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Effect of *Lepidium meyenii* (MACA) on sexual desire and its absent relationship with serum testosterone levels in adult healthy men

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Summary. This study was a 12-week double blind placebo-controlled, randomized, parallel trial in which active treatment with different doses of Maca Gelatinizada was compared with placebo. The study aimed to demonstrate if effect of Maca on subjective report of sexual desire was because of effect on mood or serum testosterone levels. Men aged 21–56 years received Maca in one of two doses: 1500 mg or 3000 mg or placebo. Self-perception on sexual desire, score for Hamilton test for depression, and Hamilton test for anxiety were measured at 4, 8 and 12 weeks of treatment. An improvement in sexual desire was observed with Maca since 8 weeks of treatment. Serum testosterone and oestradiol levels were not different in men treated with Maca and in those treated with placebo (P:NS). Logistic regression analysis showed that Maca has an independent effect on sexual desire at 8 and 12 weeks of treatment, and this effect is not because of changes in either Hamilton scores for depression or anxiety or serum testosterone and oestradiol levels. In conclusion, treatment with Maca improved sexual desire.

Introduction

Sexual function is an important component of human quality of life and subjective well being. Sexual problems are widespread and adversely affect mood, well being, and interpersonal functioning (Laumann *et al.*, 1999). Main sexual problems are related to sexual desire and male erectile dysfunction. Erectile dysfunction is probably the most commonly recognized and treated sexual dysfunction. It affects more than 30% of men aged 40–70 years (Feldman *et al.*, 1994).

Successful treatment of sexual dysfunction may not only improve sexual relationships, but also overall quality of life. Alternatives for treatment of hypoactive sexual desire are scarcer. Testosterone is used because of its property to stimulate sexual desire in hypogonadal men (Matsumoto, 1994; Arver *et al.*, 1996). Other compounds are potent regulators of sexual behaviour in animals but not in healthy men (Perras *et al.*, 2001).

Despite the broad use of oral agents for erectile dysfunction (Boolell *et al.*, 1996), and the use of testosterone for hypoactive sexual desire (Seidman, 2000), many people in the world prefer the use of natural plants. Traditional herbs have been a revolutionary breakthrough in the management of erectile dysfunction and have become known worldwide as treatment (Adimoelja, 2000). One example is the broad use of ginseng because of its supposed property to provoke sexuality (Kim *et al.*, 1976).

More recently, aphrodisiac activity has been described for the root of *Lepidium meyenii* (Maca), a Peruvian plant (Zheng *et al.*, 2000; Cicero *et al.*, 2001). Additionally, a favorable effect on spermatogenesis has been observed in adult male rats (Gonzales *et al.*, 2001a) and in adult men (Gonzales *et al.*, 2001b). Maca (*L. meyenii*) is a Peruvian hypocotyl which belongs to the Brassicaceae family and grows exclusively between 4000 and 4500-m altitude at the central Peruvian Andes. For centuries, it has been recognized traditionally for its properties to improve sexuality and fertility (see Obregon, 1998). Activity of the plant is located in the root. Actually, Maca is a commercially available product expended as a nutrient in different forms including as tablets in the drugstore. Despite the

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spread use in Peru no scientific evidence exists that Maca improves sexual desire in men.

The present study aimed to assess a role of Maca for sexual desire and to determine if this effect is because of changes in mood or in serum testosterone and oestradiol levels in adult healthy men.

Patients and methods

Design

The study was a 12-week double-blind placebo-controlled, randomized, parallel trial in which two doses of Maca Gelatinizada were orally administered and compared with the placebo.

The Institutional Review Board of the Scientific Research Office from the Universidad Peruana Cayetano Heredia approved the study.

Subjects

Fifty-seven subjects (21–56 years) were included in the study. All subjects were in apparently good health. Men were randomly placed in one of three groups.

Two groups received active treatment whereas the other group received placebo. For 12 weeks, one group ($n = 30$) received three tablets of 500 mg each of gelatinized Maca (Maca Gelatinizada La Molina, Lima) per day (Maca 1.5 g). The second group ($n = 15$) received six daily tablets of gelatinized Maca (3000 mg) and it was defined as Maca 3.0 g. The third group received tablets of placebo daily for the 12-week span in the same schedule as the Maca group. During the study, all men maintained their usual eating regimen.

Most of the subjects did not smoke or use drugs for at least 3 months before study, nor did they use dietary supplements.

Laboratorios Hersil (Lima, Peru) provided the tablets of gelatinized Maca (Maca Gelatinizada La Molina). Each tablet contains 500 mg of dehydrated root of Maca (*L. meyenii*).

Venous blood samples were drawn after a 12-h overnight fasting at 4, 8 and 12 weeks of treatment. Blood was centrifuged at 1000 ***g***, and serum was collected after centrifugation and kept frozen until assayed for hormone measurements.

Sexual desire

Sexual desire was assessed using a subjective (self-report) response about the effect of treatment on sexual desire at 4, 8 and 12 weeks of treatment. The basal value (before treatment) was considered as 1. Each subject was asked if treatment diminished (score = 0), did not change (score = 1), increased mildly (score = 3), or increased moderately to highly sexual desire (score = 5).

Depression and anxiety tests

Mood was assessed using the Hamilton Depression Rating Scale (Mykletun *et al.*, 2001), which has 17 questions.

Anxiety was scored with the Hamilton Anxiety Rating Scale (Lobo *et al.*, 2002) which assesses somatic and cognitive-affective aspects.

Hormone measurement

Serum testosterone and oestradiol were determined by radioimmunoassay (RIA) using an I^{125}-testosterone and I^{125}-oestradiol, respectively, as radioactive marker. The assays have been performed using commercial kits (Diagnostic Products Co., Los Angeles, CA). All samples were run in a same assay period. The within assay variation was 6.42% for oestradiol, and 5.5% for testosterone. Sensitivity of testosterone assay was 4.0 pg ml^{-1} and that for oestradiol assay was 8.0 pg ml^{-1}.

Statistical analysis

Data were analysed using the statistical package STATA (version 7.0) for personal computer (Stata Corporation, College Station, TX, USA).

Data are presented as frequencies. Data of serum hormones were transformed to percentage. Data were also analysed comparing Maca-treated groups with respect to placebo group. The differences between frequencies before and during treatment were assessed by the chi-squared test. Logistic regression analysis was performed to assess the independent effect of Maca on sexual desire after controlling for scores of Hamilton Depression and Hamilton Anxiety test. For this analysis, sexual desire was the dependent variable, and it was dichotomized as follows: Values 0 and 1 were recoded as 0 (no effect), and values 2 and 3 were recoded as 1 (improvement in sexual desire). A $P < 0.05$ was considered statistically significant.

Results

After 4 weeks of treatment, two men of the placebo group reported that treatment increased sexual desire (16.6%), whereas at 8 and 12 weeks of treatment none of men from this group had increased sexual desire (0.0%).

In the Maca treated group, at 4 weeks, 24.4% of men manifested that treatment increased sexual

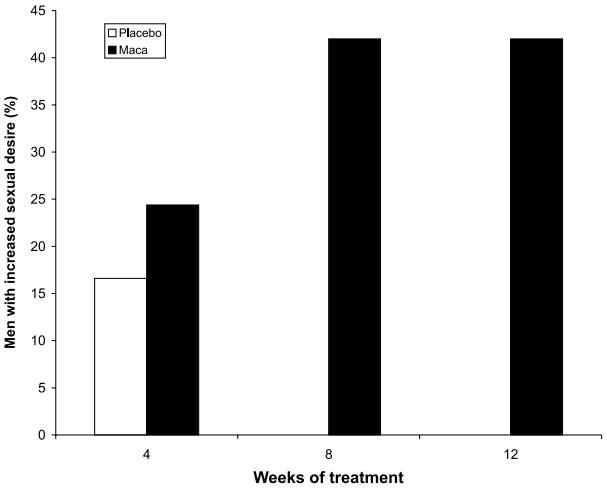

Figure 1. Prevalence of men whose treatment with placebo or gelatinized Maca increased sexual desire. 4 weeks of treatment: P: NS ($\chi^2 = 0.32$); 8 weeks of treatment: $P < 0.008$ ($\chi^2 = 7.01$); 12 weeks of treatment: $P < 0.006$ ($\chi^2 = 7.60$).

desire, whereas at 8 and 12 weeks of treatment, the prevalence of men manifesting increase of sexual desire was 40.0 and 42.2%, respectively. Significant differences between Maca-treated and placebo-treated groups were observed at 8 weeks ($\chi^2 = 7.01$; $P < 0.008$) and 12 weeks ($\chi^2 = 7.6$; $P < 0.006$) of treatment (Fig. 1).

Table 1 shows the scores for sexual desire measured as a subjective self report for the question if treatment had an effect on sexual desire. The group treated with placebo did not change the score for sexual desire (P:NS), whereas the overall group treated with Maca increased significantly the score for sexual desire at 4, 8 and 12 weeks of treatment ($P < 0.01$). However, when data in the Maca group were compared with placebo, the differences were observed at 8 and 12 weeks.

Multivariate analyses are shown in Tables 2–4. Table 2 shows data observed at 4 weeks of treatment. Treatment is assessed as dummy variable comparing the effect of Maca in relation to placebo. Logistic regression analysis showed that Maca had no effect on sexual desire. Scores of depression and anxiety tests and serum testosterone and oestradiol levels were not related to sexual desire in men. Tables 3 and 4 show data observed at 8 and 12 weeks of treatment with Maca (1.5 or 3.0 g) or placebo. Treatment with Maca 1.5 g and Maca 3.0 g are independent variables associated to sexual desire at 8 and 12 weeks of treatment. No independent effect on sexual desire was observed with score of neither depression and anxiety tests nor serum testosterone and oestradiol levels.

Discussion

During the last decade an increase in the use of plants in metropolitan areas of developed countries has been observed. A recent study in a metropolitan area of Minnesota demonstrates that herbs are used frequently to promote general health/well-being (Harnack *et al.*, 2001).

Sexual difficulties are extremely prevalent among both men and women (Leiblum, 1999). Plants are

Table 1. Effect of different doses of Maca or placebo on self-report about effect of treatment on sexual desire in apparently healthy men

Treatment	0 weeks	4 weeks	8 weeks	12 weeks
Placebo	1.00	1.33 ± 0.37	0.83 ± 0.11	0.83 ± 0.11
Maca	1.00	1.84 ± 0.24[*,a]	2.47 ± 0.27[*,b]	2.47 ± 0.27[*,b]

Data are mean ± standard error of mean (SEM).[a]P:NS; [b]$P < 0.001$ with respect to placebo. *$P < 0.01$ with respect to basal values (0 weeks).

Table 2. Logistic regression analysis for the probablity that Maca, anxiety Hamilton score, depression Hamilton score, serum testosterone and oestradiol levels affect self perception of improvement in sexual desire after 4 weeks of treatment

Variable	Coefficient of regression	Standard error	$P > \|z\|$	(95% CI)
Maca 1.5 g	1.10	0.95	NS	−0.77 2.97
Maca 3.0 g	−0.06	1.12	NS	−2.25 2.12
Anxiety score	0.08	0.10	NS	−0.13 0.28
Depression score	−0.11	0.13	NS	−0.35 0.14
Serum testosterone	0.24	0.19	NS	−0.13 0.61
Serum oestradiol	−0.03	0.03	NS	−0.09 0.04
Constant	−2.31	1.63	NS	−5.51 0.89

CI, confidence interval. Maca (1.5 or 3.0 g) were analysed as variable dummy with respect to placebo.
Logistic Regression $\chi^2(6) = 4.58$; $P > \chi^2 = 0.5984$; Pseudo $r^2 = 0.0755$.

Table 3. Logistic regression analysis for the probablity that Maca, anxiety Hamilton score, depression Hamilton score, serum testosterone and oestradiol levels affect self perception of improvement in sexual desire after 8 weeks of treatment

Variable	Coefficient of regression	Standard error	$P > \|z\|$	(95% CI)
Maca 1.5 g	19.60	0.85	0.0001	17.93 21.27
Maca 3.0 g	18.54	1.46	0.0001	15.16 21.27
Anxiety score	−0.14	0.14	NS	−.040 0.13
Depression score	0.19	0.16	NS	−0.13 0.51
Serum testosterone	0.16	0.19	NS	−0.22 0.54
Serum oestradiol	0.02	0.03	NS	−0.04 0.07
Constant	−21.15	1.51	0.0001	−24.12 −18.18

Maca (1.5 or 3.0 g) were analysed as variable dummy with respect to placebo.
Logistic Regression $\chi^2(6) = 13.25$; $P > \chi^2 = 0.0393$; Pseudo $r^2 = 0.2382$.

Table 4. Logistic regression analysis for the probablity that Maca, anxiety Hamilton score, depression Hamilton score, serum testosterone and oestradiol levels affect self perception of improvement in sexual desire after 12 weeks of treatment

Variable	Coefficient of regression	Standard error	$P > \|z\|$	(95% CI)
Maca 1.5 g	21.37	1.01	0.0001	19.20 23.16
Maca 3.0 g	19.85	1.06	0.0001	17.78 21.92
Anxiety score	−0.03	0.17	NS	−0.35 −0.30
Depression score	0.22	0.15	NS	−0.08 0.52
Serum testosterone	−0.49	0.35	NS	−1.17 0.19
Serum oestradiol	0.02	0.03	NS	−0.04 0.08
Constant	−19.70	1.83	0.0001	−23.29 −16.12

Maca (1.5 or 3.0 g) were analysed as variable dummy with respect to placebo.
Logistic Rregression $\chi^2(6) = 16.12$; $P > \chi^2 = 0.0131$; Pseudo $r^2 = 0.2898$.

extensively used to relieve sexual dysfunction, as it happens with ginseng, an essential constituent in traditional Chinese medicine. At least six million Americans use the root of this slow-growing perennial (Nocerino *et al.*, 2000).

The results of the present study demonstrate that another root, Maca (*L. meyenii*) which grows in the central Andes of Peru in altitudes between 4000 and 4500 m may also improve sexual desire. In fact, Maca (1.5 or 3.0 g day^{-1}) administered orally in tablets during 12 weeks has a beneficial effect on subjective sexual desire in adult healthy men. These data confirm results obtained in mice and rats (Zheng *et al.*, 2000; Cicero *et al.*, 2001). Our results demonstrate that effect of Maca in healthy men is noticeable since 60 days of treatment. Certainly, data at 30 days of treatment did not show differences between Maca treated men and placebo treated men.

We have not demonstrated a higher effect with 3.0 g compared to 1.5 g of Maca. We have not a clear explanation for this. Further studies will be necessary to clarify a dose-response effect.

Sexual desire may be affected by behavioural depression, stress (Kumar *et al.*, 2001), anxiety (Rowland *et al.*, 1987) and sedation (Ratnasooriya & Dharmasiri, 2000). Improvement of depression by selective serotonin reuptake inhibitors in depressed patients has been associated with improvement in sexual functioning (Ekselitus & von Knorring, 2001; Michelson *et al.*, 2001). In this case, improvement in sexual desire was related to reversion of depression rather than an effect of the increased serotonergic activity, as serotonin stimulation inhibits sexual function (Gonzales *et al.*, 1982).

Maca is prescribed because of its supposed properties to decrease anxiety, depression, and stress. However, the present study has demonstrated that the effect of Maca on sexual desire is independent of an effect on anxiety and/or depression. Furthermore, improvement in sexual desire by Maca was not related to any increase in serum testosterone or oestradiol levels. In fact, multivariate analysis has demonstrated an effect of Maca on sexual desire but this effect is independent of changes in scores for depression test, scores for anxiety text, serum testosterone levels, and serum oestradiol levels.

Effect of Maca on sexual desire could be because of any unknown chemical signal, i.e., phyto-oestrogens.

Increase in serum testosterone levels in men with low desire by low serum testosterone levels resulted

in resumption of sexual activity (Jannini *et al.*, 1999). This is not the situation of our study as men were apparently healthy. Brown *et al.*, (1978) provided evidence that differences among men in circulating testosterone concentration within the normal range do not account for differences in sexual activity and interest. Ansong & Punwaney (1999) have studied the relationship between sexual drive and serum testosterone levels among men with erectile dysfunction. Men were classified according to low (50.9%), moderate (35.2%), and high (13.9%) sexual drive. Serum testosterone levels were not different among these groups.

Data from our study demonstrate that serum testosterone levels were not associated to the improvement in sexual desire by treatment with Maca. According to our data and from others, testosterone is necessary, although not sufficient for normal or increased levels of sexual desire. In addition, supra-physiological levels of testosterone maintained for up to 2 months can promote some aspects of sexual arousability without stimulating sexual activity in normal men (Anderson *et al.*, 1992). These suggest that physiological levels of plasma testosterone do not provide a maximal stimulus in terms of sexual arousability. Moreover, an increase in plasma testosterone into supra-physiological range is not associated with any detectable changes in sexual behaviour (Anderson *et al.*, 1992). Therefore, all of these data suggest that testosterone should not be used when sexual desire is attempted to improve in men with normal serum testosterone levels. Treatment with Maca may be an interesting alternative, as it improves sexual desire without affecting serum testosterone levels.

As other plants, Maca may contain phyto-oestrogens. Phyto-oestrogens may have oestrogenic or anti-oestrogenic activities (Kuiper *et al.*, 1998). A possible role of oestrogens on both human male fertility and sexuality has also been suggested by recent studies (Rochira *et al.*, 2001). Male rodents show impaired sexual behaviour and fertility as a consequence of oestrogen defect (O'Donnell *et al.*, 2001). Therefore, it is an interesting suggestion that oestrogenic substances should be considered also as 'male hormones' (O'Donnell *et al.*, 2001).

In conclusion, treatment with tablets of Maca at 1.5–3.0 g day^{-1} for 8 or 12 weeks improved sexual desire in healthy men independently of changes in mood or serum testosterone and oestradiol levels.

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