Effect of Lepidium meyenii (maca) roots on spermatogenesis of male rats

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Abstract

Aim: To determine the effect of oral administration of an aqueous extract from the roots of Lepidium meyenii (maca) on spermatogenesis in adult male rats.

Methods: Male rats received an aqueous extract of the root (66.7 mg in one mL) twice a day for 14 consecutive days. Results: Treatment with Lepidium meyenii resulted in an increase in the weights of testis and epididymis but not the seminiferous vesicle weight. The length and frequency of stages IX-XIV seminiferous tubules, where mitoses occurred, were increased and stages I-V were reduced in rats treated with Lepidium meyenii. Conclusions: The Lepidium meyenii root invigorates spermatogenesis in male rats by acting on its initial stages (IX-XIV).

1 Introduction

Lepidium meyenii or maca is a plant of the Brassicaceae family growing in the Andean region of Peru over 3000 meters altitude. From the time of the Spanish conquest it has been recognized by its function to improve fertility[1]. It is named Andean Ginseng due to its supposed activity to provoke sexuality[2]. This activity has been scientifically documented in the literature in male mice and rats[3]. It is suggested that the plant also act on spermatogenesis[4], however no experimental evidence so far exists in the seminiferous epithelium, germ cells are arranged in distinct associations or stages. In the rat, Leblond & Clermont have defined 14 stages[5]. The wave of the seminiferous epithelium can be visualized by transillumination in freshly isolated unstained seminiferous tubules[6]. This technique allows the examination of a large amount of fresh seminiferous tubules after different treatments[7].

The present study was designed to determine the effect of an aqueous extract of Lepidium meyenii root on the pattern of stages of the seminiferous tubules epithelium cycle in male rats.

2 Materials and methods

2.1 Animals

Three-month-old male Holtzman rats from the animal house of the Universidad Peruana Cayetano Heredia were used. Animals were housed under standardized conditions. Rats were divided at random into 2 groups of 10 animals each, the control and the Lepidium meyenii treated. Control rats received 246.0 g and treated rats weighed 274.8 g on the average.

2.2 Preparation of aqueous extract of Lepidium meyenii

The root of Lepidium meyenii was obtained from Carhuamuyo at 4000 m altitude. The identity of the plant was authenticated by Irma Femandez, a Botanist of the Department of Physiological Sciences, Universidad Peruana Cayetano Heredia. An aqueous extract of the root was prepared according to a traditional method. In brief, 500 g of the root was placed in a container with 750 mL of water and boiled for 30 min. The preparation was left standing to cool and was then filtered. The filtrate, containing 66.7 mg root in 1 mL, was placed in small vials and kept in a refrigerator until use.

2.3 Treatment of animals

The extract of Lepidium meyenii was orally administered at a dose of 1 mL/rat, twice a day for 14 days. A similar volume of the vehicle was given to the control rats. Rats were sacrificed one day after the last dosing. The testis, epididymis and seminal vesicles were removed and weighed. After that the seminiferous tubules were prepared for transillumination assessment.

2.4 Assessment of stages of rat seminiferous cycle

Assessment of the frequency and stage of spermatogenesis was made by transillumination under an inverted stereomicroscope at 40 magnification as previously described[7]. For each rat, a total length of 1000 mm seminiferous tubules was assessed. The frequency of each stage in the 1000-mm tubules was recorded and calculated as percentage. The frequency of seminiferous tubules obtained from control rats were considered as 1 in each of the stages and the seminiferous tubules of treated rats were assessed relatively to the control group as previously described[8].

2.5 Statistical analysis

Data were presented as mean±SD and analyzed using Student’s t-test and analysis of variance (one-way) when more than two groups were compared. Parametric statistics was used since data were normally distributed. P<0.05 was considered significant. The relative frequency in each specific stage represents the mean value of 10 rats.

3 Results

The testicular weight (1.520±0.06 g in the control group, 1.590±0.06 g in the treated group, P<0.05) and the epididymal weight (0.400±0.03 g in the control and 0.460±0.03 in the treated rats, P<0.05) were significantly heavier in the treated rats. No significant difference was found between the seminiferous vesicle weights of the 2 groups. The length (mm) of stages I-II, I-VI, and VII-XII of 1000 mm of seminiferous tubules of the two groups were: stage I (199.3±1.3 vs 246.1±1.0; P<0.01), stage II (513.0±5.8 vs 373.4±3.8; P<0.01), stage III (248.9±1.0 vs 239.4±1.0; P<0.01), stage IV (62.7±1.9 vs 22.7±1.9; P<0.05) and stage V (73.2±0.9 vs 23.7±1.9; P<0.05). All these values were significantly higher in the control rats, whereas with stages IX-XIV (264.9±1.0 vs 356.9±2.8; P<0.05), the values were significantly higher in the treated group.

Treatment with Lepidium meyenii also resulted in increased frequency of stages IX-X, XII and XIII-XIV, and a relative reduction in stages II-III, IV-V, VII and XI. Figure 1 shows the relative frequency of stages of the cycle in the rats.

4 Discussion

Father Cobo in the History of the New World in 1653 believed that the root of Lepidium meyenii or maca in the Andean region could improve fertility in animals and humans[9].

Our results demonstrated that extract of Lepidium meyenii prepared as used by the natives of the Andean region had a beneficial effect on spermatogenesis. Testicular weight was significantly higher in the rats treated with Lepidium meyenii and the pattern of stages of the seminiferous epithelium was modified with increased stages IX-XII and ensuring reduction in stages I-VI. In stages IX and XII spermatogonial mitosis are located[10]. Therefore, in the present experimental setting, Lepidium meyenii is considered to act on the initial stages of spermatogenesis.

Our data suggest that Lepidium meyenii may improve spermatogenesis in the spermatogonial mitosis. A high testicular weight and an increase in the frequencies and lengths of stages IX-XII support this hypothesis.

It was interesting to find that the epididymal weight increased significantly in animals treated with Lepidium meyenii. Epididymis is a target for androgen action. It is not due to a possible androgenic action of the plant as the weight of the seminal vesicles, another androgen-dependent organ, was not affected. In addition, stage VII which will be increased after testosterone administration was not affected as well. The increase in epididymal weight might be due to an increase in the sperm number. Further investigations are required to clarify this point.

In conclusion, Lepidium meyenii may invigorate the initial stages of sperm agenesis. Further studies will be needed to demonstrate its time-course and dose-response relationship.

References