engagement for 3 hours after introducing the female counterparts (n=4) in an observation chamber. Profiles were monitored on the 20^{th}, 40^{th} and 60^{th} days of experimentation within the dark phase and reduced lighting effect. The mating parameters for profiling include mount latency (ML), intromission latency (IL), ejaculation latency (EL), post-ejaculatory interval (PEI), mount frequency (MF), intromission frequency (IF), ejaculation frequency (EF), inter-intromission interval (III) and intromission ratio (I/R). Ejaculation was keenly monitored resulting to a rhythmic contraction of the posterior abdomen ending with a slow forelimbs rising (Allouh, 2015; Obiandu *et al.,* 2018).

Empirical and physical measurements

Animals were weighed before and after experimentation with the standard electronic balance (Gilbertini, Italy; sensitivity = 0.001g). The amount of food consumed per day was calculated and presented in g/day, which resulted to an average of 22.8 ± 2.5g/day. Physical activities like sniffing, licking, jumping, racing, excitement, leaping, whizzing, climbing, restlessness, dullness and anxiety were monitored few hours after treatment/ female introduction to the observation chamber. Behavioral displays including anogenital sniffing and genital grooming, sexual attraction to females, caressing, and closeness or withdrawals from opposite sex were actively monitored by different assessment officers (Obiandu *et al.,* 2018).

Experimentation

Adienbo *et al.* (2013) method for determining sexual behavior in animals was adapted for mating profile in the present study. Rats were exposed to pre-experimental mating tests to ascertain their sexual experience, after which graded doses of extract were administered to the animals. The fifty-two treated male rats were placed in rectangular Plexiglas surveillance chambers measuring 52 x 45 x 38 cm and left to acclimatize for 10 minutes. Fifty-two female rats were then introduced into the chambers during the 12 hours dark cycle and were

monitored by trained expert observers who were oblivious of the experimental design in a sound-attenuated room. In order to keep the stimulated sexuality of male rats alive, we used female rats that were found to be very active during the pre-mating testing stages. Scoring was done by keen behavioral observation of the animals. Female rats that were less responsive, withdrawn and poorly interested in the opposite sex were removed while those that showed excellent receptivity like solicitation and lordosis were retained (Obiandu *et al.,* 2018).

Data analysis

Statistical analysis was performed using GraphPad Prism version 7.04 (San Diego, US). Effect of individual extracts and the mix on mating profile (ML, IL, EL, PEI, MF, IF, EF and I/R) were determined as explained earlier and expressed as mean value ± standard deviation (Mean ± SD). Mean differences was determined using one-way ANOVA and standard student's t-test and Probability values less or equal to 0.05 were regarded as significant.

Results

Uninterrupted oral administration of *P. dactylifera*, *C. nucifera* and the pooled extract for 60 days had a significant decrease ($p < 0.05$) in ML, IL, PEI and III, and were consistent across board compared to the effects on the 40^{th} and 20^{th} days respectively in comparison with the controls (Tables 1-3). In the distribution [ML: 122.30 ± 0.8 sec (20^{th} day); 96.01 ± 0.2 sec (40^{th}) and 75.16 ± 0.3 sec (60^{th}); IL (96.80 ± 0.6 sec; 88.13 ± 0.3 sec and 80.13 ± 0.6 sec); PEI (361.82 ± 1.4 sec; 343.41 ± 1.3 sec and 311.71 ± 1.1 sec); and III (31.29 ± 0.3 sec; 27.13 ± 0.1 sec and 19.12 ± 0.8 sec)] were reduced in rats treated with the highest dose of *P. dactylifera* extract in comparison to controls [ML (283.16 ± 0.15 to 286.11 ± 0.22 to 287.31 ± 0.92), IL (124.55 ± 4.1 sec; 123.46 ± 1.6 sec and 121.82 ± 1.7 sec), PEI (395.62 ± 2.3 sec; 393.12 ± 1.6 sec and 388.84 ± 1.7 sec) and III (44.58 ± 0.2 sec; 42.63 ± 0.3 and 38.63 ± 0.1 sec)]. *C. nucifera:* ML (128.31 ± 0.2 sec; 107.53 ± 0.7 sec and 99.14 ± 0.6 sec); IL (81.13 ± 0.1 sec; 81.18 ± 0.9 sec and 81.13 ± 0.1 sec); PEI (264.12 ± 1.4 sec; 281.33 ± 1.7 sec and 243.12 ± 1.6 sec); and III (26.32 ± 2.7 sec; 21.23 ± 0.6 sec and 19.02 ± 0.7 sec) were progressively reduced on the 20^{th}, 40^{th} and 60^{th} days of the experimentation compared to the controls. Also, ML (94.39 ± 5.2 sec; 86.11 ± 0.3 sec and 73.06 ± 0.1 sec); IL (75.82 ± 1.3 sec); 61.11 ± 0.7 sec and 55.95 ± 0.1 sec); PEI (263.02 ± 1.2 sec; 213.38 ± 1.6 sec and 243.12 ± 1.6 sec); and III (23.13 ± 0.6 sec; 16.32 ± 0.4 sec and 13.01 ± 0.5 sec) decreased in rats treated with 1000mg/kg dose of the pooled extract as well as the other doses after comparison with the controls (Tables 1-3). On the other hand, the values for MF, EL, EF, IF and IR increased significantly ($p < 0.05$) with a greater effect manifesting on the 60^{th} day compared to 40^{th}, 20^{th} and the controls (Tables 1-3). The distribution showed that MF (6.61 ± 0.1); EL (621.38 ± 2.7 sec); EF (3.25 ± 0.1); IF (14.11 ± 0.3) and IR (3.25 ± 0.2) increased in a dose-related manner on the 20^{th} day after oral administration of 1000mg/kg dose of *P. dactylifera* extract and other doses. On 40^{th} day, MF (7.12 ± 0.1); EL (712.16 ± 1.3); EF (8.68 ± 0.7); IF (17.10 ± 0.5) and IR (4.68 ± 0.3). On the 60^{th} day, MF (9.26 ± 0.4); EL (853.03 ± 1.3 sec); EF (11.75 ± 0.3); IF (20.10 ± 0.7) and IR (3.75 ± 0.3) all improved compared to the controls – MF (4.32 ± 0.9; 4.42 ± 0.1 and 5.07 ± 0.3); EL (445.37 ± 3.1; 461.02 ± 1.4 and 440.16 ± 1.2); EF (2.75 ± 0.4; 3.83 ± 0.2 and 3.21±0.4); IF (11.06 ± 0.5; 11.58 ± 0.6 and 11.94 ± 0.1) and IR (2.75 ± 0.3; 2.76 ± 0.4 and 2.78 ± 0.2) respectively. *C. nucifera:* MF (13.78 ± 0.1; 19.21 ± 0.4 and 26.72 ± 0.3); EL (679.16 ± 2.3 sec; 681.62 ± 1.4 sec and 774.16 ± 1.8 sec); EF (9.67 ± 0.8; 11.97 ± 0.1 and 13.72 ± 1.3); IF (26.09 ± 0.2; 29.10 ± 0.2 and 36.99 ± 0.6) and IR (2.96 ± 0.8; 3.34 ± 0.2 and 4.72 ± 0.6) were increased on the 20^{th}, 40^{th} and 60^{th} days of the treatment compared to the controls. In addition there was a rise in MF (14.71 ± 0.4; 21.18 ± 0.8 and 29.44 ± 0.2); EL (765.27 ± 3.2 sec; 827.14 ± 1.2 sec and 966.11 ± 1.8 sec); EF (10.67 ± 0.8; 14.24 ± 0.1 and 19.87 ± 0.8); IF (27.99 ± 1.3; 33.99 ± 0.6 and 39.02 ± 0.3) and IR (4.67 ± 0.8; 8.46 ± 1.1 and 8.86 ± 0.3) in animals treated with the highest dose of the pooled extract in comparison with the controls.

Our result indicated that continuous daily consumption of the individual crops and the mix resulted in a significant improvement ($p < 0.05$) in sexual performance in male rats (Tables 1-3). This study also showed a strong significance in experiment III ($P \leq 0.025$) followed closely by experiment II ($P \leq 0.045$) compared to experiment I that is negligibly insignificant ($P \geq 0.056$) using one-way ANOVA after matching with the control (Table 4). Our result further revealed that the parameters either decreased or increased in a dose-dependent manner, which is an indulgence of a good sexual performance. After the introduction of females into the observation chamber, treated male rats demonstrated a rise in careering, sniffing and snooping with an increased genital grooming as well as a sharp pursuit and anogenital smelling of the opposite sex, which are indicative of pre-sexuality activities prior to mating (Table 5). There was no trace of weakness or reduced penile reflexes especially in animals that consumed the mixed

Table 1: Mating profile in rats treated with varying doses of *Phoenix dactylifera* and *Cocos nucifera* mix for 20 days

Profile	control	250mg/kg	500mg/kg	750mg/kg	1000mg/kg	P-value
Experiment 1 (*P. dactylifera*)						
Mount latency (ML) sec.	283.16 ± 0.2*	206.15 ± 0.2	191.27 ± 0.3*	166.00 ± 0.1*	122.30 ± 0.8**	0.006
Mount frequency (MF)	4.32 ± 0.9*	5.71 ± 0.3	5.89 ± 0.3	6.19 ± 0.5	6.61 ± 0.1	0.163
Intromission latency (IL) sec.	124.55 ± 4.1*	124.80 ± 2.7	122.23 ± 1.1	103.32 ± 1.2*	96.80 ± 0.6**	0.311
Intromission frequency (IF)	11.06 ± 0.5*	11.93 ± 0.6	12.02 ± 0.4	13.10 ± 0.7	14.11 ± 0.3	0.065
Ejaculation latency (EL) sec.	445.37 ± 3.1*	534.90 ± 3.7	541.22 ± 2.1	599.16 ± 2.3*	621.38 ± 2.7*	0.046
Ejaculatory frequency (EF)	2.75 ± 0.4*	2.75± 0.4	3.05± 0.9*	3.15± 0.2*	3.25± 0.1*	0.361
Post-ejaculatory interval (PEI) sec.	395.62 ± 2.3*	385.50 ± 1.1	385.12 ± 1.3	365.22 ± 1.2*	361.82 ± 1.4*	0.004
Inter-intromission interval (III) sec.	44.58 ± 0.2*	43.19 ± 0.6	42.11 ± 2.2	37.35 ± 0.3*	31.29 ± 0.3**	0.149
Intromission ratio (I/R)	2.75 ± 0.3	2.75± 0.5	3.05± 0.1*	3.15± 0.1*	3.25± 0.2*	0.061
Experiment II (*C. nucifera*)						
Mount latency (ML) sec.	283.16 ± 0.2*	193.33 ± 0.6	177.11 ± 4.2*	151.23 ± 0.5*	128.31 ± 0.2**	0.056
Mount frequency (MF)	4.32 ± 0.9*	6.60 ± 0.4	7.83 ± 0.1*	9.11 ± 0.1*	13.78 ± 0.1*	0.002
Intromission latency (IL) sec.	124.55 ± 4.1*	103.11 ± 1.5*	91.11 ± 3.2**	90.11 ± 0.2**	81.13 ± 0.1**	0.031
Intromission frequency (IF)	11.06 ± 0.5*	16.93 ± 0.4*	19.39 ± 1.8*	21.01 ± 0.5*	26.09 ± 0.2*	0.003
Ejaculation latency (EL) sec.	445.37 ± 3.1*	551.14 ± 2.5*	580.31 ± 2.7*	628.56 ± 2.9*	679.16 ± 2.3**	0.019
Ejaculatory frequency (EF)	2.75 ± 0.4*	3.12 ± 0.1	4.25 ± 0.5*	5.57 ± 0.5*	9.67 ± 0.8**	0.057
Post-ejaculatory interval (PEI) sec.	395.62 ± 2.3*	313.33 ± 1.6**	303.19 ± 0.1**	283.92 ± 1.2**	264.12 ± 1.4**	0.041
Inter-intromission interval (III) sec.	44.58 ± 0.2*	39.36 ± 0.7**	31.24± 0.6**	28.01 ± 0.1**	26.32 ± 2.7**	0.051
Intromission ratio (I/R)	2.75 ± 0.3	2.78 ± 0.1	2.78 ± 0.6	2.92 ± 0.4	2.96 ± 0.8	0.929
Experiment III (Pooled extract)						
Mount latency (ML) sec.	283.16 ± 0.2*	171.93 ± 0.5	166.43 ± 0.5*	111.56 ± 0.3*	94.39 ± 5.2**	0.046
Mount frequency (MF)	4.32 ± 0.9*	6.76 ± 0.5*	7.92 ± 0.7*	9.53 ± 0.2*	14.71 ± 0.4**	0.002
Intromission latency (IL) sec.	124.55 ± 4.1*	101.07 ± 0.1	89.38 ± 0.3	76.16 ± 0.3**	75.82 ± 1.3**	0.325
Intromission frequency (IF)	11.06 ± 0.5*	17.67 ± 0.7*	19.84 ± 0.8*	23.78 ± 0.4**	27.99 ± 1.3***	0.002
Ejaculation latency (EL) sec.	445.37 ± 3.1*	598.18 ± 1.7*	643.25 ± 3.4*	681.18 ± 1.6***	765.27 ± 3.2***	0.051
Ejaculatory frequency (EF)	2.75 ± 0.4*	5.12 ± 0.1	6.25± 0.8*	9.57± 0.4*	10.67± 0.8***	0.051
Post-ejaculatory interval (PEI) sec.	395.62 ± 2.3*	310.12 ± 1.2*	295.32 ± 3.1*	271.63 ± 1.5*	263.02 ± 1.2*	0.051
Inter-intromission interval (III) sec.	44.58 ± 0.2*	39.05 ± 0.2*	30.11 ± 0.4*	25.46 ± 0.1*	23.13 ± 0.6**	0.053
Intromission ratio (I/R)	2.75 ± 0.3	3.12 ± 0.1	3.25 ± 0.8*	3.57 ± 0.4*	4.67 ± 0.8**	0.051

All values are expressed as mean ± standard deviation for 4 rats per group mating on 20th day in the dark phase. sec. = seconds

Values with different asterisks in superscript along the same row are significantly varied at $P \leq 0.05$

Table 2: Mating profile in rats treated with varying doses of *Phoenix dactylifera* and *Cocos nucifera* mix for 40 days

Profile	Control	250mg/kg	500mg/kg	750mg/kg	1000mg/kg	P-value
Experiment 1 (*P. dactylifera*)						
Mount latency (ML) sec.	286.11 ± 0.2*	161.11 ± 0.4*	116.04 ± 0.2**	103.06 ± 0.1**	96.01 ± 0.2**	0.001
Mount frequency (MF)	4.42 ± 0.1*	5.92 ± 0.6	6.23 ± 0.3	6.37 ± 0.2	7.12 ± 0.1	0.153
Intromission latency (IL) sec.	123.46 ± 1.6*	121.41 ± 1.3	112.10 ± 1.1*	96.12 ± 1.5**	88.13 ± 0.3**	0.003
Intromission frequency (IF)	11.58 ± 0.5*	14.03 ± 0.4	15.10 ± 0.3	15.92 ± 0.8	17.10 ± 0.5*	0.155
Ejaculation latency (EL) sec.	461.02 ± 1.4*	521.10 ± 2.1*	598.26 ± 1.1*	661.46 ± 2.2*	712.16 ± 1.3*	0.049
Ejaculatory frequency (EF)	3.83 ± 0.2*	5.12 ± 0.3	5.33 ± 0.3*	7.16 ± 0.7*	8.68 ± 0.7**	0.047
Post-ejaculatory interval (PEI) sec.	393.12 ± 1.6*	365.11 ± 1.4*	360.53 ± 1.6*	351.43 ± 2.2*	343.41 ± 1.3*	0.239
Inter-intromission interval (III) sec.	42.63 ± 0.3*	37.56 ± 0.1	33.31 ± 0.1*	31.03 ± 0.1**	27.13 ± 0.1**	0.195
Intromission ratio (I/R)	2.76± 0.4	3.03± 0.6	4.33± 0.3*	4.46± 0.7*	4.68 ± 0.3**	0.047
Experiment II (*C. nucifera*)						
Mount latency (ML) sec.	286.11 ± 0.2*	166.45 ± 0.4	143.71 ± 0.3*	126.37 ± 0.6*	107.53 ± 0.7**	0.049
Mount frequency (MF)	4.42 ± 0.1*	8.91 ± 0.2*	10.56 ± 0.3	15.41 ± 0.1	19.21 ± 0.4**	0.001
Intromission latency (IL) sec.	123.46 ± 1.6*	101.08 ± 1.4	93.13 ± 1.4*	92.39 ± 0.1*	81.18 ± 0.9*	0.032
Intromission frequency (IF)	11.58 ± 0.5*	18.11 ± 0.1	22.21 ± 0.3	27.23 ± 0.7	29.10 ± 0.2*	0.001
Ejaculation latency (EL) sec.	461.02 ± 1.4*	539.01 ± 2.1**	589.10 ± 1.1**	612.10 ± 1.3**	681.62 ± 1.4**	0.053
Ejaculatory frequency (EF)	3.83 ± 0.2*	7.15 ± 0.3	8.37 ± 0.9*	10.02 ± 0.6**	11.97 ± 0.1**	0.033
Post-ejaculatory interval (PEI) sec.	393.12 ± 1.6*	329.11 ± 2.1*	316.23 ± 5.1**	289.93 ± 1.7**	281.33 ± 1.7**	0.013
Inter-intromission interval (III) sec.	42.63 ± 0.3*	31.03 ± 0.3*	27.11 ± 0.4**	23.87 ± 0.2**	21.23 ± 0.6**	0.019
Intromission ratio (I/R)	2.76± 0.4	2.79 ± 0.6	3.14 ± 0.3*	3.23 ± 0.5*	3.34 ± 0.2*	0.056
Experiment III (Pooled extract)						
Mount latency (ML) sec.	286.11 ± 0.2*	151.31 ± 0.5*	135.89 ± 0.7*	127.58 ± 0.7*	86.11 ± 0.3**	0.031
Mount frequency (MF)	4.42 ± 0.1*	9.61 ± 0.2	13.11 ± 05*	18.31 ± 0.1**	21.18 ± 0.8***	0.001
Intromission latency (IL) sec.	123.46 ± 1.6*	91.76 ± 0.3**	86.87 ± 0.9**	75.01 ± 0.4**	61.11 ± 0.7**	0.001
Intromission frequency (IF)	11.58 ± 0.5*	18.31 ± 0.5*	22.98 ± 0.5*	29.82 ± 0.2*	33.99 ± 0.6*	0.000
Ejaculation latency (EL) sec.	461.02 ± 1.4*	508.13 ± 1.8**	681.12 ± 1.3**	761.26 ± 1.2**	827.14 ± 1.2**	0.003
Ejaculatory frequency (EF)	3.83 ± 0.2*	9.12 ± 0.3	11.37 ± 0.7*	12.11 ± 0.5**	14.24 ± 0.1***	0.003
Post-ejaculatory interval (PEI) sec.	393.12 ± 1.6*	241.14 ± 1.5**	239.13 ± 2.6**	227.13 ± 1.1**	213.38 ± 1.6**	0.001
Inter-intromission interval (III) sec.	42.63 ± 0.3*	20.21 ± 0.4**	17.03 ± 0.2**	17.01± 0.6**	16.32 ± 0.4**	0.001
Intromission ratio (I/R)	2.76± 0.4	5.15 ±0.3	5.37 ± 0.1*	8.02 ± 0.3**	8.46 ± 1.1**	0.003

All values are expressed as mean ± standard deviation for 4 rats per group mating on 40th day in the dark phase. Sec. = seconds
Values with different asterisks in super script along the same row are significantly varied at $P \leq 0.05$

Table 3: Mating profile in rats treated with varying doses of *Phoenix dactylifera* and *Cocos nucifera* mix for 60 days

Profile	Control	250mg/kg	500mg/kg	750mg/kg	1000mg/kg	P-value
Experiment 1 (*P. dactylifera*)						
Mount latency (ML) sec.	287.31 ± 0.2*	159.48 ± 0.8**	102.13 ± 0.2*	88.17 ± 0.9**	75.16 ± 0.3**	0.001
Mount frequency (MF)	5.07 ± 0.3*	6.87 ± 0.3*	7.83 ± 0.3*	8.66 ± 0.1*	9.26 ± 0.4**	0.056
Intromission latency (IL) sec.	121.82 ± 1.7*	114.80 ± 1.9	107.23 ± 1.3	101.32 ± 1.5*	80.13 ± 0.6*	0.016
Intromission frequency (IF) sec.	11.94 ± 0.1*	14.33 ± 0.3	16.97 ± 1.6	17.17 ± 0.1*	20.10 ± 0.7*	0.133
Ejaculation latency (EL) sec.	440.16 ± 1.2*	611.21 ± 1.1	631.21 ± 1.1	771.38 ± 1.7*	853.03 ± 1.3*	0.023
Ejaculatory frequency (EF)	3.21 ± 0.4*	7.16 ± 0.3**	7.24 ± 0.2**	9.56 ± 0.4**	11.75 ± 0.3***	0.002
Post-ejaculatory interval (PEI) sec.	388.84 ± 1.7*	341.41 ± 1.2*	340.12 ± 1.1*	321.49 ± 1.6**	311.71 ± 1.1**	0.011
Inter-intromission interval (III) sec.	38.63 ± 0.1*	34.23 ± 0.1*	27.41 ± 0.2**	23.24 ± 0.1**	19.12 ± 0.8**	0.001
Intromission ratio (I/R)	2.78 ± 0.2	3.16 ± 1.1	3.24 ± 4.2	3.56 ± 3.4	3.75 ± 0.3	0.062
Experiment II (*C. nucifera*)						
Mount latency (ML) sec.	287.31 ± 0.2*	152.36 ± 0.2	130.38 ± 0.1*	108.23 ± 0.7*	99.14 ± 0.6*	0.031
Mount frequency (MF)	5.07 ± 0.3*	9.60 ± 0.4*	11.43 ± 0.1*	19.18 ± 0.7**	26.72 ± 0.3***	0.000
Intromission latency (IL) sec.	121.82 ± 1.7*	103.11 ± 1.1*	91.11 ± 0.2**	90.11 ± 0.8**	76.07 ± 0.1**	0.031
Intromission frequency (IF)	11.94 ± 0.1*	21.93 ± 0.2*	23.39 ± 0.5*	29.01 ± 0.5*	36.99 ± 0.6*	0.001
Ejaculation latency (EL) sec.	440.16 ± 1.2*	573.14 ± 1.4*	620.31 ± 1.2*	698.56 ± 1.9*	774.16 ± 1.8**	0.019
Ejaculatory frequency (EF)	3.21 ± 0.4*	6.14 ± 0.6*	7.33 ± 0.2**	10.49 ± 0.5**	13.72 ± 1.3**	0.053
Post-ejaculatory interval (PEI) sec.	388.84 ± 1.7*	313.33 ± 1.5**	303.19 ± 1.1**	283.92 ± 1.2**	243.12 ± 1.6**	0.051
Inter-intromission interval (III) sec.	38.63 ± 0.1*	29.36 ± 0.8**	21.24 ± 0.6**	21.01± 1.1**	19.02 ± 0.7**	0.041
Intromission ratio (I/R)	2.78 ± 0.2	4.33 ± 0.6	4.51 ± 0.1	4.62 ± 0.2	4.72 ± 0.6	0.052
Experiment III (Pooled extract)						
Mount latency (ML) sec.	287.31 ± 0.2*	142.91 ± 0.5*	117.16 ± 0.2*	82.26 ± 0.8*	73.06 ± 0.1**	0.011
Mount frequency (MF)	5.07 ± 0.3*	10.01 ± 0.2*	13.91 ± 0.1**	22.11 ± 0.1*	29.44 ± 0.2***	0.000
Intromission latency (IL) sec.	121.82 ± 1.7**	92.23 ± 0.3**	81.32 ± 0.4**	67.99 ± 0.2**	55.95 ± 0.1**	0.001
Intromission frequency (IF)	11.94 ± 0.1*	23.29 ± 0.1*	27.11 ± 0.3*	29.87 ± 0.1**	39.02 ± 0.3***	0.000
Ejaculation latency (EL) sec.	440.16 ± 1.2*	701.10 ± 3.4**	782.11 ± 1.9**	931.06 ± 1.9**	966.11 ± 1.8**	0.003
Ejaculatory frequency (EF)	3.21 ± 0.4*	13.26 ± 0.7*	13.41 ± 0.2**	18.54 ± 0.5**	19.87 ± 0.8**	0.001
Post-ejaculatory interval (PEI) sec.	388.84 ± 1.7*	222.14 ± 1.2**	217.53 ± 1.1**	201.10 ± 1.4**	186.33 ± 1.3**	0.001
Inter-intromission interval (III) sec.	38.63 ± 0.1*	19.11 ± 0.2**	14.36 ± 0.1**	14.01 ± 0.3**	13.01 ± 0.5**	0.011
Intromission ratio (I/R)	2.78 ± 0.2	6.34± 0.6*	8.16± 0.4**	8.51± 0.9**	8.86± 0.3**	0.001

All values are expressed as mean ± Standard deviation for 4 rats per group mating on 60th day in the dark phase. sec. = seconds

Values with different asterisks in super script along the same row are significantly varied at $P \leq 0.05$

Table 4: T-test analysis for mating profile of experimental groups

	Paired t-test			
Extract	20 days	40 days	60 days	P-value
Experiment 1	4.121	3.411	3.311	0.056
Experiment II	3.433	3.501	2.113	0.045
Experiment III	3.032	4.421	2.202	0.025

Values are significantly different at P ≤ 0.05 using one-way ANOVA

extract, which indicates that all extract (date, coconut and mix) did not result in sedative effects during the period of examination (Table 5). There is an insignificant loss in weight in animals treated with *P. dactylifera* (234.32±3.1 to 231.93±1.2); *C. nucifera* (236.02± 7.6 to 232.98± 2.2) and the mix (236.02±2.6 to 232.98± 2.2) compared to an increase in the control (162.40± 1.4 to 167.32± 1.1). Consequently, daily food consumption increased slightly in the highest dose with *C. nucifera* treated animals (23.7 ± 3.6), decreased a little in the mix extract (21.6 ± 3.3) and *P. dactylifera* (20.6 ± 2.2) compared to the control (22.8 ± 2.5) (Table 5).

Discussion

In the present study, we defined each parameter for a mating profile to enable the understanding of the concepts that constitute sexuality behaviour in male rats. Firstly, mount latency (ML) is considered as the time from the introduction of a female to the incidence of first mount. Mount frequency (MF) showed the number of mounts prior to a discharge while inter-intromission interval (III) accounts for the average intermission in between succeeding intromissions. These observations have been significantly demonstrated by the mix ($P < 0.05$) especially on the 60th day of administration compared to the individual extracts and their various doses (Tables 1-3). It indicated that the mix is a better option for sexual improvement as reported earlier by Fouche *et al.* (2015), which particularly emphasized the need for reduced time of ML, IL, PEI and III as an indication of power, potency, improved sex drive and vigour in sexuality. Our report further supports the claim in which reduced ML, IL, PEI and III were observed to be a reflection of sexual inspiration in animals (Fouche *et al.*, 2015). We also agree with the report of Ralebona *et al.* (2012) stating that G*arcinia kola* seed caused a highly significant (p ≤ 0.01) increase in MF, EL, EF, IF and IR and that a rise indicates that *Garcinia kola* is capable of causing improved sexuality in treated animals. This information is buttressed by the report of Fouche *et al.* (2015) who stated that MF is an important measure of both libido and potency and as such an elevated value is indicative of a sustained increase in sexual activity and aphrodisiac property in a plant. While there is an affirmation that elevated MF is believed to be an important index of sexual stimulus, efficacy of erection and penile coordination (Prakash *et al.,* 2015).

Secondly, intromission frequency (IF) is observed as the number of vaginal penetration until there is a discharge, which differs from intromission latency (IL) that relates to the recorded time from when a female is introduced into the investigation chamber to the first vaginal penetration. A delayed penetration is an indication of poor viability and reduced libido. Our finding revealed that there was a dose-dependent significant increase in IF from the mix extract (P ≤ 0.001) and a simultaneous reduction in IL in a similar manner (P ≤ 0.009) except for *P. dactylifera* and *C. nucifera,* which did not show a significant (P > 0.05) improvement in the level of perceived sexuality in experiments I and II. This observation agrees with an earlier report by Yakubu & Quadri (2012) suggesting that medicinal crops with possible potentials to improve sexual arousal, sexual stimulus and vigour ought to result in a significant increase in IF and a decrease in IL, which are both indicative of aphrodisiac activities. We agree with Yakubu & Akanji (2011), in which a significant rise in the sum of intromission frequency (IF) is suggestive of erectile efficiency, penile positioning and the perfect manner at which ejaculatory reflexes are coordinated after activation. The improvement observed in sex drive, sexual ability, vigour, strength and erectile viability was further corroborated by increased intromission ratio (IR) across all treated groups compared to the control. According to Allouh *et al.* (2015), intromission ratio (IR) was reported as the extent of successful vaginal penetration, which is calculated as intromission frequency/ (mount frequency + intromission frequency). However, the degree of improvement is best shown in experiments II and III compared to experiment I and the control group. *Phoenix dactylifera* was better in terms of IR than *C.*

Table 5: Empirical and physical measurement in rats treated with *P. dactylifera, C. nucifera* and pooled extract

EXTRACT	Groups	Conc. (mg/kg)	Doses (mL)	Initial Average Weight (g)	Final Average Weight (g)	Difference in Weight	Reduced/ Increased Physical Activity	Food consumption in g/day
Distilled water (C)	A	0	0	162.40 ± 1.4	167.32 ± 1.1	5.44 ± 0.3 ↑↑	±	22.8 ± 2.5
P. dactylifera	B	250	0.5	186.61 ± 1.3	187.86 ± 2.5	1.25 ± 2.9 ↑	+	21.3 ± 3.3
P. dactylifera	C	500	1	200.34 ± 1.2	199.06 ± 8.6	0.62 ± 1.1 ↓	++	20.1 ± 3.1
P. dactylifera	D	750	1.5	221.60 ± 0.9	219.14 ± 3.8	2.54 ± 1.6 ↓	++	19.8 ± 2.9
P. dactylifera	E	1000	2	234.32 ± 3.1	231.93 ± 1.2	3.49 ± 1.3 ↓	++	20.6 ± 2.2
C. nucifera	F	250	0.5	187.96 ± 1.8	189.21 ± 4.7	2.25 ± 2.9 ↑	+	24.4 ± 2.2
C. nucifera	J	500	1	201.62 ± 8.2	200.96 ± 2.3	0.86 ± 3.7 ↓	+	23.7 ± 1.7
C. nucifera	H	750	1.5	220.10 ± 0.9	217.96 ± 3.0	3.64 ± 1.5 ↓	+	23.7 ± 1.5
C. nucifera	I	1000	2	236.02 ± 7.6	232.98 ± 2.2	4.34 ± 2.5 ↓↓	+	23.7 ± 2.6
Pooled Extract	J	250	0.5	189.06 ± 1.4	184.21 ± 4.7	5.25 ± 2.9 ↓↓	+	21.3± 1.4
Pooled Extract	K	500	1	205.16 ± 1.1	200.96 ± 2.3	5.62 ± 1.1 ↓	++	22.2 ± 2.7
Pooled Extract	L	750	1.5	219.23 ± 1.2	216.06 ± 3.1	3.64 ± 1.5 ↓	++	22.5 ± 1.1
Pooled Extract	M	1000	2	237.02 ± 2.1	234.98 ± 2.2	3.34 ± 3.6 ↓	++	21.6 ± 3.3

All values are expressed as mean ± standard deviation with 4 number of rats per group for matching
Conc. = concentration, physical activities include: dullness, leaping, whizzing, racing, jumping, licking, climbing, anogenital sniffing and genital grooming
C = control
negligible (±)
present (+)
absent (-)
strongly present (++)

nucifera but the mixture of both crops had a greater effect especially in the high dose administration, which is highly demonstrated on 20^{th}, 40^{th} and 60^{th} days unlike the individual extract that regain their full potentials towards the end of the experiment i.e on the 60^{th} day (Tables 1-3). This study is in consonance with reports that showed a positive demonstration of IR in male rats. It further suggests that the supposed observations may be indicative of an improved sexual appetite and polished sexual behavior indicating that the improvement may be drawn from the administered extract (Allouh *et al*., 2014; Allouh, 2015).

Thirdly, other parameters like ejaculatory frequency (EF), which is the number of discharges observed from the period of mount to a specified time frame (e.g 30 min). Ejaculatory latency (EL) being the time between the first intromission and the first discharge. Post-Ejaculatory Interval (PEI) describes the time between a discharge and the following vaginal penetration. In this study, *P. dactylifera* and *C. nucifera* mix extract were distinguishing in a dose-related form, which corroborates the finding of Ahmed & Aslam, (2018) in which elevated values of EF and EL, and a reduced PEI are positively described to be influenced by *Ganoderma lucidum* orally administered to male rats. It was concluded that the treatment may have potentials for erectile dysfunctions rather than improvement in the mating ability in rats. Anderson (2011) argues that the ability to engage in the act of sexual performance does not necessarily depend on sexual arousal but rather on erectile function. If an individual is experiencing erectile dysfunction, it can affect the entire sex life including performance even when there is a very strong sexual motivation. Sexual performance depends on neurovascular occasions by means of hemodynamic mechanism of penile erection (Anderson, 2011). We are of the opinion that the reverse of the actual situation has been described above. Meaning that when there is no motivation there is already a loss in the desire for sex as the state of mind has been rendered powerless, which ultimately prevents blood flow to the penile region for erection to occur (Odigie & Osula, 2014). In support of this discuss adequate penile erection was accomplished upon administration by different extract and was statistically significant ($P < 0.005$) in all experimental groups (Table 4), which is not dissimilar to the report of Afolayan & Yakubu (2009); in which erection was observed in all the treated rats used for experimentation. From the foregoing, Sharma *et al.* (2010) reported that PEI is a measure of potency, libido and the degree of recovery from exhaustion after the first set of mating and a vital parameter for evaluating the effect of administered extracts on erectile function. Reduced PEI also indicates an improvement in erection and the ability to copulate excellently (Fouche *et al*., 2015).

In conclusion, we suggest that pooled aqueous crop extract of *P. dactylifera* and *C. nucifera* in the right proportion has lasting potentials on the mating profile of male Wistar rats than the individual ability. Although we request that further investigation is necessary to adequately cater for the mechanism of action.

Conflicts of Interest

The authors declare no conflicts of interest.

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