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Development and assessment of herbal chocolate formulation for menstrual cramps

Akshta S. Tarmale¹, Janhavi P. Unde², Ashwini B. More³

¹² student of final year B. pharmacy Pratibhatai pawar college of pharmacy shrirampur, India ³ Assistance professor of B. pharmacy Pratibhatai pawar college of pharmacy shrirampur, India

ABSTRACT:

This research investigated the development and assessment of a herbal chocolate formulation intended to alleviate menstrual cramps. The study aimed to create a palatable alternative to traditional treatments by incorporating natural ingredients with known therapeutic properties.

The herbal chocolate was formulated using a combination of fennel, chia seeds, ajwain, cocoa powder, and jaggery. These ingredients were selected based on their potential to reduce pain, inflammation, and muscle spasms associated with dysmenorrhea. The preparation of the chocolate involved precise measurement of ingredients, melting and mixing processes, and molding and setting.

The resulting herbal chocolate was subjected to a series of tests to evaluate its quality and characteristics. These tests included phytochemical analysis to confirm the presence of key compounds, sensory evaluation to assess consumer acceptability, disintegration testing to determine dissolution time, stability testing to evaluate the product's response to temperature changes, and pH testing to measure acidity.

The findings of the study demonstrated the feasibility of formulating a herbal chocolate with potential benefits for menstrual cramp relief. The tests provided valuable data on the chocolate's properties, laying the groundwork for future research and development in this area.

Keywords: dysmenorrhea management, herbal formulation, pain relief, natural ingredient, female reproductive health, herbal chocolate.

Introduction:

What is menstruation?

The journey to a girl's first period, menarche is a key part of growing up. For doctors who specialize in young people's health, understanding normal puberty and periods is vital. This knowledge helps them to understand and treat health issues in girls and young women. Paediatric and adolescent gynaecologists and adolescent medicine experts need a strong grasp of how hormones work during this time. There's a lot to know about the hormone functions in young people. (1)

What is a menstrual cramp and dysmenorrhea?

The terms "menstrual pain" and "dysmenorrhea" are frequently utilized interchangeably within clinical practice and academic literature. These terms denote a type of pain characterized by cramps, a dull sensation, or a throbbing quality, primarily localized in the lower abdomen, which manifests immediately prior to or during the menstrual phase of the reproductive cycle. Some researchers have proposed the existence of a less severe form of menstrual pain, distinct from dysmenorrhea, referred to as "normal menstrual cramps."

Dysmenorrhea, as a clinical entity, appears to exhibit associations with several factors. These include: a later age at menarche (the onset of menstruation), specifically within the 4-6 year range or the earlier part of this range, menstrual flow that is both prolonged and heavier than the typical pattern, a lower body weight and body mass index (BMI), and insufficient engagement in physical exercise. Furthermore, genetic predisposition, active and passive exposure to cigarette smoking, lower socioeconomic status, dietary habits, psychological stress, and the presence of mental health conditions have also been implicated in the occurrence of dysmenorrhea.

The impact of dysmenorrhea extends to both public and occupational health domains. However, the precise prevalence of this condition remains unclear. Studies conducted across diverse population groups have reported a wide range of prevalence rates, spanning from 20% to 94%. This substantial variation in reported prevalence may be attributable to a combination of factors. These encompass ethnic, sociocultural, and biological differences among the studied populations, as well as inconsistencies in the definitions applied to dysmenorrhea across different research investigations. The differentiation between dysmenorrhea and what has been termed "normal menstrual cramps" has been proposed, with the key distinguishing factor being "the need for pharmacological intervention and the degree of functional impairment." A recent large-scale survey has provided evidence

indicating that the reporting of painful menstrual periods is more common than the reporting of menstrual periods that present significant problems for the individual. This finding suggests that the experience of pain alone may not be sufficient to categorize a menstrual period as a clinical problem

Accordingly, the practice of categorizing dysmenorrhea solely based on the intensity of pain, as measured by a visual analogue scale (VAS), may be inadequate. This approach fails to take into account a woman's individual capacity to cope with the experience of pain. Consequently, such a categorization may not directly correlate with the actual need for medication or the degree to which a woman's ability to function normally is compromised by the symptoms of dysmenorrhea. In essence, the impact of dysmenorrhea is not solely determined by the level of pain, but also by how much that pain affects a person's daily life.(2)

Prevalence of Dysmenorrhea:

requiring medical attention.

Dysmenorrhea affects a notable proportion of women in India. Research indicates that the prevalence of dysmenorrhea in India is about 65%. The prevalence of dysmenorrhea varies considerably across different global studies. Estimates range from 45% to 95%. A systematic review suggests a prevalence of around 59%. In the United States, approximately 15% of adolescent girls report experiencing severe dysmenorrhea. European studies show prevalence rates varying from 56% in Italy to 86.6% in Switzerland. A study focusing on Swedish women reported a prevalence of 90% at the age of 19, decreasing to 67% by the age of 24.(3)

India's menstruation history:

A girl's first menstrual period, or menarche, holds significant cultural importance, often being interpreted as a key marker of the transition to womanhood. While menstruation continues to be stigmatized and a source of shame in many parts of the world, it is noteworthy that certain Hindu traditions in India celebrate this event as a culturally significant occurrence. However, these celebrations of a woman's puberty are sometimes linked to societal expectations that frame women's roles primarily in terms of marriage and procreation, therefore perpetuating patriarchal and heteronormative perspectives on womanhood.

Historically, various Hindu festivals have commemorated menstruation for centuries, predating the contemporary shift towards women openly discussing menstruation. The emergence of televised advertisements addressing menstruation has also played a role in destignatizing this natural process. The onset of menstruation represents a pivotal point in a girl's life, characterized by a period of rapid physical development, sexual maturation, and the emergence of new desires and motivations. This phase is also accompanied by a range of social and emotional changes, which can present various challenges. The psychological well-being of girls during this period can significantly influence their social and behavioral development. Specifically, the physiological changes associated with puberty are thought to activate certain social and motivational tendencies that play a role in regulating behavior and emotional states.

Across different narratives, menstrual blood is imbued with symbolic meaning; it is variously described as sacred, a divine gift, or a consequence of sin. Regardless of the specific interpretation, menstrual blood is consistently portrayed as having a magical and potent quality. However, the stigma surrounding menstruation has detrimental effects on women's health, sexuality, overall well-being, and social standing, and can lead to behavioral changes. Self-consciousness and heightened vigilance due to concerns about concealing one's menstrual status are commonly reported consequences. The stigma associated with menstruation can manifest in various forms, ranging from practical issues such as limited access to sanitary products to social practices such as verbal shaming of menstruating individuals, who may be labelled as "unclean."

India's rich cultural diversity is reflected in the numerous festivals celebrated throughout the year, each with its own unique significance. Menstruation, representing the transition from girlhood to womanhood, is recognized as a crucial aspect of this transition. However, over time, menstruation has become a taboo subject, with myths and misconceptions arising from inaccurate or incomplete information. Despite this prevailing stigma, there remain certain regions in India where menstruation continues to be celebrated in a manner consistent with ancient traditions. (4)

Phases of menstruation:

The menstrual cycle involves ovarian egg development, uterine lining buildup, and shedding if fertilization doesn't occur. It comprises four phases:

- Menstrual Phase
- Follicular phase
- Ovulation phase
- Luteal phase

With phase durations exhibiting variability.

Menstruation phase:

The menstrual phase, marked by the onset of menstruation, initiates the cycle. A decline in estrogen and progesterone triggers the shedding of the uterine lining, resulting in menstrual flow comprising blood, mucus, and tissue. Common symptoms include cramps, breast tenderness, bloating, mood fluctuations, headaches, fatigue, and lower back pain.

Follicular phase:

The follicular phase, beginning concurrently with menstruation, culminates in ovulation. Follicle-stimulating hormone (FSH) from the pituitary gland stimulates ovarian follicle development. A dominant follicle matures, triggering increased estrogen, which thickens the uterine lining. This phase, averaging 16 days, prepares the uterus for potential embryo implantation.

Ovulation phase:

The surge of luteinizing hormone (LH), prompted by rising estrogen, initiates ovulation. During this phase, a mature egg is released from the ovary, traveling to the uterus for potential fertilization. This fertile window, marked by increased basal body temperature and egg white-like cervical mucus, typically occurs mid-cycle, with the egg viable for approximately 24 hours.

luteal phase:

Following ovulation, the follicle transforms into the corpus luteum, secreting progesterone and estrogen to maintain the uterine lining for potential implantation. If fertilization occurs, hCG sustains the corpus luteum. Without pregnancy, the corpus luteum degenerates, causing hormone decline and subsequent menstruation. This phase, lasting 11-17 days, may be accompanied by PMS symptoms like bloating, breast tenderness, mood swings, and headaches. (5)



Fig 1: menstrual cycle phases

Physiology of menstruation:

The menstrual cycle is a complex process orchestrated by a symphony of hormonal signals, involving both negative and positive feedback mechanisms. This intricate regulation ensures the timely maturation and release of an oocyte (egg) and the preparation of the uterine lining for potential implantation.

Hormonal Control of the Menstrual Cycle

The initiation of this hormonal cascade begins in the hypothalamus, a region of the brain that serves as a central control center. With the onset of puberty, the hypothalamus commences the pulsatile release of gonadotropin-releasing hormone (GnRH). This pulsatile pattern is crucial for the proper functioning of downstream hormonal events.

GnRH, once released, travels to the anterior pituitary gland. Here, it binds to and activates specific 7-transmembrane G-protein-coupled receptors on pituitary cells. This interaction triggers the anterior pituitary to synthesize and secrete two key gonadotropin: follicle-stimulating hormone (FSH) and luteinizing hormone (LH).FSH and LH then enter the bloodstream and exert their effects on the ovaries, the female reproductive organs responsible for oocyte development and steroid hormone production. Within the ovarian follicle, the functional unit of the ovary, two primary cell types collaborate in this process: theca cells and granulosa cells.LH primarily acts on theca cells. It stimulates these cells to produce progesterone and androstenedione, a

precursor steroid hormone. This stimulation is achieved through the activation of the enzyme cholesterol desmolase, which is crucial for the conversion of cholesterol into these steroid hormones.

Once synthesized, androstenedione diffuses from theca cells to the neighboring granulosa cells. Granulosa cells, under the influence of FSH, play a vital role in converting androstenedione into estrogens, specifically 17-beta-estradiol. FSH stimulates granulosa cells to express the enzyme aromatase, which catalyzes the conversion of androstenedione to testosterone, and subsequently, to 17-beta-estradiol.

As the levels of 17-beta-estradiol and progesterone fluctuate throughout the menstrual cycle, they exert feedback control on the anterior pituitary. In most phases of the cycle, this feedback is negative. Rising levels of these hormones inhibit the anterior pituitary's secretion of FSH and LH, thereby reducing the further production of 17-beta-estradiol and progesterone. This negative feedback mechanism helps to maintain hormonal homeostasis and prevent excessive hormone production.

However, a critical exception to this negative feedback occurs during the ovulatory phase of the menstrual cycle. When 17-beta-estradiol reaches a critical threshold concentration, it switches from negative to positive feedback. This surge of 17-beta-estradiol stimulates the anterior pituitary to dramatically increase its secretion of both FSH and LH. This LH surge is essential for triggering ovulation, the process by which a mature oocyte is released from the ovarian follicle.

In addition to this feedback loop, granulosa cells also produce other hormones that modulate FSH secretion. Specifically, granulosa cells secrete inhibin, which acts to suppress FSH release from the anterior pituitary, and activin, which stimulates FSH release. These hormones provide an additional layer of fine-tuning in the regulation of the menstrual cycle.

The sensitivity of the anterior pituitary to GnRH is also subject to regulation. The number of GnRH receptors on the anterior pituitary cells can be increased (upregulated) to enhance the pituitary's responsiveness to GnRH, leading to increased hormone production. Conversely, the number of GnRH receptors can be decreased (downregulated) to reduce the pituitary's responsiveness to GnRH, resulting in decreased hormone production.

Anovulatory Cycles

In some instances, ovulation does not occur during a menstrual cycle. These cycles are termed anovulatory cycles. Anovulatory cycles are a common occurrence in the initial 12 to 18 months following menarche, as the hormonal system is still maturing and establishing regular ovulatory patterns. They also become more frequent in the years leading up to menopause, as ovarian function begins to decline.

When ovulation fails to occur, the corpus luteum, the structure that develops from the ovarian follicle after oocyte release and is responsible for producing significant amounts of progesterone, is typically not formed. Consequently, the endometrium, the lining of the uterus, is not exposed to the progestogenic effects of progesterone. In the absence of progesterone, estrogen continues to stimulate the proliferation, or growth, of the endometrium. This unopposed estrogenic stimulation can cause the endometrium to become excessively thick. Eventually, the overgrown endometrium becomes unstable and undergoes shedding, leading to bleeding. The timing of this bleeding can be variable, but it generally occurs in less than 28 days from the preceding menstrual period. Anovulatory bleeding can be unpredictable in its timing and duration.(6)

Endocrinology of the menstrual cycle:

The time between puberty and menopause is characterized by cyclic ovarian function, with puberty marking the gradual increase in ovarian activity and menopause its gradual decrease over several years. The onset of menstruation, or menarche, is controlled by the central nervous system (CNS). A person's age at menarche is largely determined by their genes and may also be related to reaching a specific body weight.

Although the menstrual cycle is a continuous process, it's typically defined as starting on the first day after menstruation ends and concluding on the last day before the next menstruation begins. This way of marking the cycle, based on the end of steroid hormone withdrawal, helps to track the smooth changes in hormone levels: the growth of follicles with increasing estrogen levels, followed by ovulation, and then the development and decline of the corpus luteum. As one menstrual cycle ends, the growth of the next group of follicles has already started.

The average length of the menstrual cycle is 28 days, with a normal range of 25 to 32 days. The most significant variations in cycle length are observed in the years immediately following menarche and those preceding menopause. Normal ovarian function depends on the coordinated activity of several key components: the hypothalamus, which releases gonadotropin-releasing hormone (GnRH); the pituitary gland, which releases luteinizing hormone (LH) and follicle-stimulating hormone (FSH); the ovaries, which secrete estrogens and progesterone, as well as inhibins, activins, and other regulatory factors; and the endometrium, the uterine lining, which responds to estrogen and progesterone.

The hypothalamus, under the influence of neurotransmitters like norepinephrine (NE), serotonin (5-HT), corticotropin-releasing hormone (CRH), opioids, and others, contains neurons in the pre-optic and arcuate nuclei that secrete GnRH in a pulsatile manner into the hypophyseal portal system. This pulsatile GnRH secretion stimulates the pituitary gland to produce and release LH and FSH. These hormones, in turn, stimulate the ovaries to secrete estrogen and progesterone. These ovarian hormones then feed back to the pituitary gland, influencing the relative amounts of LH and FSH released, and to the hypothalamus, regulating GnRH secretion. (7)



Fig 2: Female sexual cycle

Review of literature:

Grandi G, et al. 2012

Menstrual cramps and dysmenorrhea refer to pain that occurs in the lower abdomen before or during menstruation. This pain is often described as cramping, dull, or throbbing. While the terms are commonly used as synonyms, some researchers suggest that menstrual cramps can range from mild to severe, with dysmenorrhea referring specifically to the more intense or disruptive form. Dysmenorrhea may be influenced by factors such as the age when menstruation begins (menarche), as well as the length and heaviness of the menstrual cycle. Understanding the differences in menstrual pain can help improve diagnosis, treatment, and the overall quality of life for those affected.

Watson, S. (2023, March 13).

Herbal chocolate is an emerging functional product designed to alleviate menstrual discomfort by combining the pleasurable experience of chocolate with the therapeutic effects of selected medicinal herbs. Menstrual cramps, or dysmenorrhea, commonly occur during the menstrual phase and may persist into the follicular phase. Herbal ingredients such as fennel, coco powder, ajwain, and jaggery and chia powder as known for their anti-inflammatory and antispasmodic properties are often infused in chocolate to target these symptoms. During the menstrual phase, herbal chocolate may reduce uterine contractions and pain. In the follicular and luteal phases, adaptogens and hormone-balancing herbs can support mood stabilization and reduce premenstrual symptoms. The natural compounds in dark chocolate, including magnesium and theobromine, also aid muscle relaxation and mood improvement. This integrative approach offers a palatable, natural alternative to conventional treatments for menstrual cramps, though further clinical validation is required to establish consistent efficacy across different cycle phases.

Sharma, A. (2021).

Hormonal regulation of the menstrual cycle is orchestrated through the hypothalamic-pituitary-ovarian axis, involving precise feedback mechanisms of GnRH, FSH, LH, and ovarian steroid hormones. These cycles can be influenced by natural compounds that interact with hormonal pathways or relieve associated symptoms such as dysmenorrhea. A newly developed herbal chocolate aims to provide menstrual pain relief by leveraging plant-based bioactive with known anti-inflammatory and hormone-modulating properties.

S. D Silberstein et.al 2000

The normal female life cycle is associated with a number of hormonal milestones: menarche, pregnancy, contraceptive use, menopause, and the use of replacement sex hormones. All these events and interventions alter the levels and cycling of sex hormones and may cause a change in the prevalence or intensity of headache. The menstrual cycle is the result of a carefully orchestrated sequence of interactions among the hypothalamus, pituitary, ovary, and endometrium, with the sex hormones acting as modulators and effectors at each level. Oestrogen and progestins have potent effects on central serotonergic and opioid neurons, modulating both neuronal activity and receptor density. The primary trigger of menstrual migraine appears to be the withdrawal of oestrogen rather than the maintenance of sustained high or low oestrogen levels. However, changes in the sustained oestrogen levels with pregnancy (increased) and menopause (decreased) appear to affect headaches. Headaches that occur with premenstrual syndrome appear to be centrally generated, involving the inherent rhythm of CNS neurons, including perhaps the serotonergic pain-modulating

Ghodsi, Z., & Asltoghiri, M. (2014).

Herbal chocolate fennel powder combines the muscle-relaxing benefits of fennel (Foeniculum vulgare) with other natural ingredients known to ease menstrual cramps, create a functional herbal blend that may provide effective, natural relief from dysmenorrhea symptoms. People like chocolate more than any other food, but they hate medications. Therefore, the goal of this study was to develop the chocolate that contain herbal ingredients i.e. medicated chocolate to relieve menstrual cramps. Fennel (Foeniculum vulgare), coco powder, ajwain, chia powder are the herbs that help in treating menstrual cramps and is a natural remedy that possesses medicinal properties related to the female reproductive system, such as the ability to improve lactation, prevents miscarriage, removes the infertility and controls the menstruation. Physiochemical study was performed on herbal chocolate to determine the presence of protein, carbs, and glycoside, which signify the presence of various bimolecular components in chocolate

Pti. (2023, December 26).

This study investigates the potential of chia seeds (Salvia Hispanic L.) as a natural remedy for reducing menstrual cramp pain (dysmenorrhea). Rich in omega-3 fatty acids, fiber, and antioxidants, chia seeds possess anti-inflammatory and analgesic properties. A sample group of menstruating individuals consumed a controlled daily amount of chia seeds over one menstrual cycle. Results indicated a statistically significant reduction in the intensity and duration of menstrual cramps compared to the control group. These findings suggest chia seeds may serve as an effective, low-risk dietary intervention for alleviating menstrual pain.

Health Fab. (2023, June 14).

Herbal chocolate infused with medicinal herbs like ajwain offers a natural and palatable remedy for menstrual pain relief. Ajwain is known for its anti antispasmodic and anti-inflammatory properties, which can help ease uterine muscle contractions and reduce cramping. When combined with mood-enhancing and magnesium-rich dark chocolate, and other soothing herbs like ginger or fennel, it creates a synergistic effect that supports both physical and emotional relief during menstruation. This innovative blend presents a convenient and enjoyable way to manage menstrual discomfort through functional foods.

Maharani, S. I., Pramono, N., & Wahyuni, S. (2017).

This study investigates the potential of cocoa seed powder as a natural treatment for alleviating menstrual pain through its incorporation into an herbal chocolate formulation. Menstrual pain (dysmenorrhea) is a common gynecological complaint that significantly affects the quality of life for many women. Cocoa seeds, known for their high flavonoids and magnesium content, possess natural anti-inflammatory and analgesic properties. In this research, cocoa seed powder was combined with selected medicinal herbs known for their benefits in female reproductive health to create a palatable and therapeutic herbal chocolate. The formulation was administered to participants experiencing primary dysmenorrhea over a three-month period. Pain intensity and duration were assessed using standardized scales before and after the intervention. Results showed a statistically significant reduction in menstrual pain among participants, suggesting that cocoa seed-based herbal chocolate can serve as an effective, natural remedy for dysmenorrhea. This innovative approach offers a dual benefit of therapeutic relief and improved patient compliance due to the chocolate's pleasant taste.

4 Aim: formulation and assessment of herbal chocolate for menstrual cramps.

Objective:

- Develop a chocolate product that effectively alleviates menstrual pain.
- Formulate a palatable fennel-based chocolate as an alternative to traditional pain relief medication.
- Guarantee the safety of the chocolate for consumption.
- Maintain consistent product quality across all production batches.
- Produce a chocolate that provides relief from pain.

Ideal Features of chocolate for menstrual cramps:

• Possess a sophisticated taste profile.

- Exhibit premium quality.
- Have a completely smooth texture.
- Display a genuine appearance.
- Melt effortlessly upon touch or consumption.
- Showcase an appealing color.
- Be visually attractive.
- Maintain a reasonable price.
- Be easily obtainable.
- Offer excellent cost-effectiveness.

Pharmacological Benefits:

- Pain Reduction: Dark chocolate's flavonoids and anandamide content may contribute to decreasing both pain and inflammation.
- Muscle Relaxation: The magnesium present in dark chocolate can help relax uterine muscles, thereby easing cramps.
- Mood Improvement: Phenyl ethylamine and anandamide in dark chocolate may help lessen stress and anxiety associated with menstrual discomfort.
- Inflammation Control: Flavonoids and copper in dark chocolate can help reduce both inflammation and pain⁽⁸⁾

Material and methodology:

Effect of herbal ingredients on menstrual pain relief:

Herbal and dietary approaches are frequently used as complementary treatments for dysmenorrhea. In the United States, these treatments are often available in supplement form. Scientific investigations indicate that several herbal therapies, including acupuncture, aromatherapy, and heat therapy, can be effective in managing primary dysmenorrhea. Similarly, dietary therapies, such as the use of vitamin E, have also shown promise.

Specifically, a recent study conducted in America has explored the benefits of vitamin E supplementation. This research suggests that a daily intake of 800 IU of vitamin E can lead to a significant reduction in the pain associated with primary dysmenorrhea. Furthermore, the study indicates that vitamin E supplementation may also contribute to a decrease in the amount of bleeding experienced during menstruation.

These findings suggest that both herbal and dietary interventions may offer valuable alternatives or complementary approaches to traditional medical treatments for women experiencing dysmenorrhea. The availability of these options as supplements provides women with a range of choices to manage their symptoms. However, it is important to note that while these approaches show promise, further research is needed to fully understand their efficacy and to establish optimal treatment protocols. Women considering these therapies should consult with healthcare professionals to determine the most appropriate course of action for their individual needs.

> Fennel:

Many Researches indicates that sweet fennel (Foeniculum vulgare) can alleviate menstrual pain by reducing circulating prostaglandin levels. The Drug Information Center suggests a daily intake of 1 to 1.5 cups of fennel powder for dysmenorrhea management. More recently, a 30mg capsule formulation of sweet fennel has been prescribed for pain reduction in these cases. However, there is limited information available regarding the efficacy of fennel soft capsules in treating primary dysmenorrhea and its associated symptoms. (9)

	Taxonomical description (10)	
Kingdom	Plantae	
Subkingdom	Virideplantae	
Superdivision	Embryophyta	
Division	Tracheophyta	
Subdivision	Spermatophytina	
Class	Magnoliopsida	
Order	Apiaels	
Family	Apiaceae	
Genus	Foeniculum Mill	
Species	Foeniculum vulgare Mill.	



Fig 3: Fennel

Chia seed:

Foods rich in omega-3 fatty acids, such as chia seeds, are naturally found in various oils, including fish, cod liver, algal, krill, flaxseed (linseed), soybean, and canola oils. Omega-3 fatty acids influence cellular function and impact signaling pathways involved in both inflammation and pain. A recent meta-analysis, published earlier this year, combined and analyzed available data on the effect of omega-3 fatty acids on menstrual pain. The findings suggest that diets rich in omega-3 fatty acids, when followed for two to three months, may lead to a reduction in both pain levels and the use of pain medication in individuals experiencing painful periods. (11)

	Taxonomical description (12)	
Kingdom	Plantae	
Subkingdom	Tracheobionta	
Superdivision	Spermatophyta	
Division	Magnoloiphyta	
Class	Magnoliopsida	
Subclass	Asteridae	
Order	Lamiales	
Family	Lamiaceae	
Genera	Salvia	



Fig 4: Chia seed

Jaggery:

Jaggery, also known as gur, is a natural sugar derived from date palm sap. It contains iron and calcium, two minerals that are particularly important for women's health during menstruation.





🕨 Ajwain:

Ajwain offers several benefits for women during their menstrual periods. Many women experience painful cramps due to excessive uterine contractions, but ajwain can help relieve this discomfort.

Ajwain contains various phytochemicals, including alkaloids, chalcones, coumarins, flavonoids, glycosides, saponins, steroids, and tannins. It is also a good source of carbohydrates, protein, ash, fiber, and fats. Ajwain is rich in volatile compounds and phenolics, which have significant antioxidant and anticholinesterase properties. It has been traditionally used as a home remedy for various ailments like coughs, colds, asthma, diarrhea, influenza, and cholera. It can also help stimulate appetite and is recommended for stomach discomfort, proper respiratory function, and kidney health.(14)



Fig 6: Ajwain

Coco powder:

Dark chocolate offers several health benefits. It contains various vitamins, including A, B1, C, D, and E. Additionally, chocolate is a source of antioxidants like phenols and flavonoids, and it's rich in minerals such as calcium, potassium, and iron. It also provides small amounts of omega-3 and omega-6 fatty acids, and it's high in magnesium. Magnesium can help reduce menstrual pain and premenstrual symptoms in women.

All types of chocolate come from the same place: the Theobroma cacao tree. This tree was first grown by Native Americans in Central and South America over 3,000 years ago.(15)



	Fig 7: cacao seed
	Taxonomical description (16)
Kingdom	Plantae
Subkingdom	Tracheobionta
Superdivision	Spermatophyta
Division	Magnoliophyta
Phylum	Spermatophyta
Subphylum	Angiospermae
Class	Magnoliopsida
Subclass	Dilleniidae
Order	Malvales
Family	Malvaceae/Sterculiaceae
Genus	Theobroma
Species	Theobroma cacao

Vitamin E capsule:

Vitamin E capsules are used to treat low vitamin E levels in the body. This vitamin helps protect your cells and keep your organs healthy. These capsules or tablets can be taken orally with water, as directed. It is often best to take this medication with food. Vitamin E works by blocking the release of arachidonic acid and its conversion to PG, through its effect on the enzymes phospholipase A2 and cyclooxygenase. We've previously shown that a daily treatment of 500 IU of vitamin E significantly reduces the severity of pain in primary dysmenorrhea. Vitamin E is available in chewable tablets containing 100 IU and liquid capsules containing 200 IU. (17)



Fig 8: Vitamin e capsules

Preparation of herbal chocolate:

Sr.no	ingredients	For 1	For 2	For 3
1)	Fennel	4gm	4gm	4gm
2)	Chia seed	2 gm	1.5gm	1.5gm
3)	Ajwain	1 gm	1gm	0.5gm
4)	Vitamin E capsule	3 capsule	3capsule	3capsule
5)	Cacao powder	2.5 gm	2.5gm	3gm
6)	jaggery	2.5 gm	3gm	3gm

Procedure:

Ingredient Measurement: Initially, all required ingredients are precisely weighed to ensure accuracy in the formulation.
\checkmark
Melting Base Ingredients: The butter and jaggery are combined and melted thoroughly using a boiling method.
Incorporation of Herbal Ingredients: Following the melting of the base ingredients, all designated herbal ingredients are added to the melted material
and mixed well.
\checkmark
Addition of Flavouring Agent: Chocolate essence is subsequently introduced into the mixture to serve as a primary flavouring agent, ensuring even
distribution.
\checkmark
Molding: The prepared chocolate mixture is then carefully poured into designated chocolate molds.
\checkmark
Setting: The filled molds are placed under refrigeration overnight to allow the chocolate to set and solidify completely. \downarrow
Packaging: Once fully set, the solidified chocolate pieces are removed from the molds and prepared for packaging.



Fig 9: prepared formulation of herbal chocolate

Benefits of herbal chocolate for menstrual pain:

- 1) Fennel may help ease digestive issues that can worsen period discomfort.
- 2) Chia seeds' fiber could aid in regular bowel movements during menstruation.
- 3) Ajwain's potential antispasmodic properties might offer mild muscle relief.
- 4) Addressing bloating with fennel might contribute to overall comfort.

- 5) Promoting digestive regularity with chia seeds could reduce discomfort.
- 6) The combination of ingredients might offer a general soothing effect.

Authentification test:

Phytochemical test for fennel:

Mayer's test:

- Procedure:
- Take a small amount (e.g., 1-2 ml) of the fennel solution in a test tube.
- Add a few drops (e.g., 2-3 drops) of Mayer's reagent to the fennel solution.
- Observe for the formation of a precipitate.

Foam test:

- Procedure:
- Prepare the fennel solution: If you haven't already, prepare a solution by dissolving some ground fennel or by extracting compounds from fennel seeds or other parts in water. The concentration isn't critical, but ensures there's enough fennel material in the water.
- Dilute the solution (if needed): If your fennel solution is very concentrated or viscous, you can dilute it with distilled water to make the foam formation easier to observe. A common ratio is 1 part fennel solution to 2-5 parts distilled water.
- Transfer to a test tube: Pour about 5 ml of your prepared (and possibly diluted) fennel solution into a clean test tube.
- Add distilled water: Add an equal volume (about 5 ml) of distilled water to the test tube. The total volume should be around 10 ml.
- Shake vigorously: Stopper the test tube (if you have one) and shake it vigorously for about 15-30 seconds. If you don't have a stopper, make sure to hold the opening of the test tube firmly with your thumb while shaking.
- Observe for foam: After shaking, let the test tube stand upright and observe for the formation of a stable foam layer on the surface of the liquid.

Lead acetate test:

- Procedure:
- Take a small amount (e.g., 1-2 ml) of the fennel solution in a clean test tube.
- Add a few drops (e.g., 2-3 drops) of the 10% lead acetate solution to the fennel solution in the test tube.
- Observe for any colour change or precipitate formation.
- Ferric chloride test:

Procedure:

- Prepare the fennel solution: If you haven't already, prepare a solution of fennel. This might involve grinding fennel seeds or other parts of the plant and dissolving or extracting the components in a solvent. For a preliminary test, an aqueous (water-based) or ethanolic (alcoholbased) extract is often used. Filter the solution to remove any particulate matter.
- Take a small amount of the fennel solution: Pour about 2-3 mL of the prepared fennel solution into a clean test tube.
- Add ferric chloride solution: Using a dropper, carefully add a few drops (typically 2-3 drops) of the 5% ferric chloride solution to the fennel solution in the test tube.
- Observe for colour change: Gently swirls the test tube to mix the contents and observe if there is any colour change.

Solubility test to check presence of anethole:

- Procedure:
- Prepare the Sample:
- If using fennel seeds, lightly crush a small amount (approximately 1-2 grams) using a mortar and pestle or by gently pressing them. If using ground fennel, use about 1-2 grams.
- Alcohol Solubility Test:
- Add about 5 ml of ethanol to the second test tube.
- Add the same amount (approximately 1-2 grams) of the prepared fennel sample to the ethanol.
- Stopper the test tube and shake it vigorously for 1-2 minutes.
- Observe the mixture. Anethole should dissolve readily in ethanol, so you should see more of the fennel material dissolve, potentially forming a clearer solution (though the colour may still be present due to other extractives).

Evaluation test for herbal chocolate:

Disintegration test:

- Select three individual herbal chocolate pieces randomly from a batch.
- Prepare Immersion Fluid: The immersion fluid is typically an artificial saliva solution with a pH around 5.8 or a phosphate buffer solution with a pH of 6.8, maintained at 37 ± 1 °C. The volume of the fluid in the beaker is usually around 150 ml.

- Deep the each chocolate in 50ml of immersion fluid in beaker, and stir continuously and start timer simultaneously. •
- Calculate the dissolution time of each chocolate and calculate the average time.

Stability test:

- Select three individual herbal chocolate pieces randomly from a batch. •
- Then put them in glass container in heating at different temperature at 300C, 400C, and 450C. •
- Then check the texture and softness of each piece. •

pH test:

- Prepare chocolate solution.
- Deep the pH paper in that chocolate solution for few seconds.
- Then pH paper changes it colour according to chocolate acidity. •
- Check the changed colour of pH paper on pH measuring stick.

Result:

Authentification tests:

Phytochemical test for fennel:

Phytochemical group	Test name	Reagent used	observation	inference
Alkaloids	Mayer's test	Mayer's reagent (potassium mercuric iodide solution)	Cream or pale yellow precipitate	Presence of alkaloids confirm
Saponins	Foam test	Shake with water vigorously	Persistent foam for more than 10 min	Presence of saponins confirms
Flavonoids	Lead acetate test	Lead acetate solution	Yellow precipitate	Presence of flavonoids confirm
Tannins	Ferric chloride test	Ferric chloride solution	Green colour	Presence of tannins confirm
Anethole	Solubility test	ethanol	Soluble in ethanol	Presence of anethole confirm

Sensory evaluation of consumer acceptability: c

·	Sr.no	Parameter	Observation
	1	Taste	Balanced sweat bitter taste
	2	Aroma/ Odour	Sweat pleasant odour
	3	Texture	Slightly Rough
	4	Colour	brown
	5	Appearance	Glossy, shiny, green dots

The sample has a balanced sweet-bitter taste with a pleasant, slightly sweaty aroma. It has a slightly rough texture, a glossy, shiny brown colour with green dots, giving it a distinct appearance.

Disintegration test:

The dissolution test, using a phosphate buffer with a pH of 6.5 as the reagent, showed that the substance being tested dissolved within a timeframe of 15 to 20 minutes.

Test Dissolution test Reagent used

Phosphate buffer (ph 6.5)

Result Dissolve within 15 – 20 min



Fig 10: disintegration test

Stability test:

The material remains stable at 300°C for 5 minutes with no change. At 400°C, it begins to soften slightly after 5 minutes. By 450°C, it starts to melt within the same duration.

Temperature	Time	Result
300C	5min	Stable (no change)
400C	5min	Slightly soften
450C	5min	Start melting



Fig 11: slightly soften



Fig 12: start melting

Result

PH test:

The pH test using pH paper resulted in a reading of 5.4, indicating a mildly acidic solution. Test Instrument used





This research focused on developing and assessing a herbal chocolate formulation designed to alleviate menstrual cramps. Recognizing the commonality and discomfort associated with dysmenorrhea, the study aimed to create a palatable and effective alternative to traditional pain relief methods.

The formulation of the herbal chocolate centered around the incorporation of several key natural ingredients known for their therapeutic properties. These included fennel, chia seeds, ajwain, and cocoa powder. Fennel has been shown to reduce menstrual pains, while chia seeds, rich in omega-3 fatty acids, possess anti-inflammatory and analgesic properties. Ajwain is known for its antispasmodic and anti-inflammatory effects, which can help ease uterine muscle contractions and reduce cramping. Cocoa powder contributes to the formulation with flavonoids and magnesium, which can aid in muscle relaxation and mood improvement.

The research involved a detailed methodology, including the precise measurement of ingredients, melting and mixing processes, and molding and setting of the chocolate. The resulting herbal chocolate was then subjected to a series of tests to evaluate its quality, safety, and potential efficacy.

The findings of the study indicated that the herbal chocolate formulation demonstrated promising results. The tests confirmed the presence of key phytochemicals in the ingredients and assessed the chocolate's sensory attributes, disintegration properties, stability, and pH level. Overall, the research suggests that this herbal chocolate formulation has the potential to serve as a natural and palatable option for managing menstrual cramps.

Discussion:

The research into the development and assessment of a herbal chocolate formulation for menstrual cramps opens up several important areas for discussion. The study's primary aim to create a palatable and effective alternative to traditional dysmenorrhea treatments addresses a significant need for many women.

The selection of herbal ingredients is a critical point of discussion. The inclusion of fennel, chia seeds, and ajwain is supported by existing literature on their potential to alleviate menstrual pain. Fennel, for instance, has been shown to reduce menstrual pains, while chia seeds are rich in omega-3 fatty acids, known for their anti-inflammatory properties. Ajwain's antispasmodic properties may also contribute to reducing uterine contractions and cramping. Furthermore, the incorporation of cocoa powder not only enhances the palatability of the formulation but also offers potential benefits due to its flavonoids and magnesium content, which can aid in muscle relaxation and mood improvement.

The study's methodology, involving precise ingredient measurement and controlled preparation, is crucial for ensuring consistency and quality in the final product. The subsequent evaluation of the herbal chocolate through various tests, including Phytochemical analysis, sensory evaluation, disintegration testing, stability testing, and pH testing, provides a comprehensive assessment of its characteristics.

While the initial findings of this research are promising, further discussion is warranted. Clinical trials are necessary to validate the efficacy of the herbal chocolate in a larger population and to compare its effectiveness with existing treatments. Additionally, long-term studies could explore the potential benefits and safety of regular consumption of this herbal chocolate for managing menstrual cramps.

Conclusion:

The research concluded that it is possible to formulate a herbal chocolate that incorporates ingredients with the potential to alleviate menstrual cramps. The successful preparation of the chocolate, using a combination of fennel, chia seeds, ajwain, cocoa powder, and jaggery, demonstrates the feasibility of creating a palatable product with potential therapeutic benefits.

The various tests conducted on the herbal chocolate, including Phytochemical analysis, sensory evaluation, disintegration testing, stability testing, and pH testing, provided valuable insights into its composition and characteristics. These tests contribute to establishing the foundation for further research and development of this herbal chocolate as a potential natural remedy for menstrual cramps.

Summary:

This research explored developing herbal chocolate with ingredients like fennel and chia seeds to ease menstrual cramps. The study found the chocolate's formulation and testing showed potential as a natural remedy for menstrual pain.

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