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Research Article

Herbal Sanitary Pads for Working Women's

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ABSTRACT

This study focuses on the formulation and evaluation of herbal sanitary pads using natural materials with antibacterial, antifungal, and absorbent properties. The pads were tested for absorbency, antimicrobial efficacy, biodegradability, and user safety. The findings suggest that herbal sanitary pads are a sustainable, health-conscious alternative, reducing both chemical exposure and environmental waste. Further research is recommended for large-scale production.

INTRODUCTION

The Menstrual Cycle: A Complex Physiological Process.

The menstrual cycle is a intricate and highly coordinated physiological process that occurs in females, governed by a delicate interplay of hormones and cellular mechanisms. This cyclical phenomenon is characterized by a remarkable degree of variability in terms of cycle length, which typically spans between 26 and 35 days.[1]

Phases of the Menstrual Cycle

The menstrual cycle can be broadly divided into several distinct phases, each marked by specific physiological and hormonal changes.

1. **Menstruation (Menses)**: The cycle commences with menstruation, a process of uterine shedding that occurs in the absence of pregnancy. This phase is typically accompanied by bleeding, which can persist for approximately 5 days.[2]

2. **Follicular Phase**: Following menstruation, the body initiates a series of complex physiological processes aimed at preparing the reproductive system for a potential pregnancy. This phase is marked by the growth and maturation of follicles within the ovaries, stimulated by the release of follicle-stimulating hormone (FSH).[3]

3. **Ovulation**: Ovulation represents the culmination of the follicular phase, during which a mature ovum is released from the dominant

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follicle. This critical event typically occurs around day 14 of a 28-day menstrual cycle.[4]

4. **Luteal Phase**: In the aftermath of ovulation, the ruptured follicle undergoes a transformation, giving rise to the corpus luteum. This temporary endocrine structure produces progesterone, a hormone essential for preparing the uterine lining for implantation of a fertilized ovum.[5]

Hormonal Regulation of the Menstrual Cycle

The menstrual cycle is governed by a complex interplay of hormones, including:

a. **Follicle-Stimulating Hormone (FSH):** Stimulates follicular growth and maturation within the ovaries. [6]

b. **Oestrogen:** Promotes proliferation and thickening of the uterine lining.[7]

c. **Progesterone:** Prepares the uterine lining for implantation of a fertilized ovum.[8]

Clinical Implications and Fertility Considerations

A comprehensive understanding of the menstrual cycle is essential for addressing various reproductive health concerns and optimizing fertility. Key considerations include:

1. **Fertility Window**: The fertile phase spans approximately 5 days preceding ovulation and the day of ovulation itself.[9]

2. **Corpus Luteum Function**: The corpus luteum plays a critical role in producing progesterone, essential for maintaining uterine lining integrity.[10]

3. **Menstrual Cycle Variability**: Inter-individual variability in menstrual cycle length and hormonal profiles can significantly impact fertility and reproductive health outcomes.[11]

Synthetic sanitary pads -

Sanitary napkins currently in use during menstruation are not composed of pure cotton; rather, they are manufactured using a variety of plastic chemicals, including Bisphenol A (BPA) and Bisphenol S (BPS), as well as polymers such as polyethylene (PET), polypropylene, polyethylene glycol (PEG), and polyurethanes. Additionally, these products often contain odor neutralizers and artificial colors. The presence of these contaminants can lead to numerous health issues, including hormonal imbalances, infertility, cervical cancer, urinary tract infections (UTIs), polycystic ovary syndrome (PCOS), skin rashes, and allergic reactions.[12]

Furthermore, there is a risk of Toxic Shock Syndrome (TSS), which can arise from harmful toxins produced by bacteria such as Staphylococcus and Streptococcus that may accumulate in the reproductive system. Another concerning aspect is the presence of dioxin, a hazardous chemical that results from the chlorine bleaching process used to achieve a desirable color in napkins. The effects of dioxin are cumulative and can persist in the body for up to 20 years following exposure. The World Health Organization (WHO) categorizes dioxin as one of the most dangerous persistent organic pollutants. Consequently, dioxins, along with various fragrances and deodorants, can enter the bloodstream, potentially impacting local tissues and the immune system, leading to a range of health complications.[13]

Chemical present into synthetic pads-

Table-1: Chemicals into synthetic pads

Sr. No.	Chemical/ Material	Source	Health Risks	Environmental Risks
1.	Dioxin	Chlorine bleaching	Pelvic inflammatory disease, hormone dysfunction, endometriosis, cancer	Toxic pollutant, accumulates in fat stores
2.	Pesticides	Conventionally grown cotton	Infertility, hormonal disruption, thyroid malfunction, diabetes, endometriosis, depression	Chemical residue on cotton
3.	Plastics	Impermeable layer in pads	Yeast and bacterial growth, burning, chafing, soreness	Contribution to menstrual waste, pollution
4.	Fragrances	Scented sanitary pads	Skin irritation, allergies, reactions, unknown chemical effects	Entry into bloodstream, potential health risks

Herbal sanitary pads -

To prevent the aforementioned issues, it is essential to produce sanitary napkins using natural resources, leading to the creation of herbal sanitary napkins.[14]

The present research is centered on the creation of sanitary napkins made from natural fibers, emphasizing their absorbency, comfort, and herbal protective qualities. These plant-derived fibers serve as an excellent resource due to their superior absorbency, cost-effectiveness, softness, and antimicrobial properties, which can alleviate pain and reduce the risk of infection for menstruating women. When combined with cotton, these fibers yield enhanced characteristics that are ideal for sanitary napkin production. Furthermore, to augment the antibacterial protection, the top layer of the sanitary napkin is treated with neem extract, providing additional health benefits.[15]

Table-2: Merits of herbal sanitary pads demerits of synthetic sanitary pads

Merits of herbal sanitary pads	Demerits of synthetic sanitary pads
Soft and breathable	Toxic Chemicals: Chlorine, dioxins
Gentle on skin	Cancer Concerns
Antimicrobial properties	Menstrual Disorders
Biodegradable	Non-Biodegradable
Eco-friendly	Skin Irritation
Cost-effective	Resource-Intensive
Affordable	Disposal Challenges

Material –

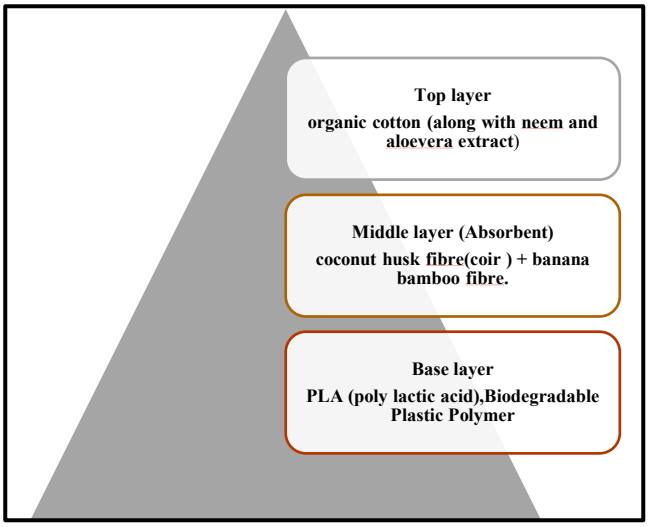

Fig.no. 1-Materials for herbal pad development

1. Top layer –

Organic cotton is frequently recommended as the primary material for sanitary napkins due to its non-irritating, skin-friendly characteristics and excellent liquid retention capabilities. Its softness and breathability contribute to comfort and dryness, while cotton effectively absorbs moisture, ensuring that the skin remains dry.

Fig.no.2-Organic cotton

Neem Extraction Process

The extraction process of neem leaves involved several steps. First, fresh neem leaves were collected and cleaned with distilled water to remove dirt and debris. The leaves were then dried in a shaded area. Next, the dried neem leaves were ground into a fine powder using a grinder or mortar and pestle. The active compounds were then extracted from the neem leaf powder using a solvent such as water through method like maceration. 200 g of neem leaf powder was macerated with 1 L of water for 24 hours.After extraction, the mixture was filtered to remove any impurities or residue. The extract was then concentrated using a rotary evaporator or by reducing the volume through heat. Finally, the concentrated extract was dried to obtain a powder or semi-solid residue. [16]

Alovera roots extraction-

The extraction process of Aloe vera roots involved several steps. First, fresh Aloe vera roots were collected, washed with distilled water to remove dirt and debris, and dried in a shaded area. The dried roots were then ground into a fine powder using a grinder or mortar and pestle. The active compounds were extracted from the Aloe vera root powder using a solvent such as ethanol maceration. 100 g of Aloe vera root powder was macerated with 500 mL of ethanol (70%) for 48 hours.After extraction, the mixture was filtered to remove any impurities or residue. The extract was then concentrated using a rotary evaporator or by reducing the volume through heat. Finally, the concentrated extract was dried to obtain a powder or semi-solid residue. [17]

2. Middle layer

Banana fiber -

Banana serves as a natural absorbent fiber primarily due to its inherent porosity. Similar to jute fiber (Corchorus olitorius), banana fiber is an environmentally friendly option. It is biodegradable and does not adversely impact the environment.[18]

Fig. no. 3- Banana fiber

Coconut husk -

Coconut is a widely distributed plant, yet the quality of its fruit is significantly affected by the minerals and nutrients present in the soil where it

is cultivated. The coconut produces fruits that contain a fibrous component, which serves to pack the fruit flesh. These fibers possess the ability to absorb water. When ground into a powder, coconut fibers can be analyzed for their absorption properties. Coconut coir powder exhibits an absorption capacity of 1.5%, which enhances the overall absorption capability of coconut fiber. This suggests that the water absorption potential of the coconut husk is quite effective.[19]

Coir fiber is characterized by remarkable properties, including waterproofing, water retention, and the ability to permit adequate water flow, along with flexibility and aeration, making it an ideal material.[20]

3. Base layer –

An alternative to synthetic back sheets is the PLA (Poly Lactic Acid) fiber, which is produced from corn starch through advanced biotechnology. This material is regarded as one of the most promising thermoplastic biodegradable polymers available.[21]

Fig. no.4- Poly lactic acid granules

Method

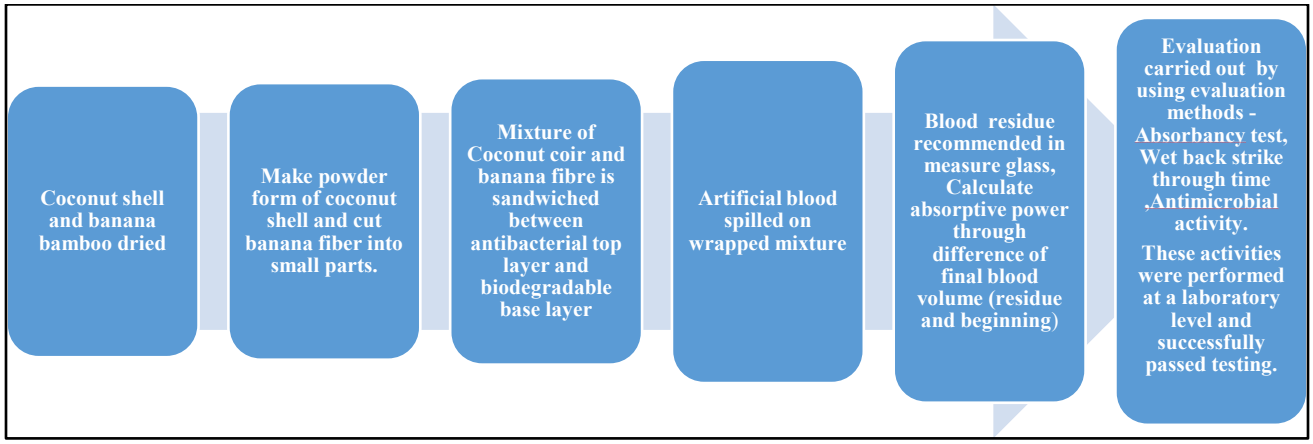

Fig.no. 5 Method of development of herbal sanitary pad

Fig.no.6 – Base of sanitary pad

Artificial blood preparation -

The synthetic blood utilized for the evaluation of sanitary napkins was formulated with 1.0% w/v Sodium chloride, 0.4% w/v Sodium carbonate, 10% w/v glycerol, 0.5% w/v carboxy methyl cellulose, and 90% w/v de-ionized water, along with 0.001g of Congo red.[22]

Evaluation tests –

1. Absorbancy test -

This procedure assesses the overall absorption capacity of the material. In accordance with the testing standard ISO 5405 -1980, a sample is positioned on a flat, transparent surface, allowing for visibility of the underside of the pad. Fluid is to be dripped at a rate of 15 ml per minute, with a total of 30 ml of fluid, maintained at a temperature of 27°C, being applied to the center of the sanitary pad from a height of approximately 1 to 2 mm. Once the pad has fully absorbed the fluid, a standard weight of 1 kg is placed on the area where the fluid has been absorbed for one minute. Subsequently, the back and sides of the pad are examined for any fluid leakage. The results are then recorded.[23]

Fig. no.7- Absorbancy test

2. Wet back strike through time –

The assessment evaluates the duration required for blood to absorb into a napkin when it is fully saturated. A colorless synthetic blood solution was created, and 10 ml of this solution was dispensed onto the napkin with a syringe to ensure it was wet. Subsequently, two drops of colored synthetic blood were applied to the napkin using a syringe, and the time taken for the blood drop to vanish from the surface of the napkin was recorded.[24]

3. Antimicrobial screening

Antimicrobial testing was conducted utilizing the Agar Diffusion method against gram-positive bacteria (Staphylococcus aureus, Streptococcus species) and gram-negative bacteria (Pseudomonas aeruginosa). The samples subjected to treatment were positioned on the agar plates that had been incubated with the test bacteria for a duration of 24 hours at a temperature of 37˚C. Following the incubation period, the samples were visually evaluated, and the area of inhibition was measured to determine antimicrobial efficacy.[25]

RESULTS AND DISCUSSION

The developed herbal sanitary pad, comprising an organic cotton top layer with neem and aloe vera extracts, a coconut husk and banana fiber middle layer, and a PLA base layer, demonstrated promising performance in various evaluation tests.

1. Absorbency Test

The herbal sanitary pad exhibited an absorbency of 18.5 ± 1.2 g, indicating its ability to absorb menstrual fluid effectively. The coconut husk and banana fiber middle layer contributed to this absorbency, while the organic cotton top layer allowed for quick absorption and distribution of fluid.

Absorbancy Test Results

Sample	Absorbency (g)
Herbal Pad	18.5 ± 1.2

2. Wet Back Strike through Time

The herbal sanitary pad demonstrated a wet back strike through time of 12.1 ± 1.5 seconds, indicating its ability to prevent fluid from penetrating through the pad and reaching the user's skin. The neem and aloe vera extracts in the top layer may have contributed to this performance.

Sample	Wet Back Strike Through Time Results (sec)
Herbal Pad	12.1 ± 1.5

3. Antimicrobial Screening

The herbal sanitary pad exhibited significant antimicrobial activity against various microorganisms, with a zone of inhibition of 15.6 ± 2.1 mm. The neem and aloe vera extracts in the top layer likely contributed to this antimicrobial activity, enhancing the pad's safety and hygiene.

Sample	Zone of Inhibition
Herbal Pad	15.6 ± 2.1

The developed herbal sanitary pad demonstrated promising performance in absorbency, wet back strike through time, and antimicrobial activity. The use of natural materials like coconut husk, banana fiber, and PLA ensures biodegradability and sustainability. The incorporation of neem and aloe vera extracts provides additional benefits, including antimicrobial activity and skin soothing properties. These results suggest that the herbal sanitary pad is a viable alternative for working women seeking safer and more sustainable menstrual hygiene options.

CONCLUSION

Menstrual hygiene should be enhanced through the introduction of herbal sanitary napkins during menstruation and menstrual hygiene management. These napkins can address essential requirements by providing an affordable, hygienic, biodegradable, and sustainable alternative for managing menstrual periods, thereby contributing to the overall health and well-being of women throughout their menstruating years.

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Conflict of Interest

The authors declare no conflict of interest.

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