

ORIGINAL ARTICLE

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Does *Lepidium meyenii* (Maca) improve seminal quality?

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Abstract

Maca (*Lepidium meyenii*) is a herbaceous plant grown at over 4,000 m in Peru. It has been studied worldwide for its properties on fertility. Previous studies have assessed maca effects on semen quality, but there is need of randomised, double-blind trials in order to make clinical decisions. The objective of this study was to assess the effect of maca on seminal parameters in infertile adult men. This is a double-blind, randomised, placebo-controlled pilot trial in which sixty-nine patients diagnosed with mild asthenozoospermia and/or mild oligozoospermia were supplied by maca ($n = 35$) or placebo ($n = 34$) (2 g/day) for a period of 12 weeks. When compared patients treated with maca and patients treated with placebo, there were no significant differences in semen volume (2.95 ± 0.52 vs. 2.90 ± 0.52 ; $p = .392$), sperm motility (22.34 ± 2.22 vs. 23.05 ± 2.22 ; $p = .462$) and normal sperm morphology (7.89 ± 1.89 vs. 7.04 ± 2.28 ; $p = .801$), but there was a significant difference in sperm concentration (15.04 ± 5.61 vs. 10.16 ± 3.59 , respectively; $p = .011$). In conclusion, patients treated with 2 g of maca for a period of 12 weeks showed a significant improvement in seminal concentration compared with patients treated with placebo. There were no significant differences in semen volume, sperm mobility and morphology when compared both groups.

KEYWORDS

Lepidium meyenii, Maca, seminogram, sperm concentration

Antioxidant supplements and semen parameters: An evidence based review

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Abstract

Many studies have focused on male infertility. There is limited evidence about the influence of nutrition on quality of semen. Approximately, 30-80% of infertility cases are caused by oxidative stress and decreased level of seminal total antioxidant capacity. This study was aimed to review the effects of oral antioxidant supplements on improving major semen parameters such as sperm concentration, motility, morphology, DNA damage, and fertility rate. Data were extracted from PubMed and Google scholar database by using the terms “antioxidant”, “multivitamin”, “carnitine”, “CoQ10”, “vitamin C”, “vitamin E”, “zinc”, “folic acid”, “N-acetyl cysteine” and “selenium” combined with “male infertility”, “semen”, and “sperm” to generate a set of relevant citations. Supplements such as CoQ10 and alpha-tocopherol significantly improve sperm count. Also, carnitine has positive effects on sperm motility and morphology. Simultaneous administration of vitamin E and vitamin C reduces the sperm DNA damage. However, in some studies, one or more factors have not changed substantially. In most of the studies, antioxidant supplementation improved the number, motility, morphology and sometimes DNA integrity of sperm. The present study showed that antioxidant supplements, especially a combination of antioxidants such as vitamin C, vitamin E, and CoQ10 intake can effectively improve semen parameters in infertile men.

Key words: Male infertility, Semen, Antioxidants, Carnitine, Coenzyme Q10 (CoQ10), Vitamins.

Astaxanthin Improves Human Sperm Capacitation by Inducing Lyn Displacement and Activation

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Abstract: Astaxanthin (Asta), a photo-protective red pigment of the carotenoid family, is known for its multiple beneficial properties. In this study, the effects of Asta on isolated human sperm were evaluated. Capacitation involves a series of transformations to let sperm acquire the correct features for potential oocyte fertilization, including the generation of a controlled amount of reactive oxygen species (ROS), cholesterol depletion of the sperm outer membrane, and protein tyrosine phosphorylation (Tyr-P) process in the head region. Volunteers, with normal spermiogram values, were divided in two separate groups on the basis of their ability to generate the correct content of endogenous ROS. Both patient group (PG) and control group (CG) were analysed for Tyr-phosphorylation (Tyr-P) pattern and percentages of acrosome-reacted cells (ARC) and non-viable cells (NVC), in the presence or absence of Asta. In addition, the involvement of ROS on membrane reorganization and the presence of Lyn, a Src family kinase associated with lipid rafts, were investigated. Results show that Lyn is present in the membranes of human sperm, mainly confined in midpiece in resting conditions. Following capacitation, Lyn translocated to the head concomitantly with raft relocation, thus allowing the Tyr-P of head proteins. Asta succeeded to trigger Lyn translocation in PG sperm thus bypassing the impaired ROS-related mechanism for rafts and Lyn translocation. In this study, we showed an interdependence between ROS generation and lipid rafts and Lyn relocation leading the cells to undergo the successive acrosome reaction (AR). Asta, by ameliorating PG sperm functioning, may be utilised to decrease male idiopathic infertility.

Keywords: astaxanthin; tyrosine kinase Lyn; human sperm capacitation; acrosome reaction; cholera toxin subunit B (CTB)

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Influences of dietary supplementation with *Lepidium meyenii* (Maca) on stallion sperm production and on preservation of sperm quality during storage at 5 °C

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SUMMARY

Stallion semen is damaged by oxidative stress during cooling and transport. Semen processing and extenders have been tested to improve the fertilizing capacity of semen and to preserve semen during transport. Dietary supplementation with natural antioxidants has been proposed to prevent oxidative damages. In this study, for the first time, the effect of dietary supplementation with *Lepidium meyenii* (Maca) on the characteristics of fresh and chilled stallion semen was evaluated. Maca is a traditional Andean crop used as a nutraceutical for the fertility-enhancing properties that are linked with antioxidant activity. The diet of five stallions was supplemented with 20 g of Maca powder daily for a total of 60 days. A control group of five stallions received the same diet without Maca. Semen was collected once before the administration of Maca (D0), twice during the administration at 30 and 60 days (D30 and D60), and finally twice at 30 and 60 days after the end of the administration (D90 and D120). Ejaculates were processed for cooled shipping at 5 °C and evaluated in the laboratory for total and progressive motility, acrosome integrity, and lipid peroxidation after collection and after 24, 48, and 72 h of storage. Dietary supplementation with Maca improved sperm concentration (from 213 ± 80.4 to $447 \pm 73.1 \times 10^6$ spz/mL) and total sperm count (from $10,880 \pm 4377$ to $24,783 \pm 4419 \times 10^6$ spz). The beneficial effects of Maca supplementation on motility and acrosome integrity in the raw semen were detected from the end of treatment with Maca (D60) until the end of the study (D120). Furthermore, during cooling storage, total motility, progressive motility, and acrosome integrity declined more slowly in the Maca-treated group than in the control group. Lipid peroxidation did not change during cooling storage in either group and did not show a significant difference between the two groups. In this study, the dietary supplementation with Maca increased sperm production and stabilized semen quality during chilled storage.

Article

Effect of Astaxanthin on Human Sperm Capacitation

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Abstract: In order to be able to fertilize oocytes, human sperm must undergo a series of morphological and structural alterations, known as capacitation. It has been shown that the production of endogenous sperm reactive oxygen species (ROS) plays a key role in causing cells to undergo a massive acrosome reaction (AR). Astaxanthin (Asta), a photo-protective red pigment belonging to the carotenoid family, is recognized as having anti-oxidant, anti-cancer, anti-diabetic and anti-inflammatory properties and is present in many dietary supplements. This study evaluates the effect of Asta in a capacitating buffer which induces low ROS production and low percentages of acrosome-reacted cells (ARC). Sperm cells were incubated in the presence or absence of increasing concentrations of Asta or diamide (Diam) and analyzed for their ROS production, Tyr-phosphorylation (Tyr-P) pattern and percentages of ARC and non-viable cells (NVC). Results show that Asta ameliorated both sperm head Tyr-P and ARC values without affecting the ROS generation curve, whereas Diam succeeded in enhancing the Tyr-P level but only of the flagellum without increasing ARC values. It is suggested that Asta can be inserted in the membrane and therefore create capacitation-like membrane alteration which allow Tyr-P of the head. Once this has occurred, AR can take place and involves a higher numbers of cells.

Keywords: human sperm; astaxanthin; Tyr-phosphorylation; acrosome reaction

Zinc is an Essential Element for Male Fertility: A Review of Zn Roles in Men's Health, Germination, Sperm Quality, and Fertilization

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Abstract

Zinc (Zn) is the second most abundant trace element in human, which can't be stored in the body, thus regular dietary intake is required. This review explained the physiological and pathogenesis roles of zinc in men's health and its potentials in germination, quality of sperm, and fertilization. Our investigation showed that Zn contained many unique properties in human, especially males. The antioxidant quality is one of them. Also, the increased reactive oxygen species levels in the seminal plasma of men who are both infertile and smokers influence the Zn content of seminal plasma in a way that physiology of spermatozoa can be affected as well. Moreover, Zn acts as a toxic repercussion against heavy metals and cigarette inflammatory agents. Zinc as a hormone balancer helps hormones such as testosterone, prostate and sexual health and functions as an antibacterial agent in men's urea system. It plays a role in epithelial integrity, showing that Zn is essential for maintaining the lining of the reproductive organs and may have a regulative role in the progress of capacitation and acrosome reaction. In contrast, Zn deficiency impedes spermatogenesis and is a reason for sperm abnormalities and has a negative effect on serum testosterone concentration. Based on these findings, Zn microelement is very essential for male fertility. It could be considered as a nutrient marker with many potentials in prevention, diagnosis, and treatment of male infertility.

Keywords: Germination, Male fertility, Microelement, ROS, Sperm parameters, Zinc.

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Oral carnitine supplementation increases sperm motility in asthenozoospermic men with normal sperm phospholipid hydroperoxide glutathione peroxidase levels

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Objective: To clarify the role of carnitine supplementation in idiopathic asthenozoospermia and to look for a rationale for its use in asthenozoospermic patients.

Design: Blind clinical study.

Setting: Academic.

Patient(s): Thirty asthenozoospermic patients divided in two groups according to phospholipid hydroperoxide glutathione peroxidase (PHGPx) levels.

Intervention(s): Placebo for 3 months, then oral L-carnitine (2 g/day) for 3 months; semen samples were collected at baseline, after placebo, after carnitine administration, and again after 3 months with no drugs.

Main Outcome Measure(s): Evaluation of seminal parameters and determination of seminal PHGPx levels, measured as rescued activity.

Result(s): When asthenozoospermic subjects were divided in two groups on the basis of PHGPx levels, we observed an improvement of mean sperm motility only in the group of patients with normal PHGPx levels.

Conclusion(s): Phospholipid hydroperoxide glutathione peroxidase has an important role in male infertility, and carnitine treatment might improve sperm motility in the presence of normal mitochondrial function. (*Fertil Steril*® 2005;83:355–61. ©2005 by American Society for Reproductive Medicine.)

Key Words: Asthenozoospermia, carnitine, mitochondrial function, phospholipid hydroperoxide glutathione peroxidase, sperm motility

Use of carnitine therapy in selected cases of male factor infertility: a double-blind crossover trial

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Objective: To determine the efficacy of L-carnitine therapy in selected cases of male factor infertility.

Design: Placebo-controlled, double-blind, crossover trial.

Setting: University tertiary referral center.

Patient(s): One hundred infertile patients (ages 20–40 years) with the following baseline sperm selection criteria: concentration, $10\text{--}20 \times 10^6/\text{mL}$; total motility, 10%–30%; forward motility, <15%; atypical forms, <70%; velocity, $10\text{--}30 \mu/\text{s}$; linearity, <4. Eighty-six patients completed the study.

Intervention(s): Patients underwent L-carnitine therapy 2 g/day or placebo; the study design was 2 months of washout, 2 months of therapy/placebo, 2 months of washout, and 2 months placebo/therapy.

Main Outcome Measure(s): Variation in sperm parameters used in the patients selection criteria, in particular, sperm motility.

Result(s): Excluding outliers, a statistically significant improvement in semen quality, greater than after the placebo cycle, was seen after the L-carnitine therapy for sperm concentration and total and forward sperm motility. The increase in forward sperm motility was more significant in those patients with lower initial values, i.e., $<5 \times 10^6$ or $<2 \times 10^6$ of forward motile sperm/ejaculate or sperm/mL.

Conclusion(s): Based on a controlled study of efficacy, L-carnitine therapy was effective in increasing semen quality, especially in groups with lower baseline levels. However, these results need to be confirmed by larger clinical trials and in vitro studies. (Fertil Steril® 2003;79:292–300. ©2003 by American Society for Reproductive Medicine.)

Key Words: Fertility, male infertility, oligozoospermia, semen, spermatozoa, therapy, L-carnitine, sperm motility, mitochondria

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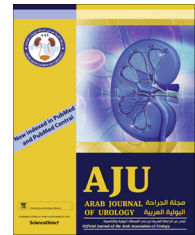
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**MANAGEMENT
ORIGINAL ARTICLE**

Systematic review of antioxidant types and doses in male infertility: Benefits on semen parameters, advanced sperm function, assisted reproduction and live-birth rate



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KEYWORDS

Male infertility;
Antioxidants;
Reactive oxygen species;
Semen analysis;
Sperm DNA fragmentation

ABBREVIATIONS

ART, assisted reproductive therapy;
coQ10, co-enzyme Q10;
DDS, DNA degraded sperm;

Abstract Objective: To explore the current evidence concerning the effect of oral antioxidant supplementation on various male fertility outcomes, as antioxidants are widely available compounds that are commonly used for the treatment of male infertility.

Materials and methods: PubMed, Medline and Cochrane electronic databases were searched according to a modified Preferred Reporting Items for Systemic Reviews and Meta-Analyses (PRISMA) guidelines looking for studies investigating the effect of antioxidant therapy on infertile men. The studies were explored looking for antioxidants: (i) types and doses; (ii) mechanism of action and rationale for use; and (iii) effect on the different outcome measures reported.

Results: In all, 26 studies reported a significant positive effect of antioxidant therapy on basic semen parameters, advanced sperm function, outcomes of assisted reproductive therapy, and live-birth rate. Vitamin E, vitamin C, carnitines, *N*-acetyl cysteine, co-enzyme Q10, zinc, selenium, folic acid and lycopene were most commonly used. The vitamins' mechanism of action and reported doses is presented in [Tables 1 and 2](#).

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ICSI, intracytoplasmic sperm injection;
IVF, *in vitro* fertilisation;
LAC, L-acetyl carnitine;
LC, L-carnitine;
MeSH, Medical Subject Heading;
NAC, *N*-acetyl cysteine;
OAT, oligoasthenozoospermia;
OS, oxidative stress;
PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses;
ROS, reactive oxygen species;
SDF, sperm DNA fragmentation

Conclusion: Antioxidants generally have a favourable effect on male fertility. Further studies are needed to identify the optimal antioxidant regimen that can be used safely and efficiently in clinical practice.

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Efficacy of Coenzyme Q10 on Semen Parameters, Sperm Function and Reproductive Hormones in Infertile Men

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Purpose: We determined the efficacy of coenzyme Q10 supplementation on semen parameters, sperm function and reproductive hormone profiles in infertile men.

Materials and Methods: A total of 212 infertile men with idiopathic oligoasthenoteratospermia were randomly assigned to receive 300 mg coenzyme Q10 (Kaneka, Osaka, Japan) orally daily (106 in group 1) or a similar placebo regimen (106 in group 2) during a 26-week period, followed by a 30-week treatment-free phase. Two semen analyses, acrosome reaction test, immunobead test for anti-sperm antibody, and determination of resting levels of luteinizing hormone, follicle-stimulating hormone, prolactin, testosterone and inhibin B were done in all participants. Blood and seminal plasma total coenzyme Q10 was also assessed.

Results: Significant improvement in sperm density and motility was evident with coenzyme Q10 therapy (each $p = 0.01$). Using the Kruger classification sperm morphology evaluation revealed an increase in the percent of normal forms in the coenzyme Q10 group ($p = 0.07$). A positive correlation was found between treatment duration with coenzyme Q10 and sperm count ($r = 0.46$, $p = 0.03$) as well as with sperm motility ($r = 0.45$, $p = 0.04$) and sperm morphology ($r = 0.34$, $p = 0.04$). The coenzyme Q10 group had a significant decrease in serum follicle-stimulating hormone and luteinizing hormone at the 26-week treatment phase (each $p = 0.03$). By the end of the treatment phase the mean $\pm$ SD acrosome reaction had increased from $14\% \pm 8\%$ and $15\% \pm 8\%$ to $31\% \pm 11\%$ and $16\% \pm 10\%$ in the coenzyme Q10 and placebo groups, respectively ($p = 0.01$).

Conclusions: Coenzyme Q10 supplementation resulted in a statistically significant improvement in certain semen parameters. However, further studies are needed to draw a final conclusion and evaluate the effect of coenzyme Q10 supplementation on the pregnancy rate.

Key Words: testis; spermatozoa; infertility, male; coenzyme Q10; dietary supplements

Abbreviations and Acronyms

CoQ10 = coenzyme Q10

FSH = follicle-stimulating hormone

LH = luteinizing hormone

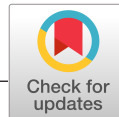
PRL = prolactin

RCT = randomized, controlled trial

TEAE = treatment emergent adverse event

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The efficacy of combined L-carnitine and L-acetyl carnitine in men with idiopathic oligoasthenoteratozoospermia: A systematic review and meta-analysis

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Abstract

The purpose of our analysis is to identify the effect of L-carnitine (LC) and L-acetyl carnitine (LAC) on the semen parameters of men with idiopathic oligoasthenoteratozoospermia (iOAT). We performed a comprehensive search to ascertain all the trials about LC and LAC in the treatment of iOAT and compared the results, including percentage of total sperm motility, sperm concentration, percentage of forward sperm motility, semen volume, percentage of atypical forms, total motile spermatozoa, forward motile spermatozoa and the number of pregnancies between the two groups that treated with LC + LAC or placebo respectively. Seven randomised controlled trials (RCTs) involving 693 patients were included in our analysis. We found that patients who treated with LC and LAC had significantly increased the percentage of forward sperm motility (MD 6.98; 95% CI 1.06–12.90; $p = .02$), total motile spermatozoa (MD 16.45; 95% CI 8.10–24.79; $p = .0001$), forward motile spermatozoa (MD 13.01; 95% CI 11.08–14.94; $p < .00001$) and the number of pregnancies (OR 3.76; 95% CI 1.66–8.50; $p = .002$). However, no significant differences were found in other semen indicators between the two groups. LC and LAC can significantly increase part of the semen parameters. The combination therapy of LC and LAC is effective in the men with iOAT.

KEYWORDS

combination therapy, idiopathic oligoasthenoteratozoospermia, L-acetyl carnitine, L-carnitine