

**POTENTIAL OF HERBS AS GALACTOGOGUES – A REVIEW**

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**Abstract**

Given that approximately 130 million babies are born worldwide each year, this study aims to help both, pregnant and breastfeeding women, to overcome the first impasse, namely the decrease or lack of lactation. To sustain this purpose, over the years were used many methods to improve lactation. A galactogogue is a substance, a food or a plant that has the ability to stimulate or increase lactation. Plants as fenugreek, fennel, anise, lemon balm, thyme, cumin, milk thistle and many others are widespread all over the globe and known as galactogogues. These plants can be used as ingredients in food or consumed in the form of herbal teas, which in turn can be obtained by different extraction methods. Even though these herbs possess many other beneficial properties for the human body, the main purpose of their use, alone or in combination, is to maintain or increase breast milk production. The purpose of this paper is to review and summarize data regarding the efficacy of galactogogues available worldwide for increasing breast milk production in food and feed nutrition.

**Keywords:** plants, lactation, galactogogue, breastfeeding, herbs

**Introduction**

This review contains information regarding the importance of breastfeeding, possible lactation problems, as well as the definition, classification and characterization of plants with lactogenic potential. Recent surveys showed that an estimated 16% of USA women, 20%–45% Chinese women, 59.9% Australian women and 97% of Italian women used at least one herbal product during the breastfeeding period (Zheng *et al.*, 2019). The main aim of the present study is to summarize useful information about eight herbal galactogogues which are used as ingredients, in simple or mixed herbal teas, to stimulate lactation and are also the most commonly passed down recommendations from one generation to another.

A number of 175 papers were read, such as short communications, research articles and review papers, which were published between 2004 and 2020. Even so, further documentation is necessary and it is wisely to consult a specialist, a lactation consultant, before consuming these plants.

### ***The importance of breastfeeding***

Over the years, the role of breast milk has become increasingly recognized as beneficial in reducing morbidity among infants and especially among premature newborns. Breast milk is known to be the ideal form of nutrition for the baby in the first 6 months of life because it brings the intake of nutrients necessary for a healthy development (Özalkaya *et al.*, 2018). Breastfeeding also confers a range of maternal benefits, which include reduced risk of breast, endometrial and ovarian cancer, together with faster return to pre-pregnancy weight and improvements in the psychological wellbeing of the nursing mother (Grzeskowiak *et al.*, 2019).

### ***Possible lactation disorders***

Insufficient breast milk supply was frequently reported as the main reason for discontinuing breastfeeding. Numerous women, particularly those who delivered preterm babies, experienced difficulties in producing the required amount of human milk (Shawahna *et al.*, 2018).

During the postpartum period, many women face acute and chronic health problems (cough, infections, back pain, migraine, depression, and many others) and need to take medication. This case is one of women's self-reported reasons for discontinuation of breastfeeding. In addition, many health professionals lack evidence-based knowledge on medication and may advise women to stop breastfeeding while taking them (Saha *et al.*, 2015).

It has been claimed that at least 5% of women experience lactation failure (called agalactias) while approximately 15% of women experience inadequate supply of their breast milk (called hypogalactias) at 3 weeks postpartum and the numbers are constantly growing (Bekoe *et al.*, 2019).

### ***Definition***

Natural products, especially herbal ones, are increasingly sought worldwide, in order to be used for pregnant and breastfeeding women, due to the low risk of complications they present (Aleandri *et al.*, 2014).

Galactogogues are foods, pharmaceutical or herbal supplements that are used to support the initiation, continuation or augmentation of breast milk production (Hayati *et al.*, 2019).

They also increase the secretion of prolactin and provide a psychological relief and a marginal contribution to the production of the breastmilk. Human milk production is a complex physiological process involving physical and emotional factors and the interaction of multiple hormones, the most important of which is believed to be prolactin (Brodribb *et al.*, 2018).

### ***Classification***

As mentioned in the definition, galactogogues are:

- foods, such as banana flower, lemon basil, Thai basil, chicken, fish, pumpkin and others (Buntuchai *et al.*, 2017);
- pharmaceuticals, such as metoclopramide, domperidone, chlorpromazine, and sulpiride;
- medicinal herbs.

There are numerous plants all over the world known as galactogogues. The most frequently used herbs in commercial preparations and formulations are fennel, anise, star anise, shatavari, torbangun, caraway, dill, fenugreek, cumin, lemon bam, milk thistle, thyme and many others (Khorshidian *et al.*, 2019).

### Characterization

The plants with lactogenic potential that will be detailed below belong mostly to the *Apiaceae* and *Lamiaceae* families. Although they originate mainly from the Mediterranean region, they are now found all over the world. What these plants have in common, in addition to their lactogenic properties, is the fact that they all possess antioxidant and antimicrobial properties and have been used since ancient times in various branches of alternative medicine.

### Herbals with galactogogue potential

In Table 1 are presented eight of the most used herbal galactogogues across the world.

**Table 1.** Medicinal plants used worldwide as galactogogues.

Scientific name	Common name	Family	Parts used	Form of administration	References
<i>Foeniculum vulgare L.</i>	Fennel	<i>Apiaceae</i>	Seeds /leaves/ root	Edible oil/ tea/ spice/ food	Yaldiz and Camlica (2019)
<i>Trigonella foenum graecum</i>	Fenugreek	<i>Fabaceae</i>	Seeds/ leaves	Edible oil/ tea / food	Ouzir <i>et al.</i> (2016)
<i>Pimpinella anisum L.</i>	Anise	<i>Apiaceae</i>	Seeds	Edible oil/ tea/ spice	Rocha and Fernandes (2016)
<i>Illicium verum</i>	Star Anise	<i>Illiciaceae</i>	Fruits	Edible oil/ tea/ spice	Ding <i>et al.</i> (2017)
<i>Cuminum cyminum</i>	Cumin	<i>Apiaceae</i>	Fruits	Edible oil/ tea/ spice	Zhao <i>et al.</i> (2019)
<i>Melissa officinalis</i>	Lemon balm	<i>Lamiaceae</i>	Leaves	Edible oil/ tea	Kamdem <i>et al.</i> (2013)
<i>Silybum marianum</i>	Milk thistle	<i>Asteraceae</i>	Seeds	Edible oil/ tea	Pereira <i>et al.</i> (2013)
<i>Thymus serpyllum</i>	Thyme	<i>Lamiaceae</i>	Leaves	Edible oil/ tea/ spice	Jovanović <i>et al.</i> (2017)

### **Fennel**

*Foeniculum vulgare L.* is an important herb of *Umbelliferae (Apiaceae)* family, which is cultivated worldwide and can be used as spice, food or for herbal tea (Yaldiz and Camlica, 2019). It has many pharmacological properties like antioxidant and antibacterial, anti-inflammatory (Mokhtari and Ghoreishi, 2019), galactagogue (Shahat et al., 2011), antimutagenic, cardiovascular, chemomodulatory, antitumor and memory enhancing property (Yaldiz and Camlica, 2019). Its essential oils and plant extracts are also used to control stored food mites (Yaldiz and Camlica, 2019). The aqueous extract obtained from aerial parts of fennel can inhibit the growth of *Agrobacterium radiobacter pv. tumefaciens*, *Erwinia carotovora*, *Pseudomonas fluorescens*, and *Pseudomonas glycinea* (Sayed-Ahmad et al., 2017). Its extract mainly consists of some major chemical compounds such as trans-anethole, estragole, fenchone and  $\alpha$ -phellandrene (Mokhtari and Ghoreishi, 2019). As mentioned above, several fennel parts are edible (bulbs, leaves, stalks and fruits) meanwhile the mature fruit (the seeds) and essential oil of fennel are used as flavoring agents/spices in food products such as liqueurs, bread, cheese or as an ingredient in cosmetics and pharmaceutical products.

Badgujar et al. (2014) mention a few regions where fennel is used as a milk stimulant for pregnant women, such as: in South Africa they use fennel leaves infusions, in Europe fruits are chewed or used as spice (in Rome, Italy) or they are turned in simple powder (in north-east of Mallorca) and in South America (in Alto, Bolivia) they make infusions from the aerial parts.

The galactagogue activity of fennel is supported by pharmacological investigations. A randomized clinical trial was performed on 78 babies, who were exclusively breastfed, by giving to their nursing mothers a herbal tea containing 3 g black tea with 7.5 g fennel seeds powder (intervention group) or only 3 g black tea (control group) three times a day for 4 weeks. The intervention group presented significantly increased lactation for nursing mothers, increased infant's weight, head circumference and increased number of breastfeeding times (Ghasemi et al., 2014). Prolactin is secreted by the anterior pituitary gland in response to nipple stimulation. It is under inhibitory control from the hypothalamus, which is mediated by dopamine. Dopamine, therefore, has inhibitory effects on prolactin secretion. Anethole, the main constituent of fennel, bears strong structural resemblance to dopamine. Therefore, anethole may influence milk secretion by competing with dopamine at the receptor sites, thereby inhibiting the antiseecretory action of dopamine on prolactin (Javan et al., 2017).

### **Fenugreek**

Fenugreek (*Trigonella-foenum graecum*) is known as one of the oldest traditional and medicinal herbs that belongs to the *Fabaceae* family. It is cultivated in the Indian subcontinent, parts of west Asia, Middle East, North Africa, United Kingdom, Russia, Mediterranean Europe, Australia and Canada (Ouzir et al., 2016).

Sim *et al.* (2014) reports that fenugreek was the most commonly used herbal galactagogue during breastfeeding among the respondents of a survey applied on 304 breastfeeding women.

The effect of fenugreek seeds on milk yield and fat percentage was studied for 9 weeks in 21 lactating dairy goats. The goats were divided into three groups (A, B and C) according to the level of fenugreek added in the feed (0%, 25% and 50% fenugreek). All diets were similar. Milk yield was recorded daily and the fat percentage was determined weekly. The Group B showed significantly higher ( $p \geq 0.05$ ) daily yield of milk and fat percentage than the other two groups, however group C showed a lower daily yield of milk and fat percentage than the control group (Group A). There were non-significant differences in plasma total protein, globulin, albumin, cholesterol, glucose and total lipids among the three groups (Wani and Kumar, 2016).

Despite being used worldwide for a long time, herbal galactagogues are lacking in scientific evaluation and confirmation of the clinical efficacy. There are numerous reports that suggest effectiveness of fenugreek in promoting lactation, including a survey of La Leche League (a breastfeeding organization) leaders and lactation consultants indicating positive effects in milk supply in approximately 75% of lactating women (Sim *et al.*, 2015). The usual recommended dose to increase milk supply varies from 1 to 6 g daily; in dosages of about 25 g or more daily, fenugreek may lower cholesterol and blood sugar (Drugs and Lactation Database).

### **Anise**

Anise (*Pimpinella anisum*) is the most widespread *Pimpinella* species of the *Apiaceae* family and has been cultivated since ancient times in different regions of the globe, mainly for its role in food (Rocha and Fernandes, 2016).

Extracts and essential oils, both, obtained from this plant are known to possess various properties such as: antioxidant, antimicrobial, carminative, expectorant, antiseptic, antispasmodic, estrogenic activity. In traditional medicine, the plant is also known to be able to alleviate menstrual pain and to be galactagogue and aphrodisiac (Anastasopoulou *et al.*, 2020).

Due to its strong estrogenic activity, which it's caused by two main oil constituents: trans-anethole (93.9%) and estragole (2.4%), anise is used as galactagogue worldwide.

Hosseinzadeh *et al.* (2014) proves that *Pimpinella anisum* aqueous and ethanolic extracts increase milk production in rats and the research confirms the traditional use of *P. anisum* seeds as a lactogenic agent.

### **Star Anise**

Star anise is a medicinal plant, which has been shown to possess numerous properties such as antibacterial, antioxidant, antifungal (Dwivedy *et al.*, 2018), digestion stimulating, antiparasitic, and antipyretic properties. Its essential oil contains trans-anethole, which is a paramethoxyphenyl propene, as its main active ingredient (about 90%). Other compounds in the essential oil of star anise are estragole and

anisaldehyde. Both, star anise and its essential oil, are generally recognized as safe and are widely used in food and health supplement industries (Ding *et al.*, 2020).

### **Cumin**

Cumin (*Cuminum cyminum L.*) also belongs to the *Apiaceae* family and according to relevant reports it showed beneficial pharmacological properties such as antibacterial, antioxidant, anticancer and hypoglycemic actions mostly due to its essential oil and its main compounds, such as cuminaldehyde, cymene and terpenoids (Zhao *et al.*, 2019).

Numerous studies were made in order to evaluate the lactogenic effect of cumin, but due to the short period of trial or to the absence of the placebo control group, results could not be attributed to the use of cumin (Drugs and Lactation Database).

### **Lemon balm**

Lemon balm or balm (*Melissa officinalis L.*) represents one of the oldest medicinal plants, traditionally used for its sedative, carminative, antispasmodic, antibacterial, antiviral, anti-inflammatory, antioxidant and neuroprotective properties (Chizzola *et al.*, 2018; Miraj *et al.*, 2016).

It contains a low amount of lemon-scented essential oil that includes citronellal, neral, and geranial monoterpenoid aldehydes. It also consists of polyphenolic compounds (such as rosmarinic acid) and flavonoids (Chizzola *et al.*, 2018).

A randomized trial assigned mothers of preterm infants to receive either an herbal galactagogue herbal tea twice a day, a fruit tea twice a day or nothing. Although the increase in volume of extracted milk was greater in the galactagogue tea group, there was no difference in maternal serum prolactin between the groups after 7 days of administration and no difference in infant weight gain was seen between groups, so the quality of the study was declared poor (Drugs and Lactation Database).

### **Milk thistle**

Milk thistle (*Silybum marianum L.*) is an annual to biennial herb, native to the Mediterranean countries, member of *Asteraceae* family (Pereira *et al.*, 2013).

Studies and clinical trials have proven its traditional use as hepatoprotective agent in the treatment of acute and chronic hepatitis, alcohol-related liver diseases and liver damage. *In vitro* anti-inflammatory, anti-arthritis, antioxidant and anticancer properties as well as clinical trials of silymarin testing in cancer therapy have also been documented (Pendry *et al.*, 2017).

It is mainly used as a medicinal plant due to the presence of active phytochemical compounds. Milk thistle seeds are a major source of silymarin flavonoids. Silymarin is a mixture of four flavonolignans, including silybin (65%), silydianin (10%), silychristin (20%) (Sajadi *et al.*, 2016) and isosilybin (5%). They are bioflavonoid phytoestrogens which stimulate lactation directly, but they could act on estrogen receptors by limiting the endogenous receptor antagonism of milk production (Zecca *et al.*, 2016).

A study was made with a commercial dairy herd with lactating cows located in northern Italy. At approximately 30 days from the expected date of parturition, 30

pregnant cows were selected according to their health condition and previous milk production and were assigned randomly to either the control or treated group. From day 10, before the expected date of calving (assuming a gestation period of 280 days) today 15 after calving, 15 cows were treated with 10 g of silymarin (76% pure extract consisting in flavonolignans, taxifolin, and other trace compounds) per day. To guarantee the dose intake, the extract was mixed with water into a ready-to-use suspension and was immediately administered by an oral drench. Animals were monitored daily to evaluate general physical condition and health disorders by herd personnel or herd veterinarian. Although the biochemical mechanisms that led to the study's effects have not been established, the results showed a higher and earlier milk peak and no negative conditions attributable to the use of silymarin. There were not any adverse effects, indicated by blood and milk parameters, of feeding cows with this natural compound (Tedesco *et al.*, 2004).

An *in vivo* study with gestational sows, which were fed with 4g silymarin twice a day for 20 days was made and the results showed a significant increase of circulating prolactin levels (Farmer *et al.*, 2014).

Another study made on sows by Jiang *et al.* (2020), also indicate that silymarin supplementation during transition and lactation can increase circulating concentrations of prolactin transiently, reduce oxidative stress, increase feed intake and enhance protein metabolism, thereby significantly increase milk yield of sows and subsequently improve growth performance of their descendants.

### **Thyme**

Thyme (*Thymus serpyllum L.*) or wild thyme, as it is also known, is a perennial subshrub of the *Lamiaceae* family, which grows in almost all the countries bordering the Mediterranean, in Asia and in parts of Central Europe (Jovanović *et al.*, 2017).

This medicinal plant possesses numerous properties, such as: antiseptic, diaphoretic, analgesic, carminative, expectorant, diuretic, emmenagogue, and stimulant properties (Nikolić *et al.*, 2014).

The main component of the essential oil of *T. serpyllum* is carvacrol, while it also contains borneol, isobutyl acetate, caryophyllene, 1,8-cineole, citral, citronellal, citronellol, p-cymene, geraniol, linalool,  $\alpha$ -pinene,  $\gamma$ -terpinene,  $\alpha$ -terpineol, terpinyl acetate, and thymol in relatively high concentrations. Carvacrol and thymol are isomers, belonging to the group of monoterpenic phenols with high antiseptic properties (Jarić *et al.*, 2015).

In Table 2 are presented the administration dose of the herbal galactogogues.

### **Controversial galactogogues**

Although they have many health benefits, herbs used without the supervision of a specialist can cause side effects. In Table 3 are presented the selected eight herbs with galactogogue potential and their possible harms.



**Table 2.** Specified doses for plants with galactogogues properties.

Scientific name	Recommended daily dose	References
<i>Foeniculum vulgare L.</i>	0.1 to 0.6 mL of fennel oil (equal to 100 to 600 mg) daily	Nice (2011)
<i>Trigonella foenum graecum</i>	Orally, from 1 to 6 g daily	Nice (2011); Drugs and Lactation Database
<i>Pimpinella anisum L.</i>	Not mentioned	-
<i>Illicium verum</i>	Not mentioned	-
<i>Cuminum cyminum</i>	A handful of boiled seeds in approximately two cups of water, filtered, with a spoonful of honey as a first thing in the morning is recommended, in India, to enhance lactation	Sayed et al. (2007)
<i>Melissa officinalis</i>	Not mentioned	-
<i>Silybum marianum</i>	12 to 15 g daily as infusion	Nice (2011)
<i>Thymus serpyllum</i>	Not mentioned	-

**Table 3.** Possible harms that galactogogues herbs might cause.

Scientific name	Botanical part used	Possible harm	References
<i>Foeniculum vulgare L.</i>	Fruit	Photo sensitivity, atopic dermatitis, increased gastrointestinal motility. Essential oil may be toxic in large amounts.	Foong et al. (2020)
<i>Trigonella foenum graecum</i>	Seeds/ leaves	Digestive upset or loose stools (mother or infant), lower blood sugar, maple smell in the urine and sweat; mild allergic reaction. Possible peanut allergen cross sensitivity	Foong et al. (2020)
<i>Pimpinella anisum L.</i>	Fruit	Allergen	Foong et al. (2020)
<i>Illicium verum</i>	Fruit	Oral administration of high dose (500mg/kg) of its ethyl- acetate extract produced convulsions and lethal toxicity in mice	Wang et al. (2011)
<i>Cuminum cyminum</i>	Fruit	None known	Foong et al. (2020)
<i>Melissa officinalis</i>	Leaves	No side effects have so far been reported for the herb, when used topically or orally in recommended doses (up to 30 days)	Miraj et al. (2016)
<i>Silybum marianum</i>	Aerial parts/seeds	Nausea, flatulence, diarrhoea	Foong et al. (2020)



## Conclusions

Fennel, anise, cumin and the rest of the plants mentioned in the study are known for their ability to increase lactation, but in order to choose the appropriate herbal galactagogue is important to evaluate the potential benefits and side effects of each herb aside. Even if they are spread worldwide and they are promoted from generation to generation, it is wisely recommended to consult a specialist in breastfeeding/lactation before use.

## Further research

These herbal galactagogues should be deeper investigated in order to know their nutritional and phytochemical composition, their efficacy, safety and their mechanism of action because these herbs have the advantage of being cheaper and easily available for breastfeeding women.

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