Maturitas 92 (2016) 64–69

Contents lists available at ScienceDirect

Maturitas

journal homepage: www.elsevier.com/locate/maturitas

Review article

The use of maca (*Lepidium meyenii*) to improve semen quality: A systematic review

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ARTICLE INFO

Article history:
Received 28 April 2016
Received in revised form 15 July 2016
Accepted 19 July 2016

Keywords:
Maca
Lepidium meyenii
Semen
Infertility

ABSTRACT

The aim of this review was to assess the evidence for the effectiveness of maca (*Lepidium meyenii*) in improving semen quality. We searched 11 databases from their inception to March 2016 and included all clinical trials on the improvement of semen quality parameters in infertile and healthy men, regardless of the study design or the type of maca. The risk of bias for each study was assessed using the Cochrane criteria. The selection of studies, data extraction, and validation were performed independently by the first two authors. Discrepancies were resolved through discussion by the same two authors. Five studies – 3 randomized clinical trials (RCTs) and 2 uncontrolled observational studies (UOSs) – met all of the inclusion criteria. One RCT found favorable effects of maca on sperm mobility in infertile men. The two other RCTs showed positive effects of maca on several semen quality parameters in healthy men. The two UOSs also suggested favorable effects of maca on semen quality. The results of our systematic review provide suggestive evidence for the effectiveness of maca in improving semen quality. However, the total number of trials, the total sample size, and the risk of bias of the included studies prevent the drawing firm conclusions. More rigorous studies are warranted.

Contents

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http://dx.doi.org/10.1016/j.maturitas.2016.07.013
0378-5122/

1. Introduction

Infertility affects approximately 15% of reproductive-aged couples worldwide and 9% of men aged 15–44 years in the US [1,2]. The cause of infertility involves male factors alone in 40% of infertile couples [3]. Semen analysis is indicated as part of the initial evaluation of male factors [4]. These couples often seek supportive complementary and alternative medicine (CAM) as a solution for their failure to conceive. One recent prospective cohort study reported that 30% of infertile couples use some form of CAM, such as herbal medicine or acupuncture [5]. Another survey showed that 22% to 66% of responders used CAM for improving infertility [6–8]. Maca is one of the herbal products used for treating infertility and seminal quality.

Maca (*Lepidium meyenii*) is a Peruvian plant that has been used as a food supplement and as medicine for humans and animals [9–11]. One of the medicinal usages for maca is to improve sexual function and menopausal symptoms [12,13]. Several in vivo studies showed that maca has spermatogenic and fertility-enhancing activities, improving sperm parameters, sexual behavior and enhancing androgen-like effects [9,11,14–19]. Clinical trials and one systematic review have reported that maca may increase sperm count and mobility and improve sexual function in humans [12,13]. The mechanisms of action of maca for improving sperm parameters are not yet clear, however. One of possible mechanism which has been suggested is aphrodisiac activities of the lipidic fraction of maca, including fatty acid and macanmides [20,21].

Currently, no systematic review of this topic is available. The aims of this systematic review are to summarize and critically assess the evidence on the effectiveness of maca in improving semen quality.

2. Methods

2.1. Data sources

The following electronic databases were searched from inception through March 2016: Pubmed, EMBASE, AMED, the Cochrane Central Register of Controlled Trials and the Cochrane Database of Systematic Review, six Korean Medical Databases (Korean Studies Information, DBPIA, Korea Institute of Science and Technology Information, RISS, KoreaMed, and Korean National Assembly Library), Chinese Medical Databases (CNKI). The search terms used were “Lepidium OR maca” AND “semen OR sperm OR hyposperm OR subfertility”. The search strategy comprised a mixture of free text and thesaurus terms. The references in all located articles were manually searched for further relevant articles.

2.1.1. Study selection

All prospective clinical trials involving healthy people or men with subfertility were included. Trials related to the effects of any type of maca preparation, regardless of origin, on semen quality were included. Trials were included if they used maca as the sole treatment compared with any type of control. Those comparing two different types of maca were excluded. Any trials with maca as a part of a complex intervention were excluded. For duplicate publications with different outcome measures originating from one trial published as separate papers, the original publication was given priority, and all others were excluded. The main outcome measures were semen quality parameters, including sperm morphology, sperm concentration, sperm count, semen volume, and sperm mobility. No language restrictions were imposed.

2.1.2. Extraction of data and assessment of risk of bias

Hard copies of all articles were obtained and read in full. Two independent reviewers extracted predetermined sets of data that related to methods (e.g., design, blinding, duration of follow-up), sample (e.g., population size, conditions, age, duration of disease), intervention and control treatment, and outcome measures. The Cochrane risk of bias was applied to evaluate the quality of included trials [22]. Differences in opinions between the reviewers were settled through discussion.

2.1.3. Data synthesis

We had originally intended to conduct a formal meta-analysis when we had identified a large enough number of studies, but this did not prove possible.

3. Results

3.1. Study description

Our search identified 228 articles, of which 5 met our inclusion criteria (Fig. 1), and key data of the included studies are summarized in Table 1 [21,23–26]. Three were randomized clinical trials (RCTs) [21,23,24], and two were uncontrolled observational studies (UOSs) [25,26]. Of the five studies, one RCT was conducted in Panama [23], one in Korea [24], one in the Czech Republic [21], one in Bolivia [25], and one in Peru [25]. All 5 studies employed commercial maca. All of the participants in the five studies ingested the maca orally. The dosages were 1 g to 5 g of maca daily for 12 or 16 weeks. The male participants were healthy subjects in three studies [21,24,26] and infertile men in two trials [23,25].

3.2. Risk of bias

One RCT reported random sequence generation methods and employed allocation concealment [21] (Fig. 2). This study used a double-blind design, but the baseline between the two groups was significantly different [21]. Another RCT was published as an abstract only, and most of the domains were unclear [23]. The third RCT was an unpublished report, and most domains were unclear [24]. The other two studies were uncontrolled trials, and they are open to several risks of bias [25,26].

3.3. Outcomes

3.3.1. Infertile men

One RCT compared the effects of maca on semen quality parameters compared with placebo, L-carnitine and Spermotrend [23]. This trial showed positive effects of maca on sperm mobility compared with placebo and L-carnitine, while it failed to show effects on sperm morphology and sperm concentration. One UOS showed significant improvements in sperm motility, progressive motility, sperm vitality and morphology [25].

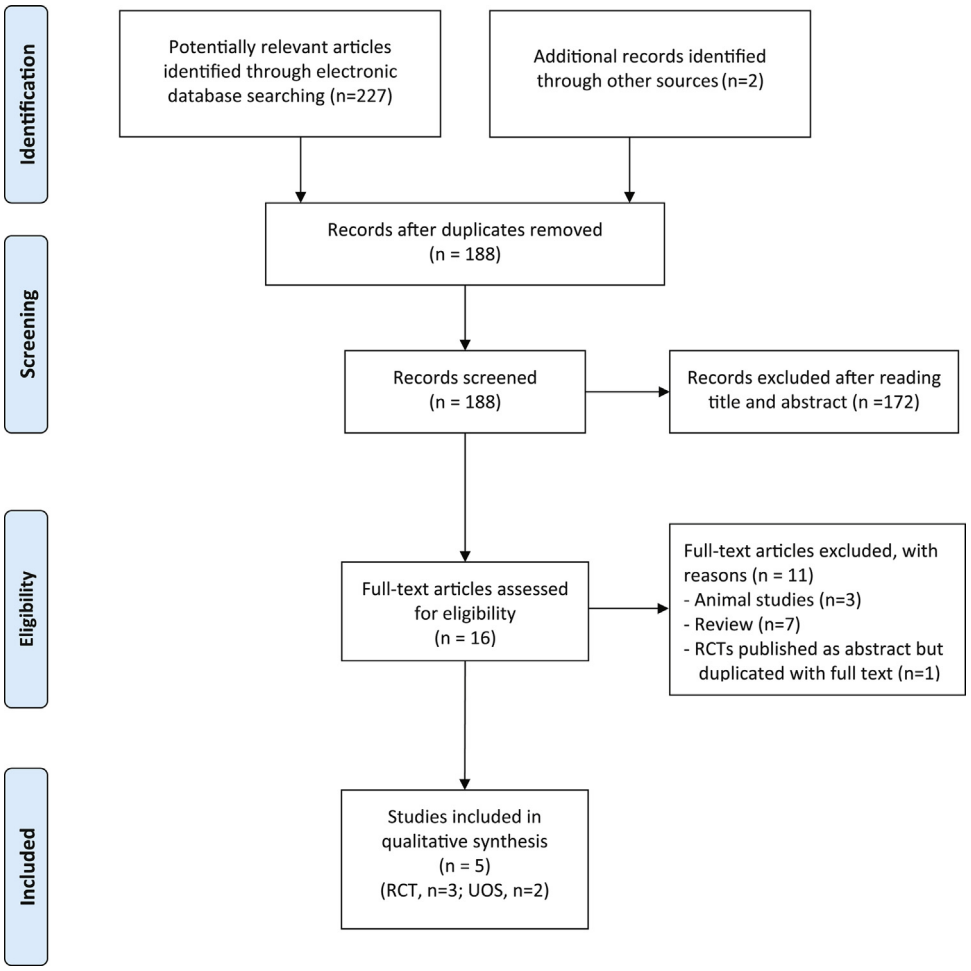

Fig. 1. Flow chart for the selection of included trials. RCT: randomised clinical trial; UOS: uncontrolled observational study.

3.3.2. Healthy volunteers

Two RCTs tested the effects of maca on semen quality compared with placebo in healthy men [21,24]. The results showed favorable effects of maca on semen quality parameters, including motile sperm count and normal sperm morphology, as well as on erectile function. One UOS showed significant improvements in total sperm count, motile sperm count and sperm mobility [26].

3.3.3. Adverse effects

None of the included trials attempted to assess the adverse effects of maca.

3.3.4. Meta-analysis

We had originally intended to pool the data in order perform a formal meta-analysis. However, only one trial published the full data [21]; one trial was reported as an abstract without data [23] and another as an unpublished report [24]. A meta-analysis could not therefore be done.

4. Discussion

Few rigorous trials have tested the effects of maca on semen quality parameters. All of the included trials suggested positive effects of maca on semen quality. One RCT found favorable effects of maca on sperm mobility in infertile men [23]. Two other RCTs showed positive effects of maca on several semen quality parameters in healthy men [21,24]. The two UOSs also suggested favorable effects of maca on semen quality [25,26]. Collectively, the evidence from the included studies suggests that maca may be effective in improving semen quality in both infertile and healthy men. However, the total number of RCTs and the total sample size were too small to draw firm conclusions.

Of the five studies analyzed in this review, one study was published only as an abstract [23], and one RCT as an unpublished report [24]; hence, they had not been formally peer reviewed, and they also lacked essential details. Two of the five studies in this review were UOSs [25,26], which are open to selection bias that often leads to exaggerated treatment effects. The sample sizes were very small in the included studies (ranging from 7 to 20 in each group) and are therefore susceptible to type II error.

Assuming that maca was beneficial for improving semen quality, possible mechanisms of action may be of interest. Maca increases the length of stages VII–VIII, related high-sperm counts [15] and epididymal sperm counts without affecting daily sperm production [15,18]. Another study showed that maca reverses the reduced DSP and epididymal sperm count from lead acetate induced oxidative stress [19]. One study suggested maca may regulate sperm count by maintaining the balance between oxidant and antioxidant status [27]. More basic research is needed to fully understand the mechanism of action of maca on semen parameters. The potential bioactive ingredients in maca include macaridine, macamides, macaene, gluosinolates, maca alkaloid, and maca nutrients. However, these data are insufficient for determining whether maca is clinically effective.

Table 1
Summary of randomised clinical trials with maca for semen quality parameters.

First author (year) [ref] location	Design Sample size/condition Age (years)	Intervention (regimen)	Control intervention (regimen)	Main outcome measures	Results	Adverse effects
Melnikovova [21] Czech	RCT 20 healthy men 20–40	(A) Maca (company commercial product, Peruvian company Andean Roots SRL, gelatinized and dried maca in the capsules, 1.75 g/d, for 12 weeks, n = 11)	*(B) Placebo (milled apple fiber, n = 7)*	1) Normal sperm morphology 2) Sperm concentration 3) Progressively motile sperm count 4) Motile sperm count 5) Total sperm count 6) Semen volume	1) P < 0.00001 in favour of A 2) NS 3) P = 0.02 in favour of A 4) P = 0.003 in favour of A 5) NS 6) P < 0.05 in favour of B	n.r.
Poveda [23] Panama	RCT 60 infertility men n.r.	(A) Maca (company commercial product, Nature Way Product, 1 g/12 h, n = 15)	(B) Placebo tablets (1pill/12 h, n = 15) (C) L-Carnitine (1pill/12 h, n = 15) (D) Spermotrend (1pill/8 h, n = 15)	1) Sperm mobility 2) Sperm morphology 3) Sperm concentration	1) P < 0.05 in favour of A 2) NS 3) NS	n.r. abstract only
Kim [24] Korea	RCT 45 light ED 30–60	(A) Maca (company commercial product, gelatinized and dried Peruvian black maca in the capsules, 5 g/d, for 12 weeks, n = 15) (B) Fermented maca (Peruvian black maca in the capsules, 5 g/d for 12 weeks, n = 15)	(C) Placebo (5pill/d, *n* = 15)	1) Sperm concentration 2) Motile sperm count	1) A + B vs. C, P < 0.05; A vs. C, NS; B vs. C, P = 0.03 2) A + B vs. C, P = 0.001 A vs. C, P = 0.001; B vs. C, P = 0.001	Unpublished reports
Tancara [25] Bolivia	UOS 10 infertility men 25–50	(A) Maca (company commercial product, Maca Sprit, 3 g/d, for 12 weeks, n = 10)	N/A	1) Sperm morphology 2) Sperm concentration 3) Sperm motility 4) Sperm vitality 5) Immature germ cell	1) P < 0.01 2) NS 3) P < 0.001 4) P < 0.01 5) P < 0.01	n.r.
Gonzales [26] Peru	UOS 12 healthy men 22–44	(A) Maca (company commercial product, Maca Geletinizada Le Monlina, 1.5–3 g/d for 16 weeks, n = 9)	N/A	1) Normal sperm morphology 2) Sperm concentration 3) Motile sperm count 4) Total sperm count 5) Semen volume 6) Sperm motility	1) NS 2) NS 3) P < 0.05 4) P < 0.05 5) P < 0.05 6) P < 0.05	n.r.

NA: not available; n.r.: not reported; NS: not significant; The italic parts were not considered in the analysis.

One argument for the use of maca to improve semen parameters may be that it causes fewer adverse effects than conventional drug treatments. However, none of the included studies described here assessed the adverse effects of maca. This should be tested in future studies.

Our review has several limitations. Our literature searches of the English, Chinese and Korean databases were extensive, but we cannot be absolutely sure that all relevant articles were located. It is noteworthy that a number of studies were supported by manufacturers of maca products, a factor that may have introduced a degree of bias. Most trials sponsored by the industry had positive outcomes. In this review, all of the included studies received their maca powder for trials from a company associated with a maca product. Further limitations include the paucity and often suboptimal methodological quality of the primary data. Some of the RCTs included in the present review were not successful at minimizing bias.

Future and more rigorous research testing the effects of maca should be performed. There are several issues for trial design regarding optimal treatment dosages, standardization of maca, and sample size. It is very important to follow CONSORT guidelines when designing and reporting clinical trials.

In conclusion, the results of our systematic review provide suggestive evidence for the favorable effects of maca on semen quality. However, the total number of trials, the total sample size, and the average methodological quality of the primary studies were too limited to draw firm conclusions. More rigorous studies are warranted.

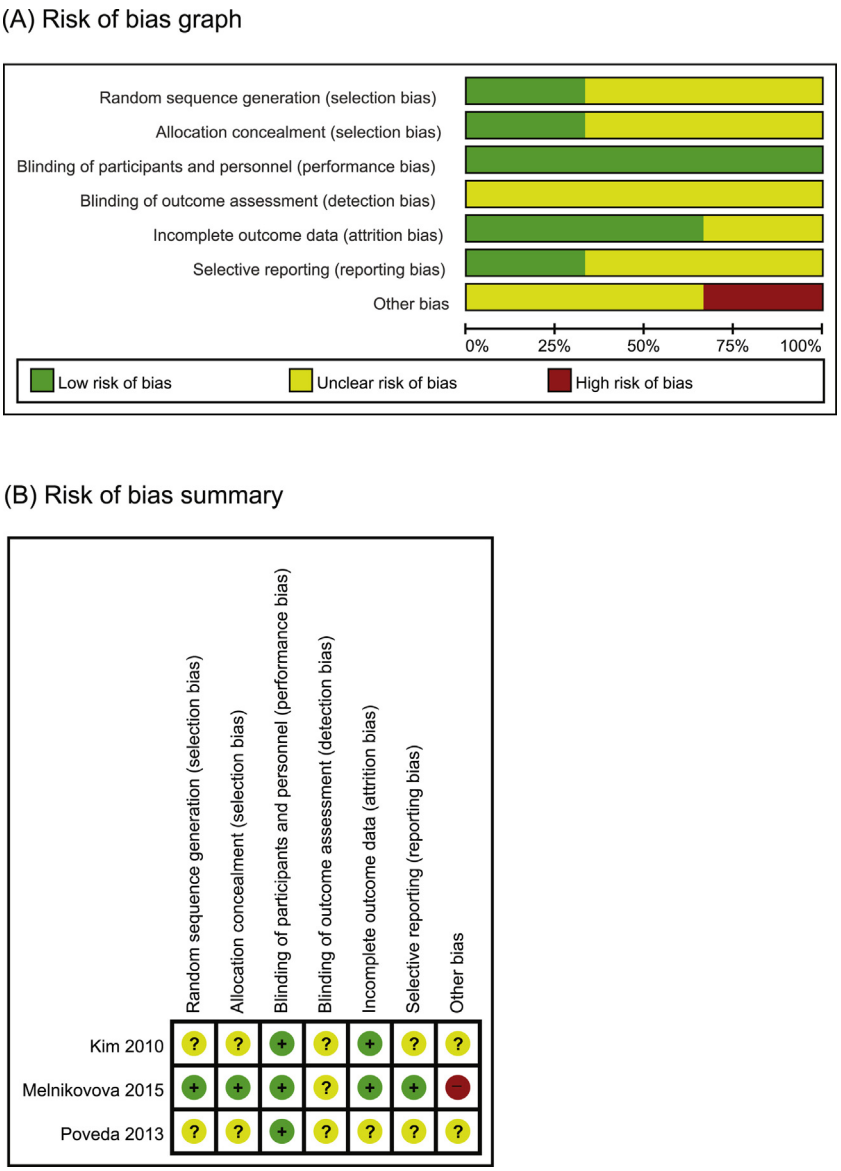

Fig. 2. (A) Risk of bias graph: review authors' judgments about each risk of bias item presented as percentages across all included studies; (B) Risk of bias summary: review authors' judgments about each risk of bias item for each included study.

Conflict of interest

None declared.

Provenance and peer review

This article has undergone peer review.

Funding

MSL and HWL were supported by KIOM (K16292 and K162921).

Contributors and their role in the paper

MSL and HYL designed the review, performed searches, appraised and selected trials, extracted data, contacted authors for additional data, carried out analyses and interpretations of the data, and drafted this report. SY reviewed and critiqued this review and report and assisted with interpretation of the data. SY and KH reviewed and critiqued the review protocol and this report and assisted in designing the review. All authors read and approved the final manuscript.

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