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Exploring the Aphrodisiac Potential of Tongkat Ali Hitam (*Polyalthia bullata*) In Male Sprague-Dawley Rats

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Introduction

Aphrodisiac can be defined as a substance that can enhance sexual performance, increase libido and treat sexual dysfunction[1]. There are several plants that have been claimed to contain aphrodisiac property such as *Polyalthia bullata (PB), Eurycoma longifolia (EL), Rafflesia sp., Terminalia catappa, Labisia pumila* and *Smilax myosotiflora*[2]. *Polyalthia* genus consists of 120 species of shrubs and trees commonly found in tropical and subtropical regions. *Polyalthia bullata* or 'Tongkat Ali Hitam' is a small tree that can be found in Peninsular Malaysia and Borneo. It comes from the family of Annonaceae[2]. This plant is one of the aphrodisiac plants traditionally used in Malaysia[3]. It stimulates sexual desire and the root decoction is consumed as a male tonic[4]. *Polyalthia bullata* shares the same local name 'Tongkat Ali' that has lead the locals to believe it can be used as an aphrodisiac for men[5]. The leaf, flower and root of *PB* plant have been reported to treat high blood pressure and diabetes. It is also used to increase male sexual drive, treat skin problems and as a general tonic for both men and women. It is also claimed to treat liver disease[6]. However, there is no accurate information regarding its claimed medicinal uses[5]. To our knowledge, the mechanism of action of *PB* on the reproductive system has not been extensively studied.

Male hypogonadism that is not widely being diagnosed is characterized by the symptoms such as sexual dysfunction and erectile dysfunction that requires treatment. This problem can be diagnosed when level of testosterone in serum shows an abnormally low result. Testosterone replacement therapy (TRT) is the common treatment for this problem[7] which also increases the risk of getting prostatic cancer. Therefore, there are erectile dysfunction's sufferers that seek for alternative or herbal supplement to treat their problem but without the recommendations by the clinicians as there is insufficient scientific evidence on the efficiency and safety of alternative treatment[8]. Natural aphrodisiac is believed to be a natural alternative for TRT as it has been proven to elevate serum testosterone level[9] and the extract can be used as an alternative treatment without causing the side effects of TRT[10]. Therefore, the present study aimed to identify the potential effect of PB on male, specifically on body weight, reproductive organ weight and regulation of serum androgens. To our knowledge, no studies had made a comprehensive investigation on the effect of PB on the male reproductive system.

Methods

Materials

PB extract (in powdered form) was obtained from LJack Sdn Bhd, Malaysia. Dihydrotestosterone (DHT) and androstenedione (ASD) ELISA kit was purchased from Elabscience Biotechnology, China. Dehydroepiandrosterone (DHEA) ELISA kit was purchased from Shanghai Qayee Biotechnology, China. All other ingredients used were of analytical grade.

Animal and treatment

Sixteen male Sprague-Dawley (SD) rats weighing 150-250g were kept in separate individual ventilated cages (IVC) at the Laboratory Animal Facility and Management (LAFAM), University Teknologi

MARA (UiTM) Malaysia. The rats were fed with pellets and water *ad libitum*. Table 1 shows the animal grouping and treatment received. All treatments were administered orally everyday between 8.00 am to 11.00 am for fourteen days. Body weights of the rats were recorded daily. Ethic approval for the present study was obtained from UiTM CARE (Committee on Animal Research and Ethics: #198/2017).

Table 1: Animal group and treatment

Group	Quantity (n)	Treatment
Control	8	Purified water
PB 800 mg/kg	8	*Polyalthia bullata*

Sacrifice and organ/blood collection

At day 15, all rats were anesthetized with Zoletil (0.1g/kg). Blood was collected via cardiac puncture. Animals were dissected and reproductive organs were removed and weighed. Blood collected were centrifuged at 3000 rotation per minute (rpm) at 4°C for 10 minutes. Serum samples were stored at -80°C until hormonal assay assessment.

Hormone assay

Enzyme linked-immunosorbent assay (ELISA) method was performed according to manufacturer's protocol to quantify the level of dihydrotestosterone (DHT), androstenedione (ASD) and dehydroepiandrosterone (DHEA).

Statistical analysis

All data were recorded and statistically analyzed using independent T-Test (parametric data) and Mann-Whitney U Test (non-parametric data). Pearson's correlation coefficient was used for correlation of body weight changes during the 14 days of treatment (SPSS version 23.0). The value of $p<0.05$ was considered as significant. The results are presented as mean ± SD/SEM.

Results and discussion

Mean daily body weight

Following the treatment of animals, *PB* has caused a significantly lower mean daily body weight compared to control (P=0.00).

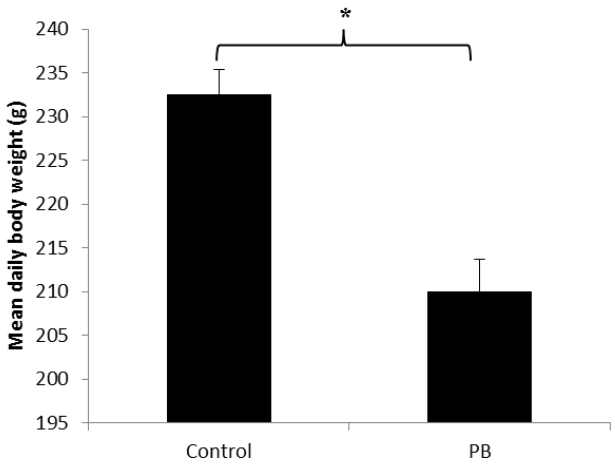

Figure 1: Mean daily body weight of rats at for control and treatment group

Reproductive organs weight

Treatment of *PB* on rats has no effect on reproductive organ weights as compared to control. However, there is a trend of decrease testes and seminal vesicle weight while epididymis and prostate showed an increase pattern compared to control, although all these changes were not statistically significant ($p>0.05$).

Table 1: Mean reproductive organs weight for control and treatment group

Mean reproductive organ weight (g) ± SEM		
Organ	**Control**	***PB* 800mg/kg**
Testis left	1.30 ± 0.099	1.122 ± 0.113
Testis right	1.293 ± 0.092	1.119 ± 0.108
Epididymis left	0.490 ± 0.027	0.5445 ± 0.043
Epididymis right	0.495 ± 0.029	0.506 ± 0.032
Seminal vesicle	0.501 ± 0.081	0.439 ± 0.110
Prostate	0.885 ± 0.038	1.1105 ± 0.026

Hormone analysis

Treatment of *PB* has caused a significant increase in serum DHT concentration compared to control ($p=0.04$). Serum androstenedione was significantly decreased by PB ($p<0.05$) and no significant different was observed between both groups for DHEA serum concentration, although *PB* showed a decreased pattern of serum DHEA concentration compared to control.

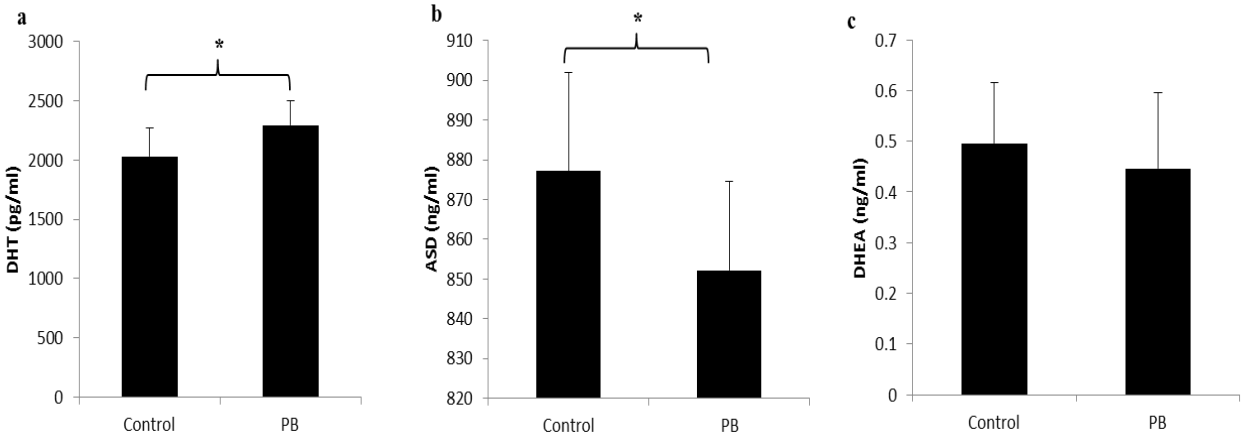

Figure 2: Mean serum DHT level (a), ASD level (b) and DHEA level (c) for control and treatment group

Discussion

From this study, it is shown that PB has caused a significantly lower daily body weight by 9.68% compared to control. Decreased body weight was reported for rats treated with other aphrodisiac plants such as *Eurycoma longifolia* (EL)[10]. It is said that the decrease in body weight is due to increase in testosterone and decrease in fat mass due to decrease in omentum fat. For reproductive organ weight, rats treated with *PB* showed no changes in all related organs. This result was supported by previous study by Solomon et al., (2014) where there are no changes in male reproductive organ weights (testes, epididymis and prostate) of rats that received low dose 200 mg/kg and high dose 800 mg/kg of *EL*[11]. However, another study reported significant changes in prostate weight of male SD rats treated with *EL* 10 mg/kg compared with control group and *EL* 5 mg/kg[12]. This is due to increase in proliferative activity of the prostatic epithelium and histopathological changes of prostate gland that are related to testosterone level. Rats undergone treatment with androgen is also associated with increased weight of the epididymis, prostate and seminal vesicles[9]. This is because growth, sex differentiation of the epididymis, prostate and seminal vesicles are androgen-dependent processes[13].

Treatment of *PB* has caused a significant increase serum DHT concentration by 31% compared to control. DHT is an enzyme produced by the conversion of testosterone by enzyme 5α-reductase[14]. Aphrodisiacs are known to increase testosterone levels, and this is possibly lead to higher conversion to DHT. The well-known aphrodisiac *EL* roots have been found to enhance various androgens' biosynthesis[9]. Root extract of *EL* has the highest concentrated quassinoids, known as eurycomanone. It enhances fertility by

increasing testosterones production and spermatogenesis through hypothalamus-pituitary-gonadal axis. A study was done on PB for different chemical properties and found two new structures of *bisaporphine* alkaloids which were *7,7'-bisdehydro-O-methylisopiline* and *7-dehydronoruuciferinyl-7'-dehydro-O-methylisopiline* from the ethyl acetate extract of PB stem bark that may be responsible for its aphrodisiac effect[3]. Further study is needed to fraction other active compunds of PB.

Conclusion

PB has shown to have morphometric and androgenic effect by decreasing body weight and increasing DHT levels. This is parallel with its claim as an aphrodisiac and energy enhancer. Further investigation such as sexual behaviour study is essential to determine the potential of PB as an aphrodisiac.

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