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Review Article

A Comprehensive Review on Shatavari, Flaxseed, and Herbal Gummies as Emerging Nutraceutical Delivery Systems

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ABSTRACT

Women's reproductive health is closely regulated by hormonal balance, and increasing attention has been directed toward plant-based nutraceuticals for long-term endocrine support. Shatavari (*Asparagus racemosus*), a traditional Ayurvedic medicinal herb, and flaxseed (*Linum usitatissimum*), a nutrient-dense functional food, have individually demonstrated significant potential in promoting hormonal harmony and reproductive wellness. Shatavari root contains steroidal saponins (shatavarins), flavonoids, alkaloids, and polyphenolic compounds that exhibit adaptogenic, antioxidant, anti-inflammatory, immunomodulatory, and phytoestrogenic properties. Experimental and clinical evidence suggests its beneficial role in regulating menstrual cycles, improving ovulation, enhancing fertility, alleviating premenstrual syndrome (PMS), and reducing menopausal symptoms. Flaxseed is a rich source of alpha-linolenic acid (ALA), lignans, and dietary fiber. Its lignan content, particularly secoisolariciresinol diglucoside (SDG), is metabolized into enterolignans that modulate estrogen metabolism and influence sex hormone profiles. Clinical and epidemiological studies indicate that flaxseed consumption may improve menstrual regularity, reduce menopausal discomfort, enhance cardiometabolic parameters, and exert anti-inflammatory effects. The combinatorial use of Shatavari and flaxseed offers a complementary and potentially synergistic strategy targeting multiple physiological pathways, including the hypothalamic-pituitary-ovarian axis, oxidative stress modulation, and metabolic regulation. Additionally, the development of nutraceutical formulations such as gummies provides a patient-friendly delivery system that may improve compliance and long-term supplementation outcomes. Although preliminary evidence supports their therapeutic potential, further well-designed randomized clinical trials are required to establish standardized dosing, safety profiles, and long-term efficacy in women's hormonal health management.

INTRODUCTION

SHATAVARI

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Asparagus racemosus, also called shatavari, is an herb that has been used in various therapies for a long time. Shatavari is well known medicinal plant that grows in the tropical and subtropical areas of india. The name shatavari means one who has hundred or is pleasant to many. Is part of the Liliaceae family [1] *Asparagus racemosus*, is one of the most important herbal medicines used by Ayurvedic doctors for a very long time. The drug has a wide range of healing effects and is referred to as a rasayan in ancient Ayurvedic texts. In Ayurveda, it is seen as a tonic for women.

The main part used is a root. Shatavari has also been used by many Ayurvedic practitioners to treat nerve-related issues, stomach problems like acid peptic disease, and some types of infections. Even though it is a refreshing herb, it can also help with female infertility. It boosts sexual desire, treats inflammation in the sexual organs, keeps the tissues moist, supports the development of follicles, and improves ovulation [2]. Menopause is a natural change in a woman's body that happens when her monthly periods stop. Menopause is when a woman's reproductive years come to an end. Menopause can cause several symptoms like changes in the monthly period, hot flashes, night sweats, trouble with muscles and joints, painful breasts, and emotional ups and downs. Phytoestrogens are being looked at because they might help with menopausal symptoms, stop bone loss, and lower the chance of getting cancer. It might help keep bones strong by acting like oestrogen, which protects bones, especially in women after menopause. *Asparagus racemosus* has been found to be very helpful for women's reproductive health, especially when it comes to treating symptoms like PMS, missed periods, painful periods, and pelvic inflammatory diseases. Most women go through this during their 45 to 56 years old. A sudden or gradual drop in estrogen levels affects the hypothalamic-pituitary-ovarian

(HPO) axis. This could cause the endometrium to not develop properly, leading to uneven menstrual periods. During menopause, the changes in hormone levels, especially oestrogen and progesterone, lead to various symptoms. Oestrogen levels drop, and this shortage affects about 75% of women, causing symptoms that happen during the time before menopause or during menopause itself. Menopause is a natural part of a woman's life, not a sickness [3]. *Asparagus racemosus* is a popular medicinal plant known for its nutritive, rejuvenative aphrodisiac, laxative, galactagogue, antispasmodic, antacid, diuretic, antitumor, demulcent, anti-diarrheal, anti-depressant, antimicrobial, antioxidant, adaptogenic and immune modulatory properties. It is thought to be quite useful in promoting female reproductive health particularly in treating PMS symptoms, amenorrhea, dysmenorrhea, and pelvic inflammatory illnesses.

Shatavari helps balance the female hormones, boosts fertility, and enhances the quality of the egg. It also helps increase breast milk production in women after childbirth and in those who have had a hysterectomy.. [3] Shatavari, which is also known as *Asparagus racemosus* Willd, has been used for a long time in Ayurvedic medicine to support women's health, but there isn't much real evidence to show how well it actually works. Steroidal saponins are believed to be the main active compounds found in shatavari root. These saponins are called shatavarins I to IV, and they are made from sarsasapogenin with sugar attached. Shatavari root also has other important chemicals like racemosides, racemosol, racemofuran, and asparagine A, and all of these chemicals have antioxidant properties [4]. The bioactive substances which found in asparagus roots, like flavonoids, polyphenols, and saponins, have uses in pharmaceutical and nutraceutical manufacturing [5]. Shatavari which is a type of herb called



Asparagus racemosus Willd., has been commonly used in Ayurveda, but there isn't a lot of scientific evidence to prove that it really works. Shatavari mainly helps balance the Pitta dosha, and then the Vata dosha. Pitta dosha is the body's natural energy that helps with digestion and keeps all the body's metabolic and hormone-related processes in balance. Shatavari has chemicals called phytoestrogens, which act like estrogen in the body. These chemicals help reduce the symptoms that come with menopause. Steroidal saponins, known as Shatavarins, are the main active compounds found in Shatavari root. Others are alkaloids, quercetin, and glycosides of quercetin. The traditional use of Shatavari shows possible help in dealing with women's hormone-related issues, which makes it a good subject for more study and research [6]. Asparagus roots have a lot of important minerals like calcium, magnesium, phosphorus, and zinc. Minerals in the fluid around the follicles help control how the follicles grow and make steroids. Minerals help enzymes work properly, which is important for the growth and development of egg cells. They also play a role in how the ovaries function and whether a person can get pregnant. This study also found that the experimental groups given asparagus extracts had more ovarian follicles and corpus luteum, and there was a small increase in the number of atretic follicles [7].

FLAXSEED

In Indian languages, it is also called *Alsi*, *Jawas*, or *Aksebjia*. Flaxseed is a very important crop that is used for food, animal feed, fiber, and industrial uses. In business, nearly every part of the flaxseed plant is used either as is or after some sort of processing. Flaxseed has a crunchy texture and a slightly nutty flavor, as found in a study. The Latin name for flaxseed means "very useful," and there are two main types: brown and yellow, also called

golden. Both have similar nutrition and the same amount of short-chain ω -3 fatty acids. The exception is a type of yellow flaxseed called *solin*, also known as *Linola*, which has a completely different oil makeup and contains very little ω -3 fatty acids [8]. The primary female sex hormones are estrogen and progesterone, which are produced 4RFEF and secreted in response to pituitary hormones such as luteinizing hormone (LH) and follicle-stimulating hormone (FSH) [9]. The synthesis and metabolism of sex hormones are influenced by various factors including genetics, lifestyle, dietary intake, physical activity and environmental factors. Based on evidence, flaxseed might influence the sex hormone levels due to its phytoestrogens content such as lignans [9]. Flaxseed oil has around 53% alpha-linolenic acid (ALA), which makes it the best plant source for this nutrient, and also contains about 19% oleic acid. Flaxseed oil, because it has a lot of ALA, has a good ratio of n-6 to n-3 fatty acids, about 0.3 to 1. Because it helps reduce inflammation and stops unhealthy cell growth, ALA can help prevent cancer in the body. This means it may stop bad tumors from forming and stopping them from spreading to other parts of the body. Alpha-linolenic acid found in flaxseed helps improve the levels of fats in the blood.[10] Flaxseed has a lot of active ingredients that are good for the body, like alpha-linolenic acid, lignans, and fiber. Because of its many health benefits, flaxseed is called a "superfood." This means it's a natural food that has helpful substances in it and can be good for your health in several ways. Eating flaxseed can play a big role in helping prevent certain diseases, especially those that are connected to how well you eat and stay nourished [10].

Phytochemical Constituents of Shatavari root:

Shatavari consists of a diverse range of molecules in which major constituent is steroidal saponins



along with alkaloids, flavonoids, dihydrophenanthrene derivatives, furan derivatives & volatile constituents.[1] Rutin, 9,10-dihydro-1,5-methoxy-quercetin, glucuronides, 8-methyl-2,7-phenanthrenediol, Racemofuran, Shatavarin I-IV, Immunoside, Racemosal, 7-O-beta-D-glucopyranoside, Sterols, Alkaloid, Tannins, Carbohydrates, Flavonoids, Lactones, Amino acids.[2]

Anti-Inflammatory Properties of Shatavari

Inflammation is the body's defense against infection. Before starting treatment for any type of infection, inflammation needs to be reduced in order to treat better and to reduce pain in patients. Although there are a number of synthetic anti-inflammatory drugs which are available, it is always reliable to make use of herbal extracts, as it is safe for individuals. Studies show that the root extracts of Shatavari possess anti-inflammatory properties. Intake of the root extract reduces inflammatory cytokine production, myeloperoxidase activity. Anti-inflammatory activity was also evident histopathologically.[3]

TRADITIONAL USES OF *ASPARAGUS RACEMOSUS*:

- In Unani medicine, it is used to cure stomach issues and general weakness. It is also utilized in ayurvedic formulations like Shatavari Kalpa.
- Tribal and traditional medicine employ the root extract to treat inflammation, ulcers, and wounds.
- Additionally, it has been used to treat coughs, diabetes, and urinary tract conditions.[6]

Traditional Uses in Female Fertility

In Ayurveda, Shatavari is known as a 'Rasayana' (rejuvenating tonic) and 'Stanyajanana' (galactagogue). It has been used for many years:

- Manage and balance menstrual cycles
- It improves the process of ovulation and exalts the quality of eggs.
- In the processes of embryo implantation and the maintenance of pregnancy..
- Enhance the health and functionality of the female reproductive system.
- It reduces the effects of menopause.
- Efficiently oversees disorders such as polycystic ovarian syndrome (PCOS) and endometriosis.
- Minimize the impact associated with premenstrual syndrome (PMS)[7]

Clinical Applications of Shatavari in Female Health

- Infertility treatment: Used as a natural supplement to improve egg quality & ovulation.
- Menstrual irregularities: It helps to maintain a painless period, irregular cycle & heavy bleeding.
- Pregnancy support: Used to promote a healthy pregnancy by strengthening the uterus and improving fetal development.
- Postpartum recovery: Enhances lactation and aids in faster postpartum healing.
- PCOS management: It helps to regulate hormones and restore ovarian function.
- Menopausal relief: Common symptoms such as vaginal dryness, night sweats, mood swings.[7]

Phytochemical Constituents of Flaxseed



- Alkaloids
- Flavonoids
- Tannis
- Saponins
- Glycosides
- Proteins
- Carbohydrates
- Mucilage

Health benefits of flaxseed

By improving cholesterol levels, eating flaxseed can help reduce the risk of heart disease, particularly in those with elevated cholesterol. Studies on rats suggest that flaxseed may help prevent ovarian, colon, and bone cancers by stopping tumors from forming and slowing down the growth of blood vessels that feed them. Because flaxseed contains lignan, adipose acid, and beneficial fiber, it has a protective impact against the risk of diabetes. found that giving diabetic women supplements of flaxseed greasepaint (15 and 20 g/day) reduced their postprandial blood glucose by 7.9 and 19.1, respectively, over the course of two months. Because omega-3 adipose acids preserve anti-inflammatory properties, they can compensate for adult feather loss. Consuming more omega-3 adipose acids can help reduce the risk of developing a habitual order problem.[8]

Anti-Inflammatory Properties of Flaxseed

Flaxseed and flaxseed oil are good for your diet because they contain antioxidants like lignans, phenolic acids, and tocopherols. Flaxseed can help reduce levels of substances in the body that cause inflammation. A study looked at how eating flaxseed oil affects markers of inflammation in the blood and blood vessels of 34 people on hemodialysis. These patients were split into two groups. One group got 6 grams of flaxseed oil each day for 8 weeks. The other group got 6 grams of a

mix of medium-chain fatty acids, which included 59.4% caprylic acid, 39.6% capric acid, 0.7% caproic acid, 0.2% lauric acid, and 0.1% myristic acid.[9]

The Effect of Flaxseed on Sex Hormones and Menopause Symptom

Lignans may affect women's attention to coitus hormones because of their structural similarity to natural estrogens. Free estradiol, estrone, estrone sulfate, estriol, 2-methoxyestrone, 2-hydroxyestrone, 16-hydroxyestrone, and the 216-hydroxyestrone rate were among the coitus hormones that were evaluated in relation to flaxseed. The study involved 99 postmenopausal women who were randomly allocated to either the controls group or the intervention group. Two soup spoons (15g) of ground flaxseed were given to the intervention group every day for seven weeks. The women in the controls group continued eating as they usually did. The authors discovered that women in the intervention group had significantly greater levels of total enterolignans, serum 2-hydroxyestrone concentration, and 216-hydroxyestrone rate than those in the control group. Furthermore, alteration in enterolignans, serum 2-hydroxyestrone concentration, and 216-hydroxyestrone rate and negatively correlated with prolactin conditions. In another study, 90 women were studied to evaluate if flaxseed affected menopausal symptoms like hot flashes. Women who consumed flaxseed extract or ground flaxseed saw a noticeable decrease in menopausal symptoms when compared to those who did not, according to the experimenters setup. Hot flashes and the total. Symptom score (as determined by the kupperman indicator) both sharply decreased in the first group, falling by 2.5 and 1.6 points, respectively. In fact, symptoms decreased by 3.05 points more in the other group. However, neither



group's uterus nor vaginal fullness was significantly impacted by the flaxseed.[9]

Omega-3-fatty acids

Alpha-linolenic acid is the key part of flaxseed that gives it its special benefits. It's a good source of omega-3 fatty acids, especially for people who don't eat meat. Out of all the fats in flaxseed, which make up about 30%, around 55% is alpha-linolenic acid (ALA), 17% is linoleic acid (LA), 19% is oleic acid, 3% is stearic acid, and 5% is palmitic acid. This gives a good balance between n-6 and n-3 fatty acids, with a ratio of about 0.3 to 1. The fatty acid content of different oilseeds is listed in Table 1. The data shows that flaxseed has the highest amount of linolenic acid, followed by soybeans and mustard oil. Sunflower and safflower oils have a lot of linoleic acid, which might cause some health issues.[10]

Marcelina Handoyo et al(2026) the author tell us about that the gummies formulation had met the organoleptic requirements, weight uniformity, and the dimensions of the gummies. the gummy formulation had met the organoleptic requirements, weight uniformity, and the dimensions of the gummies[11]. Kanchana Yadav et al (2026) in this paper author study about develop gummies with *Elettaria cardamomum*, *Amomum subulatum* Roxb, *Zingiber officinale*, *Beta vulgaris* L. using different concentrations of gelling agents, plasticizers and pH modifier.[12] Nurhafizah Amir Nordin et al (2026) the author studied about the international literature on gummy candies as a healthier food alternative to design micro-credential training targeted towards community-based entrepreneurship. This review adopted the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology. [13]

GUMMIES:

Gummy formulations have emerged as a novel and patient-friendly oral dosage form in the pharmaceutical and nutraceutical industries. Originally developed as confectionery products, gummies have evolved into functional delivery systems for vitamins, minerals, herbal extracts, probiotics, and bioactive compounds. Their palatability, chewable texture, and ease of administration have significantly enhanced consumer compliance, particularly among pediatric, geriatric, and dysphagic populations [14, 15].

From a formulation perspective, gummies are semi-solid dosage forms typically composed of gelling agents (gelatin, pectin, starch, agar, or carrageenan), plasticizers (glycerol or sorbitol), sweeteners, flavoring agents, colorants, and active pharmaceutical or nutraceutical ingredients [16]. Gelatin-based systems are traditionally used due to their favorable gel strength and elasticity; however, plant-based alternatives such as pectin have gained popularity in response to vegetarian, vegan, and halal consumer preferences [17].

The rapid growth of the global nutraceutical market has contributed substantially to the expansion of gummy-based supplements. Vitamins such as vitamin D, vitamin C, B-complex, omega-3 fatty acids, and plant-derived phytoconstituents are increasingly incorporated into gummy matrices [18]. Herbal extracts, including phytoestrogen-rich botanicals, have also been explored for incorporation into gummies to improve acceptability and encourage regular consumption in women's health applications [19].

Pharmaceutically, gummies offer several advantages including improved patient adherence, reduced swallowing difficulties, and the potential for taste masking of bitter phytochemicals. However, formulation challenges remain, such as ensuring dose uniformity, stability of thermolabile

compounds, moisture control, sugar crystallization, microbial safety, and prevention of active ingredient degradation during heat processing [20]. Additionally, the high sugar content in some formulations raises concerns regarding dental health and glycemic impact, prompting research into sugar-free or low-glycemic alternatives using polyols or natural sweeteners [21].

Bioavailability is another important consideration in gummy formulations. The matrix composition, pH, and interaction between active compounds and gelling agents can influence dissolution and release kinetics. Studies have demonstrated that certain lipid-soluble compounds (e.g., fat-soluble vitamins and omega-3 fatty acids) may exhibit variable bioavailability depending on formulation design [22]. Therefore, careful optimization of excipient selection and processing conditions is essential for maintaining efficacy and product stability.

In the context of women's hormonal health, gummies represent a promising delivery platform for functional botanicals such as *Asparagus racemosus* (Shatavari) and *Linum usitatissimum* (Flaxseed), as they may enhance compliance in long-term supplementation regimens. The incorporation of phytoestrogenic extracts into palatable matrices aligns with the growing demand for preventive, plant-based, and lifestyle-integrated therapeutic strategies [23].

Given the increasing consumer preference for convenient dosage forms and natural health products, gummies are positioned as an innovative intersection between confectionery technology and pharmaceutical science. However, rigorous standardization, stability testing, regulatory compliance, and clinical validation remain critical for ensuring safety and therapeutic reliability.

REVIEW OF LITERATURE:

1. The goal of Rashmi P and Mona K's gummy formulation development and optimization was to select vegan components. Customers expressed satisfaction with the texture profile of agar-agar (red algae) combined with carrageenan to increase compressibility, with spirulina emerging as the preferred color. They included five distinct formulas. In general, the research verified that gummies are a fun and efficient way to include important nutrients into daily living while fusing convenience and nutrition. Further investigation into sensory tuning and formulation enhancements may increase their marketability and functional effectiveness.[24]
2. Ganesh H. et al. evaluated the clinical efficacy and patient outcomes of two innovative delivery systems: oral dissolving strips (ODS) and opaque gummies, which were developed using liposomal encapsulation and nanodrop technology. Participants with certain health conditions or dietary deficiencies were enrolled in the 12-month study. They were divided into two groups: Group A (opaque) Group B (ODS) and Gummies. Biochemical markers (such as vitamin D and hemoglobin), patient-reported results, and adherence, with improvements in patient satisfaction, adherence rates, and sleep quality reported without any negative events. There was no control group in the study.[25]
3. To make fiber-rich gummies, Lohar PB et al. used stevia, watermelon juice, beetroot juice, and plant-derived pectin in place of gelatin. As part of the study, the ash and moisture levels, total dietary fiber, vitamin C was measured using iodometric titration, microbiological examination was carried out using the pour plate technique and the standard plate count



method, ancomparing the samples; shelf lives in the refrigerator and at room temperature. In the market, gummies are growing in popularity, and melo beet gummies can be created using a wide range of materials. Numerous sugar reduction techniques can be used to lower blood sugar levels.[26]

4. Surana K. et al. investigated the creation of gummies with antitussive properties and in treating a range of coughs using the study's designated agents, which have a broad range of antitussive properties that are well-known. Studies demonstrate the effectiveness of antimicrobial, antibacterial, and antitussive properties for a range of age groups. The Additionally, the study asserts that it has outstanding antibacterial action and may be given to kids in several solid dosage forms.[27]
5. Finding out how gummy candy containing KGM affects excessive hunger and other appetite-related data is demonstrated by Fernandes AC et al. Konjac glucomannan is a herbal remedy. The randomized study on oxidative stress in overweight individuals was completed by 42 participants, ages 18 to 45. Benefits of the KGM include lowering blood pressure, cholesterol, blood sugar, and immunity. The research indicates that decrease in body weight following daily intake of 1g This study demonstrates how well gimmies are evaluated using KGM, with noteworthy findings.[28]
6. The goal of Teixeira-Lemos E. et al. was to make natural gummies with just natural ingredients and no additives. Two formulation conclusions were reached: one using berries blend (BEM) and one with honey added orange juice (ORH). Sensory analysis revealed that the panelists still liked the handmade gummy jellies, particularly the ORH, even if they were scored somewhat lower than the store-bought kind. This achieved ratings that were almost identical to those of the brand-name product. Generally speaking, customers may find that ORH and BEM gummy jellies are a healthier alternative to the common jelly sweets that are sold in supermarkets. The study; analysis findings verify that the gummies were safe to eat in accordance with EU regulations.[29]
7. Gummy jellies were made by Deshmukh SD and Bodhankar H using only natural materials and no added sugar or other chemicals. The objective was to create nutrient-dense gummy jelly sweets by using a crude extract of the leaves as directed by the study. The goal of this research was to create candies enhanced with unrefined leaf extracts. The ready-made candies can provide the body with a sufficient amount of nourishment. These candies can be taken by those with diabetes and high blood pressure. The ingredients used to make the gummies were carefully chosen to guarantee they provide sufficient nourishment that is advantageous for a healthy lifestyle.[30]
8. The goal of the Gawande S. et al. study was to create gummies with several formulas that included cinnamon, ginger, fennel, and cumin. Physical appearance, moisture content, and pH determination are evaluation factors that should be carried out. The results imply that these candies could be used as a functional food product, providing a convenient and socially acceptable way to reduce common stomach issues. Advanced formulation technologies should be the main focus of future research in order to address these issues.[31]



9. The effectiveness and safety of a gummy supplement containing botanical components, zinc, and vitamin B were the main topics of Martin-Biggers J and de Campos ME. 65 women between the ages of 18 and 60 were recruited to evaluate the gummies. Between baseline and six months, the test product-using patients' hair density increased in comparison to the placebo group. The subject of this investigation was perception of results that did not analyze hair for more than six months and diverged from clinical evaluations. synergistic activity of the ingredients in the new supplement formulation to improve subjective assessment and hair growth without having and adverse effect.[32]
10. Gummy candies containing probiotics, essential oils, and bovine colostrum were the focus of E. Bartkiene et al. They developed antimicrobial nutraceuticals in this work, including gummy candies (GC) derived from bovine colostrum (BC), essential oils (EOs), and probiotic lactic acid bacteria (PLAB). Antibacterial GC was prepared using heteropolysaccharide (agar).[33]

CONCLUSION

Shatavari (*Asparagus racemosus*) and flaxseed (*Linum usitatissimum*) represent promising plant-based interventions for supporting women's reproductive and hormonal health. Shatavari contributes to endocrine balance through its phytoestrogenic steroidal saponins and adaptogenic properties, demonstrating potential benefits in menstrual regulation, fertility enhancement, menopausal symptom relief, and lactation support. Its antioxidant and anti-inflammatory effects further strengthen its therapeutic relevance in stress-related reproductive disorders.

Flaxseed complements these effects through its high content of omega-3 fatty acids, lignans, and dietary fiber. By modulating estrogen metabolism, improving lipid and glucose profiles, and reducing systemic inflammation, flaxseed supports both reproductive and cardiometabolic health in women.

The combined use of Shatavari and flaxseed may provide a multifaceted approach to hormonal regulation by influencing endocrine pathways, reducing oxidative stress, and enhancing metabolic stability. The incorporation of these botanicals into innovative nutraceutical formulations, including gummy dosage forms, may enhance patient compliance and acceptability, particularly for long-term use.

Despite encouraging findings from preclinical and clinical studies, the current body of evidence remains limited by sample size, heterogeneity in study design, and lack of long-term safety data. Future research should focus on standardized extract formulations, mechanistic investigations, and large-scale randomized controlled trials to validate their synergistic efficacy and establish evidence-based clinical guidelines.

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