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Study The Properties and Composition of Various Ayurvedic Compound as Galactagogue

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ABSTRACT:
Indians have known the value of breast milk since ancient times and have also recognised the significance of specific medicinal plants for this purpose. The Ayurvedic literature has comprehensive explanations of the physiology of milk production and ejection, illnesses that affect the quantity and quality of breast milk, and how to treat them. For the purpose of conducting additional study and developing new treatments, it is essential to explain the lost knowledge regarding plant medications that are mentioned in ancient and mediaeval Ayurvedic literature and are suggested for their Galactogogue action. Understand the mode of action of these plant drugs based on their traditional use, the principles mentioned in Ayurvedic texts, and by applying modern pharmacological ideas, in order to ensure their rational and evidence-based use and the development of safe, effective, and acceptable pharmacological dosage forms.The outcomes will provide scientific validation for traditional claims, potentially leading to improved therapeutic options for lactating mothers. Understanding these compounds' mechanisms may also contribute to broader applications in herbal medicine and lactation science.

KEYWORDS: Breast milk, augmentation, galactogogue, Ayurveda, medicinal plants.

INTRODUCTION

Ayurveda, the ancient system of medicine originating in India, has a rich history of using natural remedies for a wide range of health conditions. Among its diverse array of treatments, Ayurvedic medicine includes numerous formulations believed to act as galactagogues—substances that promote or increase lactation in nursing mothers. With breastfeeding recognized as critical for the health and development of infants, enhancing milk production naturally has become an area of growing interest. This study aims to explore the properties and composition of various Ayurvedic compounds traditionally used as galactagogues, bringing scientific scrutiny to these time-honored practices.The significance of galactagogues is underscored by the challenges some mothers face in producing sufficient breast milk. Insufficient milk supply can lead to early cessation of breastfeeding, which is linked to poorer health outcomes for both the infant and the mother. Breast milk provides optimal nutrition, strengthens the infant's immune system, and fosters bonding between mother and child. Therefore, finding effective and safe ways to support lactation is crucial.Ayurvedic medicine offers a variety of herbal galactagogues, often used in combination to enhance their effectiveness. Commonly cited herbs include Shatavari (Asparagus racemosus), Fenugreek (Trigonella foenum-graecum), and Vidari (Pueraria tuberosa). These

herbs are traditionally believed to stimulate milk production through their phytoestrogenic properties and other bioactive compounds. However, the scientific validation of these claims remains limited, necessitating comprehensive research to understand their mechanisms and efficacy.The primary aim of this study is to dissect the pharmacological properties and chemical compositions of these Ayurvedic galactagogues. This involves identifying the key active ingredients through advanced analytical techniques.Understanding the efficacy and safety of Ayurvedic galactagogues could have broader implications beyond traditional medicine. The findings could contribute to the development of new, natural therapeutic options for enhancing lactation, potentially benefiting a global population. Furthermore, elucidating the mechanisms of these herbs could lead to novel insights in lactation science and herbal pharmacology.

PHYSIOLOGY OF BREAST MILK:

Breast milk is a complex and dynamic biological fluid uniquely tailored to meet the nutritional and immunological needs of infants. Understanding its physiology involves exploring the intricate processes of milk production, secretion, and composition, all of which are tightly regulated by hormonal, cellular, and molecular mechanisms.

Milk Production and Secretion:

Milk production, or lactogenesis, occurs in two main stages:

1. **Lactogenesis I:** This stage begins during the second half of pregnancy, where the mammary glands are prepared for milk production under the influence of hormones like estrogen, progesterone, prolactin, and human placental lactogen. During this period, colostrum, a nutrient-rich fluid, is produced in small quantities.
2. **Lactogenesis II:** This stage starts around the time of birth, triggered by a drop in progesterone levels following the delivery of the placenta. Prolactin, produced by the anterior pituitary gland, plays a crucial role in initiating copious milk secretion approximately 30 to 40 hours postpartum. The feedback inhibitor of lactation (FIL) regulates milk production to match the infant's demand.

Milk secretion involves two primary pathways:

1. **Merocrine Secretion:** The majority of milk proteins, lactose, and water are synthesized and secreted by mammary epithelial cells through the merocrine pathway, where vesicles containing these components merge with the cell membrane and release their contents into the alveolar lumen.
2. **Apocrine Secretion:** Lipid droplets are secreted via the apocrine pathway, where a portion of the mammary epithelial cell membrane envelops the lipid droplet and pinches off into the lumen.

Composition of Breast Milk:

Breast milk composition changes over time and within feeds to adapt to the growing infant's needs. It contains a balanced mixture of nutrients, immune factors, and bioactive molecules.

1. **Colostrum:** Produced in the first few days postpartum, colostrum is high in immunoglobulins, particularly IgA, which provide critical passive immunity to the newborn. It is also rich in proteins, minerals, and vitamins, and has a laxative effect to help clear the infant's meconium.
2. **Transitional Milk:** Following colostrum, transitional milk is produced for about two weeks. It gradually increases in volume and adjusts its composition, with higher levels of fats and lactose to support the infant's energy needs.
3. **Mature Milk:** From about two weeks postpartum, mature milk is produced. It contains a stable balance of nutrients:

4. **Proteins:** Primarily casein and whey, which are easily digestible and support growth.
5. **Fats:** Essential fatty acids, including long-chain polyunsaturated fatty acids (LCPUFAs), which are critical for brain development.
6. **Carbohydrates:** Lactose is the main carbohydrate, providing energy and promoting the growth of beneficial gut bacteria.
7. **Vitamins and Minerals:** Necessary for overall growth and development, including vitamins A, C, and D, and minerals like calcium and iron.
8. **Immunological Components:** Antibodies, leukocytes, and bioactive molecules such as lactoferrin and lysozyme help protect against infections.

Regulation of Lactation:

The regulation of lactation is a complex interplay between hormonal signals and physical factors:

1. **Hormonal Regulation:** Prolactin and oxytocin are the primary hormones regulating milk production and ejection. Prolactin stimulates milk synthesis, while oxytocin, released in response to the infant's suckling, causes the myoepithelial cells around the alveoli to contract and eject milk (the "let-down" reflex).
2. **Autocrine Regulation:** The rate of milk removal from the breast directly influences milk production. Frequent and effective breastfeeding or pumping stimulates continued milk production by maintaining high prolactin levels and preventing the build-up of FIL, which inhibits milk synthesis.

the physiology of breast milk involves a sophisticated coordination of hormonal, cellular, and molecular processes that ensure the provision of optimal nutrition and immunological protection to the infant. Understanding these mechanisms highlights the importance of breastfeeding and supports efforts to promote and sustain lactation in new mothers.

NEED FOR DEVELOPMENT OF SAFE AND EFFECTIVE APPROACH FOR AUGMENTATION OF BREAST MILK:

The need for developing safe and effective approaches to augment breast milk production is driven by several critical factors that impact both maternal and infant health. Breastfeeding is universally recognized as the optimal method of feeding infants due to its unmatched nutritional, immunological, and developmental benefits. However, various challenges can hinder adequate milk production, necessitating interventions to support and enhance lactation.

Challenges in Lactation:

Despite the benefits, many mothers encounter difficulties in breastfeeding. Common challenges include:

Insufficient Milk Supply: Many mothers worry about not producing enough milk, which can be due to physiological issues, poor breastfeeding techniques, or psychological stress.

Medical Conditions: Conditions like polycystic ovary syndrome (PCOS), thyroid disorders, and certain medications can impair lactation.

Preterm Births: Premature infants may struggle with effective breastfeeding due to underdeveloped sucking reflexes, requiring enhanced lactation support.

Postpartum Complications: Mothers experiencing postpartum hemorrhage or infections may face difficulties in establishing and maintaining milk production.

Need for Effective Galactagogues:

Galactagogues are substances that promote lactation in humans. While some mothers may turn to pharmaceutical options, these can come with potential side effects and risks. Therefore, there is a

growing interest in natural and safer alternatives to support lactation.Considering the limitation of certain synthetic agents for augmentation of breast milk it is imperative to develop safe and effective alternate agents preferably from plant source.

Ayurveda enumerate a number of such medicinal plants for augmentation of breast milk.

Galactagogue in ayurveda:

Classical literatures of Ayurveda describe the utilization of several drugs as galactogogues with their diverse properties. A critical evaluation has been done from these literatures and it was observed that mainly 32 medicinal plants are used as galactogogues (Table 1).

Table 1: Medicinal plants indicated for augmentation of Brest milk in ayurveda text.

S. No	Sanskrit Name	Botanical Source Family	Rasa	Guna	Veerya	Vipaka	Specific terminolo-gies in Ayurveda
1.	Nala	Arundo donax L. (Poaceae)	Madhura, Kashaya, Tikta	Laghu, Snigdha	Sheeta	Madhura	Stanyajanan
2.	Rohisha	Cymbopogon martini (Roxb.)Wats (Poaceae)	Katu, Tikta	Laghu, Ruksha, Tikshna	Ushna	Katu	Stanyajanan
3.	Veerana	Vetiveria zizaniodes (L.) Nash (Poaceae)	Tikta, Madhura	Ruksha, Laghu	Sheeta	Katu	Stanyajanan Kseerjanana
4.	Shali	Oryza sativa L. (Poaceae)	Madhura, Kashaya	Snigdh Laghu	Sheeta	Madhura	Stanyajanan Kseerjanana
5.	Darbha	Imperata cylindrical (L.) Beauv. (Poaceae)	Madhura, Kashaya	Laghu, Snigdha	Sheeta	Madhura	Stanyajanan Kseerjanana
6.	Kusha	Desmostachya bipinnata (L.) Stapf. (Poaceae)	Madhura, Kashaya	Laghu, Snigdha	sheeta	Madhura	Stanyajanan Kseerjanana
7.	Kasha	Saccharum spontaneum L. (Poaceae)	Madhura, Kashaya	Laghu, Snigdha	Sheeta	Madhura	Stanyajanan Kseerjanana
8.	Gundra	Typha australis Schum & Thonn. (Typhaceae)	Kashaya, Madhura	Guru	Sheeta	Madhura	Stanyajanan Kseerjanana
9.	Itkata	Sesbania bispinosa (Jacq.) W.Wight.	Madhura	Snigdha Guru	Sheeta	Madhura	Stanyajanan Kseerjanana

10.	Kattrina-mula	Cymbopogon citrates (DC.) Stapf. (Poaceae)	Katu, Tikta	Tikshna, Laghu, Ruksha	Ushna	Katu	Stanyajanan
11.	Ksheer Kakoli	Lilium polyphyllum D.Don (Liliaceae)	Madhura	Guru, Sheeta	Sheeta	Madhura	Stanyakara
12.	Kakoli	Fritillaria roylei Hook. Liliaceae	Madhura	Guru, Snigdha	Sheeta	Madhura	Stanyakara
13.	Jeevaka	Malaxis acuminata D. Don. (Orchidaceae)	Madhura	Snigdha Pichchila	Sheeta	Madhura	Stanyakara
14.	Mudgapa -rni	Vigna trilobata (L.) Verdc.(Fabaceae)	Tikta, Madhura	Laghu, Ruksha	Sheeta	Madhura	Stanyakara
15.	Mashapa - rni	Teramnus labialis (L.f.) Spreng. (Fabaceae)	Tikta, Madhura	Laghu, Ruksha	Sheeta	Madhura	Stanyakara
16.	Meda	Litsea glutinosa (Lour.) C.B.Rob (Lauraceae)	Katu, Tikta, Kashaya	Laghu, Snigdha	Ushna	Katu	Stanyakara
17.	Mahame da	Polygonatum cirrhifolium Royle, (Liliaceae)	Madhura	Guru, Snigdha	Sheeta	Madhura	Stanyakara
18.	Guduchi	Tinospora cordifolia (willd.) Miers. (Menispermaceae)	Tikta, Kashaya	Laghu	Ushna	Madhura	Stanyakara
19.	Kakata-shringi	Pistacia chinensis Bunge (Anacardiaceae)	Kashaya, Tikta	Guru	Ushna	Katu	Stanyakara
20.	Tuga	Bambusa arundinacea Willd. (Poaceae)	Madhura, Kashaya	Ruksha, Laghu, Tikshna	Sheeta	Madhura	Stanyakara
21.	Padmaka	Prunus cerasoides Buch.-Ham. ex D.Don. (Rosaceae)	Kashaya, Tikta	Laghu	Sheeta	Katu	Stanyakara
22.	Riddhi	Habenaria intermedia D. Don, (Orchidaceae)	Madhura	Guru, Snigdh, Pichchila	Sheeta	Madhura	Stanyakara
23.	Mridvee ka	Vitis vinifera L. (Vitaceae)	Madhura, Kashaya	Guru, Sara, Snigdha	Sheeta	Madhura	Stanyakara
24.	Jeevanti	Leptadenia reticulate W.&A. (Asclepiadaceae)	Madhura	Laghu, Snigdha	Sheeta	Madhura	Stanyakara
25.	Yashti-madhu	Glycyrrhiza glabra L. (Leguminosae)	Madhura	Guru, Snigdha	Sheeta	Madhura	Stanyakara Ksheerajana-na
26.	Yava	Hordeum vulgare L. (Poaceae)	Kashaya, Madhura	Ruksha, Guru, Pichchil, Mridu	Sheeta	Katu	Ksheerajana-na
27.	Lashuna	Allium sativum L. (Liliaceae)	Madhura, Lavana, Tikta, Katu, Kashaya	Guru, Snigdh, Tikshna, Sara, Pichchila	Ushna	Katu	Ksheerajanan a
28.	Kasheruk a	Scirpus kysoor Roxb. (Cyperaceae)	Madhura, Kashaya	Guru , Ruksha	Sheeta	Madhura	Ksheerajanan a
29.	Shringa-taka	Trapa natans L. (Trapaceae)	Madhura, Kashaya	Guru	Sheeta	Madhura	Ksheerajanan a
30.	Bisa	Nelumbo nucifera	Tikta,	Guru,	Sheeta	Madhura	Ksheerajanan

	(Kamala Naala)	Gaertn. (Nymphaeaceae)	Madhura, Kashaya, Katu, Lavana	Ruksha			a
31.	Vidari-kanda	Pueraria tuberosa (Willd.) DC. (Fabaceae)	Madhura	Guru, Snigdha	Sheeta	Madhura	Ksheerajanana
32.	Shatavari	Asparagus racemosus Willd. (Liliaceae)	Madhura, Tikta	Guru, Snigdha	Sheeta	Madhura	Ksheerajanana

AYURVEDIC PHARMACOLOGICAL PROFILE:

Numerous studies have been conducted on the Ayurvedic pharmacological principles of 32 plants that are recommended for increasing breast milk. These studies have focused on several aspects, including Rasa (taste), Guna (bio-physical property), Virya (active principle/potency), Vipaka (product of biotransformation/drug-receptor complex), and Dosha karma (action on doshas). Among the 63 components of Rasa of 32 plants, 26 plants (41.3%) have Madhura rasa, 2 (3.2%) Lavana rasa, 5 (7.9%) have Katu rasa, 13 (20.6%) have Tikta rasa, and 17 (27%) have Kashaya rasa. (Table-2)

Table-2: Distribution of 63 Rasa components of 32 Plants used for Galactogogue effect.

S. No	Rasa	Number of plants	Percentage (%)
1.	*Madhura*	26	41.3
2.	*Kasaya*	17	27
3.	*Tikta*	13	20.6
4.	*Katu*	5	7.9
5.	*Lavana*	2	3.2

Out of 69 components Guna of 32 plants, 15 plants (21.7%) possess Laghu guna, 16 (23.1%) Guru Guna, 17 (24.6%) Snigdha Guna, 9 (13%) Ruksha Guna, 4 (5.7%) plants possess Tikshna Guna, 4(5.7%) Pichchila Guna, 2 (2.9%) Sara Guna, 1 (1.4%) Sheeta Guna and 1 (1.4%) Mridu Guna. (Table-3)

Table-3: Distribution of 69 component Guna of 32 Plants used for Galactogogue effec

S. No	Guna	Number Of Plants	Percentage (%)
1.	*Laghu*	15	21.7
2.	*Guru*	16	23.1
3.	*Snigdha*	17	24.6
4.	*Ruksha*	9	13
5.	*Pichchila*	4	5.7
6.	*Tikshna*	4	5.7
7.	*Sara*	2	2.9
8.	*Sheeta*	1	1.4
9.	*Mridu*	1	1.4

Out of 32 components Virya of 32 plants, 26 plants (81.2%) possess Sita virya while 6(18.8%) plants possess Ushnavirya. (Table-4).

Table-4: Distribution of 32 components Virya of 32 Plants indicated for Galactogogue effect

S. No	Virya	Number of Plants	Percentage (%)
	Sita	26	81.2
	Ushna	6	18.8

Out of 32 component Vipaka of 24 plants (75%) possess Madhura vipaka and 8 (25%) Katuvipaka (Table-5)

Table-5: Distribution of 32 components Vipaka of 32 Plants indicated for Galactogogue effect

S. No	Vipaka	Number of Plants	Percentage (%)
1.	*Madhura*	24	75
2.	*Katu*	8	25

The dominating principles of the attributes viz. Rasa, Guna, Virya, and Vipaka ascribed to these plants, include Madhura rasa -26 (41.3%) out of 63 component of rasa, Snigdha Guna-17 (24.6%) out of 69 component of Guna, Sita, Virya -26(81.2%) out of 32 components of Virya and Madhura Vipaka - 24 (75%) out of 32 component Vipaka.(Table- 6).

Table-6: Distribution of Dominating attributes among 32 Plants indicated forGalactogogue effect

S.No	Attributes	Distribution	Percentage (%)
1.	*Madhura rasa*	26 (of 63 component Rasa)	**41.3**
2.	*Snigdha Guna*	17 (of 69 component Guna)	**24.6**
3	*Sheeta Virya*	26 (of 32 component Virya)	**81.2**
4	*MadhuraVipaka*	24 (of 32 component Vipaka)	**75**

An insight into effect of dominating attributes among 32 plants designated for theaugmentation of breast milk on Kapha dosha -the factor attributed for increasing the milk revealed that all the factors ascribed with Kapha vardhaka action i.e. increased of Kapha dosha) (Table -7).

Table-7: Effect of dominating attributes of 32 Plants indicated for galactogogue effect on Kapha dosha.

S.No.	Attributes	Effect on kapha dosha
1.	*Madhura rasa*	*Kapha vardhaka* (increases Kapha)
2.	*Snigdha Guna*	*Kapha vardhaka* (increases Kapha)
3.	*Guru Guna*	*Kapha vardhaka* (increases Kapha)
4.	*Laghu Guna*	*Kaphahara* (alleviates Kapha) (Guna of breast milk)
5.	*Sheeta Virya*	*Kapha vardhaka* (increases Kapha)
6.	*Madhura Vipaka*	*Kapha vardhaka* (increases Kapha)

AYURVEDIC PATHOPHYSIOLOGICAL UNDERSTANDING OF MODE OF ACTION:

The mechanism of action of classical excerptions on galactogogue activity can be understood in the context of Ayurvedic pharmacological and pathophysiological principles. These excerptions are genuine proof, or Aptopadesha. The use of Kapha vardhaka medicines to increase breast milk production was

mentioned in Ayurvedic writings. Moreover, Madhura, Kashaya anurasa, Sheeta, and Laghu guna of breast milk were mentioned in the classics. Since Kapha Dosha is the primary cause of an increase in breast milk, an explanation of the pharmacological principles that increase Kapha, such as Rasa (taste), Guna (biophysical property), Virya (active principle/potency), and Vipaka (product of biotransformation/drug-receptor complex), of medicinal plants that are indicated for galactogogue action, may be helpful in researching the mechanisms underlying these medications. A plausible explanation is that some characteristics that predominate in the pharmcodynamic profile, such as Vipaka, Madhura rasa, Sheeta Virya, and Guru Guna, are associated with Kaphavardhaka activity, which elevates kapha dosha.According to Ayurvedic principles (sarvada sarva bhavanam samanyamvriddhi karanam, Samanyam ekatvakaram, tulyarthata samanyam), drugs with physical and pharmacological properties similar to body elements or tissues are the ones responsible for the growth, development, or augmentation of respective body components. The pharmacological and physical characteristics of the 32 plant-based medications are similar to those of breast milk. The sole exception to this rule is the presence of laghu guna in 15 medications, which may be justified by the fact that laghu guna is a natural component of breast milk even though it is not the primary cause of the galactogogue effect—that is, an increase in kapha dosha.

AYURVEDIC TERMINOLOGY FOR GALACTOGOGUE ACTION :

An observation on distribution of Ayurvedic terminology cited for galactogogue actions among 32 plants mentioned in Ayurveda revealed that the words -Stanyajanana has beenascribed for two plants, both Stanyajanana and Kseerjanana for 8 plants, Stanyakara for 14 plants, both Stanyakara and Ksheerajanana for 1 plant, Kseerjanana for 7 plants. (Table-8)

Table-8: Distribution of Terminology cited for Galactogogue drugs

S. No.	Terminology for Galactogogue actions in Ayurvedic Texts	Distribution among number of plants
1.	*Kseerjanana*	15
2.	*Stanyakara*	15
3.	*Stanyajanan*	10

Conclusion:

The augmentation of breast milk production is a critical area of focus in maternal and infant health, given the profound benefits of breastfeeding. The challenges faced by many mothers in producing sufficient milk necessitate the development of safe and effective strategies to support lactation. This conclusion synthesizes the need, potential solutions, and broader implications for enhancing breast milk production.

Recognizing the Importance of Breastfeeding:

Breastfeeding is the gold standard for infant nutrition. It provides comprehensive nourishment, supports immune system development, and fosters a strong bond between mother and child. Breast milk is uniquely formulated with the right balance of nutrients, antibodies, and bioactive compounds essential for the infant's growth and health. The long-term benefits of breastfeeding extend to reducing the risk of chronic diseases and promoting optimal development.

Despite these benefits, many mothers encounter difficulties in breastfeeding, leading to insufficient milk supply. This can stem from various factors, including physiological issues, medical conditions, preterm births, and postpartum complications. Addressing these challenges is crucial to ensure that all infants can benefit from the unparalleled advantages of breast milk.

Ayurvedic medicine, with its rich history of natural remedies, offers several herbal compounds traditionally used to enhance lactation. Key herbs like Shatavari (Asparagus racemosus), Fenugreek (Trigonella foenum-graecum), and Vidari (Pueraria tuberosa) are believed to possess galactagogue properties. These herbs are thought to stimulate milk production through their phytoestrogenic and nourishing properties. However, their traditional use requires scientific validation to ensure efficacy and safety.

The development of safe and effective approaches to augment breast milk production is crucial for public health. By validating and integrating natural remedies, such as Ayurvedic compounds, with modern scientific methods, we can provide mothers with reliable tools to support lactation. This not only enhances the health and well-being of infants but also empowers mothers, promoting a healthier start for future generations.

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