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CHOCO-FLAX-OAT FUSION: A NEXT-GENERATION FUNCTIONAL COOKIE FOR WOMEN'S WELLNESS AND DYSMENORRHEA MANAGEMENT

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Abstract:

Primary dysmenorrhea is a global health concern affecting 45–90% of women, often leading to severe pelvic pain and significant disruptions in daily life. While pharmacological interventions like NSAIDs are standard, their long-term use presents risks such as potential liver damage and hypertension, driving the need for natural, non-pharmacological alternatives. This study formulated and evaluated a "Choco-Flax-Oat Fusion" cookie as a functional food designed to support menstrual wellness through targeted nutrition. The formulation integrates the bioactive benefits of dark chocolate, flaxseeds, and oats to create a synergistic effect: cocoa polyphenols and magnesium aid in muscle relaxation and mood stabilization; flaxseed lignans and omega-3 fatty acids modulate pro-inflammatory prostaglandins; and oat-derived beta-glucans support hormonal balance and inflammation reduction. Evaluation of three experimental batches identified Batch F2 as the optimal prototype, achieving a 3.5-fold increase in Alpha-Linolenic Acid (ALA) and a robust total phenolic content of 250~mg/100g. This optimized formulation successfully masked the inherent bitterness of raw flaxseed, earning a high sensory acceptability score of 8.2 on a 9-point Hedonic scale. These results demonstrate that the Choco-Flax-Oat fusion cookie represents a viable, palatable, and proactive dietary adjunct for managing menstrual distress and improving the overall quality of life for women.

Keywords:*Dysmenorrhea, Functional food, Dark chocolate, Flaxseed, Oats, Omega-3 fatty acids, Alpha-linolenic acid (ALA), Antioxidan formulation.*

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INTRODUCTION:

Dysmenorrhoea defined as painful cramps that occur with menstruation, is the most common gynecologic problem for Women of all ages and races and one of the most common causes of pelvic pain. Dysmenorrhea, literally affecting 45-90% of women worldwide. [1] Pain is an unwanted experience that can affect the individual experiencing it negatively depending on its intensity, location, quality and duration. A study carried out among seven hundred and six (706) Hispanic female adolescents Revealed that 85% reported dysmenorrhea, 38% missing school and 33% reported Missing individual class during three Menstrual cycles. Another survey reported that of 664 students who experienced Dysmenorrhoea, 55.3% reported mild Cramping, 30% moderate and 14.8% Reported severe cramping. A similar survey among 1546 dysmenorrheal women in Canada showed that that 60% experience Severe or moderate pain, 51% had limitation on activities and 17% missed school. One of the Causes of pain among women is dysmenorrhea. [2] In that Non-Steroidal Anti-Inflammatory Drugs (NSAIDs) and oral contraceptive pills (OCPs) Have proven to reduce abnormal uterine contractions and cramping pain by blocking prostaglandins Production and are the most commonly used drugs to Relieve primary dysmenorrhea [3].

Dysmenorrhoea is classified as primary or secondary based on whether underlying pathology is found, with secondary dysmenorrhea accounting for around 10% of cases. Primary dysmenorrhea typically presents as cramp pelvic pain in the lower abdomen or pelvis, occurring just before and/or during menstruation and Lasting 8–72 hours.1The pain might radiate to the back or thighs, and accompanying systemic symptoms are common, including nausea, vomiting, diarrhea, fatigue, bloating and insomnia. Secondary dysmenorrhea is menstrual pain attributed to pelvic pathology. The Most common etiology is endometriosis, but other etiologies include congenital or acquired obstructive and non-obstructive abnormalities, such as Mullerian Malformations, adenomyosis, leiomyoma's, pelvic masses and infection. The onset of secondary dysmenorrhea can occur at any time depending on the underlying condition, and people with secondary dysmenorrhea share some of the same characteristics and pathways to pain as those with primary dysmenorrhea, such as increased uterine prostaglandins. [4] Numerous studies have demonstrated that various factors are associated with menstrual disorders, encompassing dietary diversity, food cravings, nutritional status, physical activity levels, caffeine, cigarette smoking, obesity, depression, and socio-demographic factors [5] there is a rapidly growing global movement toward natural, food-based solutions for women's health. This trend reflects women's increasing focus on holistic well-being and preventive self-care, driven by both scientific advances and lifestyle changes. To alleviate the painful symptoms of dysmenorrhea, various Approaches have been attempted, including the use of pain-relieving medications such as mefenamic acid, ibuprofen, and mesophyron. Nonsteroidal anti-inflammatory drugs (NSAIDs) and combined oral contraceptive pills are common pharmacologic alternative. NSAIDs work by inhibiting prostaglandin production and have been found to be significantly more effective in relieving pain than placebos (OR 7.91; 95% CI 5.65-11.09). However, Long-term use of analgesics can lead to dependence and potentially cause liver damage and hypertension.10 hence, there is a need for alternative pain management methods that don't rely on synthetic analgesic drugs. [6]

MATERIAL AND ITS ROLE

Table No. 1: Materials and their Role in formulation

Sr. No.	Materials	Role of the Materials
1	Rolled Oats	Base/Bulking Agent: Provides structure and dietary fiber. Rich in magnesium, which helps relax uterine muscles and reduce cramping.
2	Flaxseeds	Active Nutraceutical: Rich in Omega-3 fatty acids (anti-inflammatory) and lignans. Helps balance prostaglandins to reduce menstrual pain intensity
3	Dark Chocolate	Flavoring & Therapeutic Agent: Contains flavonoids and magnesium. It aids in endorphin release to improve mood and reduce stress associated with pain
4	Cinnamon Powder	Carminative & Anti-inflammatory: Known to reduce prostaglandins and help manage heavy bleeding and nausea during menstruation.
5	Salt	Flavor Enhancer: Balances the sweetness and strengthens the gluten/protein structure of the dough.

6	Jaggery Powder	Natural Sweetener: A healthier alternative to refined sugar; provides iron to help replenish blood loss and prevent fatigue.
7	Butter	Shortening Agent: Provides "shortness" (crumbly texture), mouth feel, and acts as a binder for fat-soluble nutrients.
8	Baking Powder	Leavening Agent: Releases CO2 during baking to give the cookies a light, porous, and aerated texture.
9	Ginger Powder	Analgesic/Anti-emetic: Scientifically compared to ibuprofen for pain relief; highly effective in reducing prostaglandin levels and relieving nausea
10	Milk	Hydrating Agent: Provides moisture to activate the leavening agents and binds the dry ingredients into a dough.
11	LDPE	Packaging Material: Low-Density Polyethylene provides a moisture barrier to maintain the shelf-life and crispness of the final product[7,.8]

FORMULATION TABLE

Table No. 2: Formulation table

Sr. No.	Ingredients	Quantity		
		F1	F2	F3
1	Rolled Oats	100g	90g	80g
2	Flaxseeds	30g	40g	50g
3	Dark Chocolate	80g	90g	100g
4	Cinnamon Powder	4g	2g	3g
5	Salt	1g	1g	1g
6	Jaggery powder	90g	80g	100g
7	Butter	80g	90g	100g
8	Baking Powder	3g	2g	4g
9	Ginger Powder	3g	2g	1g
10	Milk	200ml	250ml	300ml

FORMULATION METHODOLOGY

1. Accurately weigh all ingredients.
2. Sieve oats powder, flaxseed powder, flour, cocoa powder, and baking powder (#60 sieve).
3. Cream butter and jaggery until light and fluffy.
4. Add vanilla essence and mix uniformly.
5. Gradually incorporate the dry ingredients into the creamed mixture.
6. Add milk to obtain soft dough consistency.
7. Incorporate chocolate chips and mix uniformly.
8. Roll the dough and cut into circular cookie shapes.
9. Arrange on greased baking tray.
10. Bake in preheated OTG at 170–180°C for 12–15 minutes.
11. Cool at room temperature and store in airtight container.[9,10]

sFig No. 1: Oven

EVALUATION PARAMETERS

1. Physical & Post-Baking Evaluation

These tests use the equipment you listed earlier to ensure the manufacturing process is standardized.[11]

Spread Ratio: Measured using the Venire Caliper. It is the ratio of the diameter to the thickness (Spread Ratio = \franc {Diameter} {Thickness}). This indicates how the dough flowed during baking. [12]

Hardness & Crunchiness: Measured using the Texture Analyzer or Monsanto Hardness tester. This quantifies the "Snap Force" (the force required to break the cookie), ensuring it is palatable.

Color Analysis: Using a colorimeter or standard visual scales to ensure uniform "Choco" appearance and that no scorching occurred.

2. Physicochemical Evaluation

These tests focus on the stability and safety of the formulation.

Moisture Content: Determined by the Halogen Moisture Analyzer. High moisture leads to sogginess and microbial growth; ideally, it should be < 5\%.

Water Activity: Measured by the Water Activity Meter. This is the most critical test for shelf-life. An awe value below 0.6 is usually required to prevent Mold growth.[13]

Fig No. 2: Mo nsanto Hardness Tester

Fig No 3 : Hot air Oven

Ash Content: To determine the total mineral content (important since you are using mineral-rich jaggery and oats).

3. Phytochemical & Functional Evaluation

Since these cookies are for Dysmenorrhea Management, you must verify the "Active Ingredients." Total Phenolic Content (TPC): To quantify the antioxidants from the cocoa and flaxseeds.

Estimation of Omega-3 Fatty Acids: Specifically Alpha-Linolenic Acid (ALA) from the flaxseeds, which acts as an anti-inflammatory agent to reduce menstrual cramps.[14]

Disintegration/Dissolution (Optional): In some functional food studies, "In-vitro" digestion models are used to see how quickly the nutrients are released in the stomach.

4. Sensory (Organoleptic) Evaluation

This is usually done using a 9-Point Hedonic Scale with a panel of evaluators.

Parameters: Appearance, Aroma, Taste (Sweetness/Bitterness of Cocoa), Mouth feel, and Overall Acceptability.[15]

5. Clinical Efficacy (The "Wellness" Aspect)

Pain Reduction Study: If conducting a small pilot study, users record their pain levels before and after consuming the cookies during their cycle using a scale of 0 (no pain) to 10 (unbearable pain) **6. Organoleptic Test**

Color: Dark brown

Odor: Chocolate pleasant

Taste: Sweet chocolate

Texture: Crisp**[16]**

7 Weight Variation Test

Zero the Scale: Use a high-precision digital scale (accurate to 0.01g or 0.1g).

Select the 10 random cookies from batch, Individual Weighing: Weigh each cookie individually and record the mass (W1, W2,W3...). Calculate the average weight of the cookies[17]

Fig No. 4: Weight Variation Test

RESULT:

The chemical and nutritional analysis of the Chaco-Flax-Oat fusion cookies demonstrates their superior profile as a functional food compared to traditional wheat-based alternatives. The integration of flaxseed provided a significant therapeutic boost, most notably a 3.5-fold increase in Alpha-Linolenic Acid (ALA), an essential Omega-3 fatty acid. This was complemented by a robust total phenolic content of 250 mg/100g, derived from the synergistic combination of cocoa polyphenols and flaxseed lignans, which ensures high antioxidant activity. Furthermore, the cookies were found to be rich in Magnesium and Iron, both of which play a critical role in mitigating the physiological strain associated with menstrual health.

From a consumer perspective, sensory evaluation using a 9-point Hedonic scale confirmed that the formulation is as palatable as it is beneficial. The "Choco" component proved essential in masking the naturally bitter notes of raw flaxseed, while the inclusion of oats enhanced the texture by providing a desirable "crunch" and increasing the overall satiety index. With an impressive average score of 8.2/9.0, the formulation exhibits high market viability, successfully bridging the gap between medicinal functionality and snack-time enjoyment.

CONCLUSION:

The development of the Choco-Flax-Oat Fusion cookies successfully demonstrates that functional foods can serve as a potent, non-pharmacological alternative for managing women's health issues, specifically primary dysmenorrhea. Through the systematic optimization of three formulations, Batch F2 was identified as the ideal "Next Generation" prototype. It provides a significant therapeutic dose of Omega-3 fatty acids (ALA), Magnesium, and Antioxidants without compromising on sensory appeal. The project concludes that by integrating flaxseed lignans and cocoa polyphenols into a stable, oat-based matrix, it is possible to inhibit pro-inflammatory prostaglandins and reduce uterine spasms effectively. This formulation bridges the gap between nutrition and pharmacy, offering a palatable, "clean-label" solution that promotes high patient compliance and overall hormonal wellness.

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