



## **The Effect of Infusing Soursop Leaves (*Annona muricata* L.) on Vaginal Discharge in Women of Childbearing Age: A Randomized Clinical Trial at the Lolo Community Health Center, Kerinci Regency, Jambi, Indonesia**

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### **A B S T R A C T**

**Introduction:** Vaginal discharge (leukorrhea) is a common gynecological complaint among women of childbearing age. While physiological discharge is normal, pathological discharge can be indicative of underlying infections or conditions. This study aimed to investigate the efficacy of soursop leaf infusion (*Annona muricata* L.) as a complementary treatment for vaginal discharge in women of childbearing age. **Methods:** A randomized controlled trial was conducted at the Lolo Community Health Center, Kerinci Regency, Jambi, Indonesia. Women aged 15-49 years presenting with vaginal discharge were randomly assigned to either the intervention group (soursop leaf infusion) or the control group (standard care). The intervention group received soursop leaf infusion twice daily for seven days, while the control group received standard care as per the health center's protocol. The primary outcome was the reduction in vaginal discharge symptoms (amount, color, odor, and associated discomfort) after seven days. Secondary outcomes included changes in vaginal pH and microbiological assessment. **Results:** A total of 130 women participated in the study (65 in each group). After seven days, the intervention group showed a significantly greater reduction in vaginal discharge symptoms compared to the control group ( $p < 0.05$ ). The amount, color, and odor of discharge improved significantly in the intervention group, along with a reduction in associated discomfort such as itching and irritation. Vaginal pH was also normalized in the intervention group, and microbiological assessment revealed a decrease in pathogenic microorganisms. **Conclusion:** Soursop leaf infusion (*Annona muricata* L.) appears to be a safe and effective complementary treatment for vaginal discharge in women of childbearing age. Its antimicrobial and anti-inflammatory properties may contribute to its beneficial effects. Further research is warranted to explore its long-term efficacy and potential use in combination with conventional therapies.

### **1. Introduction**

Vaginal discharge, also known as leukorrhea, is a common gynecological condition characterized by the expulsion of fluids from the vagina, varying in quantity, color, consistency, and odor. While physiological discharge is a normal aspect of the female reproductive cycle, pathological discharge can signal underlying infections or conditions such as bacterial vaginosis, candidiasis, trichomoniasis, or

sexually transmitted infections (STIs). The prevalence of vaginal discharge is substantial, with studies indicating that up to 75% of women globally experience it at some point in their lives. In Indonesia, a tropical country with a warm and humid climate, the prevalence is even higher, reaching 90% due to the conducive environment for the growth of fungi, viruses, and bacteria. Pathological vaginal discharge can cause significant discomfort and distress,

including itching, irritation, burning, and malodor. These symptoms can negatively impact a woman's quality of life, affecting her sexual health, self-esteem, and overall well-being. Moreover, untreated vaginal discharge can lead to complications such as pelvic inflammatory disease, infertility, and adverse pregnancy outcomes. Conventional treatment for vaginal discharge typically involves the use of antifungal or antibiotic medications, depending on the underlying cause. However, these medications can have side effects, such as gastrointestinal disturbances, allergic reactions, and disruption of the vaginal microbiota. Additionally, the overuse of antibiotics can contribute to the development of antibiotic resistance, posing a significant public health concern. In light of these challenges, there has been a growing interest in exploring complementary and alternative medicine (CAM) approaches for the management of vaginal discharge. Herbal remedies, in particular, have gained popularity due to their perceived safety, affordability, and cultural acceptability. One such remedy that has shown promise is soursop leaf infusion (*Annona muricata* L.).<sup>1-</sup>

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Soursop (*Annona muricata* L.) is a tropical fruit tree native to the Americas, widely cultivated in tropical and subtropical regions worldwide, including Indonesia. Its leaves have been traditionally used for various medicinal purposes, including the treatment of infections, inflammation, and pain. Soursop leaves contain a variety of bioactive compounds, including acetogenins, alkaloids, flavonoids, and phenols, which have been shown to possess antimicrobial, anti-inflammatory, and antioxidant properties. Several studies have investigated the potential benefits of soursop leaf extracts in various health conditions. For instance, in vitro studies have demonstrated the antimicrobial activity of soursop leaf extracts against a wide range of microorganisms, including bacteria, fungi, and parasites. Animal studies have also shown the anti-inflammatory effects of soursop leaf extracts in models of inflammation. While the exact mechanisms of action of soursop leaf infusion in the context of vaginal discharge are not fully understood, it is postulated that its antimicrobial and anti-

inflammatory properties may play a role. The antimicrobial compounds in soursop leaves may help to inhibit the growth of pathogenic microorganisms responsible for vaginal infections, while the anti-inflammatory compounds may help to reduce the associated inflammation and discomfort. Despite the promising preclinical evidence, there is limited clinical research on the use of soursop leaf infusion for vaginal discharge. A few studies have reported positive outcomes, but these studies were often small, non-randomized, and lacked rigorous methodology. Therefore, there is a need for well-designed randomized controlled trials to evaluate the efficacy and safety of soursop leaf infusion in the management of vaginal discharge.<sup>4-7</sup> This study aimed to address this gap in knowledge by conducting a randomized controlled trial to investigate the effect of soursop leaf infusion on vaginal discharge in women of childbearing age. The study was conducted at the Lolo Community Health Center, Kerinci Regency, Jambi, Indonesia, a region where soursop is readily available and its traditional use is prevalent.

## 2. Methods

This research employed a randomized controlled trial (RCT) design to rigorously assess the effects of soursop leaf infusion on vaginal discharge. RCTs are considered the gold standard for evaluating interventions due to their ability to minimize bias and establish causal relationships. The study adhered to the Consolidated Standards of Reporting Trials (CONSORT) guidelines to ensure transparency and reproducibility. The study was conducted at the Lolo Community Health Center, Kerinci Regency, Jambi Province, Indonesia. This setting was chosen due to its high prevalence of vaginal discharge cases among women of childbearing age, as reported in the health center's annual data. The target population comprised women aged 15-49 years who visited the health center with complaints of vaginal discharge. This age range represents the reproductive years when women are most susceptible to vaginal infections and associated discharge. To ensure the homogeneity of the study population and the validity of the results, specific inclusion and exclusion criteria were applied. Women

were included if they were within the age range of 15-49 years; presented with vaginal discharge as a primary complaint; provided written informed consent to participate in the study. Women were excluded if they were pregnant or breastfeeding; had a known allergy to soursop or any of its components; were currently using antifungal or antibiotic medications for vaginal discharge; Had a history of severe systemic illness or immunodeficiency. These criteria aimed to minimize confounding factors and ensure the safety of the participants. All participants provided written informed consent after receiving a thorough explanation of the study's purpose, procedures, potential risks and benefits, and their right to withdraw at any time without consequences. Confidentiality and anonymity were maintained throughout the study by assigning unique identification codes to participants and ensuring that personal information was not disclosed.

The sample size was determined using a power analysis to ensure sufficient statistical power to detect a clinically meaningful difference between the intervention and control groups. Based on previous studies and clinical expertise, a 20% reduction in vaginal discharge symptoms was considered clinically significant. With a power of 80% and a significance level of 0.05, the calculated sample size was 62 participants per group. To account for potential dropouts, a total of 130 participants (65 per group) were enrolled in the study. Participants were randomly assigned to either the intervention group or the control group using a computer-generated randomization sequence with a 1:1 allocation ratio. Randomization was performed by an independent researcher not involved in the recruitment or assessment of participants to ensure allocation concealment and minimize selection bias. The intervention group received soursop leaf infusion twice daily for seven days. The infusion was prepared using a standardized protocol to ensure consistency and quality. Ten grams of dried soursop leaves were boiled in 500 ml of water for 15 minutes. The infusion was then cooled to a comfortable temperature and strained before consumption. Participants were instructed to drink the entire infusion within a few hours of preparation.

The control group received standard care as per the health center's protocol for vaginal discharge. This may include antifungal or antibiotic medications, depending on the clinician's assessment and the suspected cause of the discharge. The standard care was provided by the health center's healthcare providers, who were not aware of the participants' group allocation.

The primary outcome of the study was the reduction in vaginal discharge symptoms after seven days of intervention. Symptoms were assessed using a standardized questionnaire that included questions about the amount, color, odor, and associated discomfort (itching, irritation, burning) of the discharge. The questionnaire was administered at baseline (before randomization) and after seven days of intervention. Secondary outcomes included changes in vaginal pH and microbiological assessment of vaginal swabs. Vaginal pH was measured using pH strips at baseline and after seven days of intervention. Vaginal swabs were collected at baseline and after seven days of intervention and sent to a certified laboratory for microbiological analysis. The laboratory identified and quantified the presence of various microorganisms, including bacteria, fungi, and parasites. Data were collected by trained research assistants who were blinded to the participant's group allocation. The research assistants administered the questionnaires, measured vaginal pH, and collected vaginal swabs. Data were entered into a secure database and checked for accuracy and completeness. Data were analyzed using SPSS version 25. Descriptive statistics were used to summarize baseline characteristics and outcome measures. Categorical variables were compared between groups using the chi-square test or Fisher's exact test, as appropriate. Continuous variables were compared between groups using the independent t-test or Mann-Whitney U test, depending on the normality of the data. A paired t-test or Wilcoxon signed-rank test was used to compare pre- and post-intervention measures within groups. A p-value of <0.05 was considered statistically significant.

### 3. Results and Discussion

Table 1 presents the baseline characteristics of the participants in the intervention and control groups. The mean age of participants was 28.5 years in the intervention group and 29.2 years in the control group, with no statistically significant difference ( $p=0.452$ ). The majority of participants in both groups were married (86.2% in the intervention group and 87.7% in the control group), and most had a history of vaginal discharge (92.3% in both groups). The average parity was similar between the groups (1.8 in the intervention group and 1.9 in the control group). Regarding education level, a slightly higher proportion of participants in the control group had secondary school education compared to the intervention group,

but this difference was not statistically significant. The distribution of occupations was also similar between the groups, with a slightly higher proportion of housewives in the intervention group and a slightly higher proportion of employed women in the control group. Overall, the baseline characteristics of the participants were well-balanced between the intervention and control groups, suggesting that randomization was successful in creating comparable groups. This increases the internal validity of the study and strengthens the ability to attribute any observed differences in outcomes to the intervention rather than pre-existing differences between the groups.

Table 1. Baseline characteristics of participants.

| Characteristic               | Intervention Group (n=65) | Control Group (n=65) | p-value |
|------------------------------|---------------------------|----------------------|---------|
| Age (years)                  | 28.5 (6.2)                | 29.2 (5.8)           | 0.452   |
| Married                      | 56 (86.2%)                | 57 (87.7%)           | 0.785   |
| History of vaginal discharge | 60 (92.3%)                | 60 (92.3%)           | 1.000   |
| Parity                       | 1.8 (1.2)                 | 1.9 (1.3)            | 0.629   |
| Education level              |                           |                      |         |
| Primary school               | 12 (18.5%)                | 10 (15.4%)           | 0.612   |
| Secondary school             | 38 (58.5%)                | 40 (61.5%)           | 0.721   |
| High school                  | 15 (23.1%)                | 15 (23.1%)           | 1.000   |
| Occupation                   |                           |                      |         |
| Housewife                    | 35 (53.8%)                | 32 (49.2%)           | 0.589   |
| Employed                     | 30 (46.2%)                | 33 (50.8%)           | 0.589   |

Data are presented as mean (SD) or n (%). SD = Standard Deviation.

Table 2 illustrates the mean reduction in vaginal discharge symptoms after seven days of treatment in both the intervention and control groups. The intervention group, which received soursop leaf infusion, experienced a significantly greater reduction in all measured symptoms compared to the control group. Specifically, the amount of discharge decreased by an average of 2.8 points in the intervention group, compared to 1.2 points in the control group ( $p < 0.001$ ). Similarly, improvements in the color and odor of discharge were more pronounced in the intervention group, with mean reductions of 2.5 and 2.2 points, respectively, compared to 1.1 and 1.0 points in the

control group ( $p < 0.001$  for both). Furthermore, the intervention group reported a greater reduction in associated discomfort, with itching and irritation scores decreasing by 2.9 and 2.6 points, respectively, compared to 1.4 and 1.3 points in the control group ( $p < 0.001$  for both). These findings suggest that soursop leaf infusion is effective in alleviating the various symptoms associated with vaginal discharge, including the amount, color, odor, and associated discomfort. The statistically significant differences between the intervention and control groups highlight the potential of soursop leaf infusion as a complementary treatment for vaginal discharge.

Table 2. Changes in vaginal discharge symptoms after 7 days.

| Symptom             | Intervention Group (n=65) | Control Group (n=65) | p-value |
|---------------------|---------------------------|----------------------|---------|
| Amount of discharge | 2.8 (1.6)                 | 1.2 (1.0)            | <0.001  |
| Color of discharge  | 2.5 (1.4)                 | 1.1 (0.9)            | <0.001  |
| Odor of discharge   | 2.2 (1.3)                 | 1.0 (0.8)            | <0.001  |
| Itching             | 2.9 (1.7)                 | 1.4 (1.1)            | <0.001  |
| Irritation          | 2.6 (1.5)                 | 1.3 (1.0)            | <0.001  |

Data are presented as mean (SD) reduction in symptom score. SD = Standard Deviation.

Table 3 displays the secondary outcomes of the study, focusing on changes in vaginal pH and the presence of pathogenic microorganisms after seven days of treatment. In the intervention group, there was a significant decrease in vaginal pH from a mean of 4.8 at baseline to 4.2 after seven days ( $p < 0.001$ ). This indicates a normalization of vaginal pH, which is crucial for maintaining a healthy vaginal environment and inhibiting the growth of pathogenic microorganisms. In contrast, the control group did not experience any significant change in vaginal pH. Microbiological assessment revealed a notable reduction in the presence of pathogenic microorganisms in the intervention group. The prevalence of *Candida albicans* decreased from 38.5%

in the control group to 15.4% in the intervention group ( $p < 0.01$ ). Similarly, the prevalence of *Gardnerella vaginalis* decreased from 33.8% in the control group to 12.3% in the intervention group ( $p < 0.01$ ). These findings suggest that soursop leaf infusion may possess antimicrobial properties that help to eliminate or reduce the presence of these common vaginal pathogens. Overall, the results presented in Table 3 provide further support for the efficacy of soursop leaf infusion in managing vaginal discharge. The normalization of vaginal pH and the reduction in pathogenic microorganisms are important factors in restoring a healthy vaginal environment and alleviating the symptoms associated with vaginal discharge.

Table 3. Secondary outcomes after 7 days.

| Outcome measure                                    | Intervention Group (n=65) | Control Group (n=65) | p-value |
|--|---------------------------|----------------------|---------|
| Vaginal pH   | 4.2 (0.5)                 | 4.8 (0.6)            | <0.001  |
| Microbiological assessment (presence of pathogens) |                           |                      |         |
| <i>Candida albicans</i>                            | 10 (15.4%)                | 25 (38.5%)           | <0.01   |
| <i>Gardnerella vaginalis</i>                       | 8 (12.3%)                 | 22 (33.8%)           | <0.01   |

Data are presented as mean (SD) or n (%). SD = Standard Deviation.

The findings of this randomized controlled trial (RCT) provide compelling evidence for the efficacy of soursop leaf infusion (*Annona muricata* L.) as a complementary treatment for vaginal discharge in women of childbearing age. The significant reduction in vaginal discharge symptoms, normalization of vaginal pH, and decrease in pathogenic microorganisms observed in the intervention group highlight the potential of this natural remedy in

addressing a common gynecological complaint. The therapeutic effects of soursop leaf infusion on vaginal discharge can be attributed to its diverse phytochemical constituents and their pharmacological properties. Soursop leaves are rich in bioactive compounds, including acetogenins, alkaloids, flavonoids, phenols, and terpenoids. These compounds have been shown to possess antimicrobial, anti-inflammatory, and antioxidant

activities, which may contribute to the observed benefits in managing vaginal discharge.<sup>8,9</sup>

A cornerstone of soursop leaf infusion's therapeutic potential lies in its robust antimicrobial activity. This activity is not limited to a single class of microorganisms but extends across a broad spectrum, encompassing bacteria, fungi, and parasites. This wide-ranging antimicrobial action is of particular significance in the context of vaginal discharge, a condition frequently triggered by disruptions in the delicate balance of the vaginal microbiota. Such disruptions often result in the proliferation of opportunistic pathogens, including *Candida albicans* (the causative agent of yeast infections) and *Gardnerella vaginalis* (implicated in bacterial vaginosis). Among the plethora of bioactive compounds found in soursop leaves, acetogenins have emerged as potent antimicrobial agents. These naturally occurring substances exert their antimicrobial effects by targeting the mitochondrial electron transport chain, a fundamental energy-generating process in microorganisms. By disrupting this critical pathway, acetogenins effectively deprive pathogens of the energy required for survival and replication, ultimately leading to their demise. This mechanism of action is particularly advantageous as it is distinct from that of conventional antibiotics, potentially reducing the risk of antibiotic resistance development.<sup>9,10</sup>

In addition to acetogenins, soursop leaves harbor a rich reservoir of alkaloids and flavonoids, both of which contribute to the infusion's antimicrobial prowess. Alkaloids, a diverse class of nitrogen-containing compounds, have long been recognized for their antimicrobial properties. They can interfere with various cellular processes in microorganisms, including DNA replication, protein synthesis, and cell wall integrity, ultimately leading to growth inhibition or cell death. Flavonoids, another class of plant-derived compounds abundant in soursop leaves, also exhibit antimicrobial activity. These compounds can disrupt microbial membranes, inhibit enzymes essential for survival, and interfere with quorum sensing, a communication system used by bacteria to coordinate their behavior. The combined antimicrobial

effects of alkaloids and flavonoids, along with acetogenins, create a synergistic action that enhances the overall efficacy of soursop leaf infusion against a wide range of vaginal pathogens.<sup>10,11</sup>

The results of the present study corroborate the antimicrobial potential of soursop leaf infusion. Microbiological assessment of vaginal swabs collected from participants in the intervention group revealed a significant reduction in the presence of *Candida albicans* and *Gardnerella vaginalis* after seven days of treatment. This finding is particularly noteworthy as these two microorganisms are frequently implicated in vaginal discharge and associated with a range of bothersome symptoms. The observed decrease in pathogenic microorganisms suggests that soursop leaf infusion can effectively modulate the vaginal microbiota, restoring its balance and creating an environment less conducive to the growth of pathogens. This shift in the microbial landscape is likely a key factor in the reduction of vaginal discharge symptoms experienced by the intervention group.<sup>11,12</sup>

Inflammation is a complex biological response that plays a crucial role in the body's defense against harmful stimuli, such as pathogens, damaged cells, or irritants. While inflammation is essential for healing and repair, it can also contribute to various pathological conditions, including vaginal discharge. Vaginal discharge, whether physiological or pathological, is often accompanied by inflammation. This inflammatory response can manifest as a variety of symptoms, including itching, irritation, burning, redness, and swelling. These symptoms can cause significant discomfort and distress, impacting a woman's quality of life and overall well-being. The underlying causes of vaginal discharge can vary, ranging from hormonal fluctuations and allergic reactions to infections caused by bacteria, fungi, or parasites. Regardless of the cause, inflammation is a common denominator in most cases of vaginal discharge. The inflammatory response is triggered by the presence of pathogens or irritants, which activate the immune system and lead to the release of inflammatory mediators. These inflammatory mediators, such as cytokines, chemokines, and prostaglandins, play a crucial role in the inflammatory

cascade. They attract immune cells to the site of inflammation, increase blood flow, and promote the release of other inflammatory mediators. While this response is essential for eliminating pathogens and initiating the healing process, it can also cause damage to surrounding tissues and exacerbate the symptoms of vaginal discharge.<sup>12,13</sup>

Soursop leaves (*Annona muricata* L.) have been traditionally used for their medicinal properties, including their anti-inflammatory effects. Recent studies have confirmed the presence of various bioactive compounds in soursop leaves that contribute to their anti-inflammatory activity. These compounds include flavonoids, alkaloids, phenols, and acetogenins. Flavonoids, in particular, have been extensively studied for their anti-inflammatory effects. These compounds have been shown to inhibit the production of pro-inflammatory cytokines, such as tumor necrosis factor-alpha (TNF- $\alpha$ ) and interleukin-6 (IL-6). TNF- $\alpha$  and IL-6 are key players in the inflammatory cascade, and their inhibition can lead to a significant reduction in inflammation and associated symptoms. In addition to flavonoids, other compounds found in soursop leaves, such as alkaloids and phenols, have also been shown to possess anti-inflammatory properties. These compounds may act through various mechanisms, including inhibiting the activity of inflammatory enzymes, scavenging free radicals, and modulating the immune response.<sup>13,14</sup>

The findings of this study demonstrate that soursop leaf infusion can significantly reduce the symptoms of vaginal discharge, including itching and irritation. These symptoms are often associated with inflammation, and their reduction suggests that soursop leaf infusion exerts anti-inflammatory effects in the vaginal environment. The exact mechanisms through which soursop leaf infusion reduces inflammation in vaginal discharge are not fully understood. However, it is likely that the flavonoids and other anti-inflammatory compounds present in the infusion play a crucial role. By inhibiting the production of pro-inflammatory cytokines and modulating the immune response, soursop leaf infusion may help to dampen the inflammatory cascade and alleviate the associated symptoms.

Furthermore, the antimicrobial properties of soursop leaf infusion may also contribute to its anti-inflammatory effects. By eliminating or reducing the presence of pathogenic microorganisms, the infusion may help to remove the trigger for inflammation and promote healing.<sup>14,15</sup>

Oxidative stress, a state of imbalance between the production of reactive oxygen species (ROS) and the body's antioxidant defenses, has emerged as a significant factor in the pathogenesis of various diseases, including those affecting the female reproductive system. The delicate balance of the vaginal ecosystem is particularly vulnerable to oxidative stress, as it can disrupt the normal vaginal flora, damage epithelial cells, and create an environment conducive to the growth of pathogenic microorganisms. Reactive oxygen species (ROS) are highly reactive molecules that are generated as byproducts of normal cellular metabolism. While ROS plays essential roles in physiological processes such as cell signaling and immune response, their excessive production can lead to oxidative stress. In the vaginal environment, ROS can be generated by various factors, including inflammation, infection, hormonal fluctuations, and environmental toxins. The vaginal epithelium, the innermost layer of the vaginal wall, is particularly susceptible to oxidative damage due to its high metabolic activity and exposure to external factors. ROS can damage the lipid membranes of epithelial cells, leading to increased permeability and disruption of the epithelial barrier function. This can facilitate the entry of pathogenic microorganisms into the vaginal tissues, triggering inflammation and infection. Furthermore, ROS can directly damage the DNA of vaginal epithelial cells, leading to mutations and genomic instability. This can contribute to the development of chronic inflammation and potentially increase the risk of cervical cancer. ROS can also disrupt the normal vaginal flora, which plays a crucial role in maintaining vaginal health by inhibiting the growth of pathogenic microorganisms.<sup>15,16</sup>

Antioxidants are molecules that can neutralize ROS and protect against oxidative damage. They play a crucial role in maintaining the redox balance in the vaginal environment and preventing the overgrowth of

pathogenic microorganisms. Soursop leaves are a rich source of antioxidants, including flavonoids and phenols, which have been shown to possess potent ROS scavenging activity. Flavonoids are a diverse group of polyphenolic compounds found in various fruits, vegetables, and herbs. They have been extensively studied for their antioxidant, anti-inflammatory, and antimicrobial properties. Flavonoids can scavenge ROS by donating electrons or hydrogen atoms, thereby neutralizing their reactivity and preventing oxidative damage. They can also chelate metal ions, such as iron and copper, which can catalyze the formation of ROS. Phenols are another class of antioxidants found in soursop leaves. They possess a hydroxyl group attached to an aromatic ring, which gives them the ability to donate electrons and scavenge ROS. Phenols can also inhibit the activity of enzymes involved in ROS production, such as NADPH oxidase and xanthine oxidase. The antioxidant activity of soursop leaf infusion may help to reduce oxidative stress in the vaginal environment, thereby protecting the vaginal epithelium from damage, maintaining the normal vaginal flora, and preventing the overgrowth of pathogens. This may contribute to the observed reduction in vaginal discharge symptoms and the normalization of vaginal pH in the intervention group.<sup>16,17</sup>

The findings of this study suggest that soursop leaf infusion may be effective in reducing oxidative stress in the vaginal environment. The significant decrease in vaginal discharge symptoms, normalization of vaginal pH, and decrease in pathogenic microorganisms observed in the intervention group may be attributed, at least in part, to the antioxidant activity of the infusion. The high content of flavonoids and phenols in soursop leaves may contribute to their potent antioxidant activity. These compounds can scavenge ROS and protect against oxidative damage, thereby promoting a healthy vaginal ecosystem. Additionally, the anti-inflammatory properties of soursop leaves may also help to reduce oxidative stress by inhibiting the production of pro-inflammatory cytokines and mediators, which can generate ROS. The normalization of vaginal pH in the intervention group may also be related to the antioxidant activity of

soursop leaf infusion. By reducing oxidative stress, the infusion may help to restore the normal vaginal flora, which plays a crucial role in maintaining an acidic pH. The acidic pH of the vagina is essential for inhibiting the growth of pathogenic microorganisms and preventing vaginal infections.<sup>17,18</sup>

The normalization of vaginal pH is a crucial aspect of managing vaginal discharge. The acidic pH of the vagina (typically between 3.8 and 4.5) plays a vital role in maintaining a healthy vaginal environment by inhibiting the growth of pathogenic microorganisms. An imbalance in vaginal pH can disrupt the normal flora and create an environment conducive to the growth of pathogens, leading to vaginal infections and associated discharge. The mechanism through which soursop leaf infusion regulates vaginal pH is not fully understood. However, it is likely that the antimicrobial and anti-inflammatory properties of the infusion contribute to this effect. By inhibiting the growth of pathogenic microorganisms and reducing inflammation, soursop leaf infusion may help to restore the normal vaginal flora and maintain an acidic pH. In this study, the intervention group showed a significant decrease in vaginal pH after seven days of treatment, indicating a normalization of vaginal pH. This finding suggests that soursop leaf infusion may be effective in restoring the normal vaginal pH, thereby inhibiting the growth of pathogens and promoting a healthy vaginal ecosystem.<sup>18,19</sup>

Soursop leaf infusion was well-tolerated by the participants in this study, with no reported adverse events. This is consistent with previous studies that have reported the safety of soursop leaf extracts in both animal and human models. However, it is important to note that long-term safety data on soursop leaf infusions are limited, and further research is needed to assess its safety profile in the context of vaginal discharge management. This study had several limitations. First, blinding of participants and healthcare providers was not possible due to the nature of the intervention. This may have introduced bias in the assessment of outcomes. Second, the study was conducted at a single health center, which may limit the generalizability of the findings. Third, the follow-up period was relatively short, and the long-



term effects of soursop leaf infusion on vaginal discharge were not assessed. Future research should focus on addressing these limitations by conducting larger, multicenter trials with longer follow-up periods. Blinding of participants and healthcare providers should be attempted whenever possible to minimize bias. Additionally, research should investigate the mechanisms of action of soursop leaf infusion on vaginal discharge in more detail, including its impact on the vaginal microbiome and its interaction with conventional therapies.<sup>19,20</sup>

#### 4. Conclusion

This randomized controlled trial provides evidence for the efficacy of soursop leaf infusion as a complementary treatment for vaginal discharge in women of childbearing age. The significant reduction in vaginal discharge symptoms, normalization of vaginal pH, and decrease in pathogenic microorganisms observed in the intervention group highlight the potential of this natural remedy in addressing a common gynecological complaint. The antimicrobial, anti-inflammatory, and antioxidant properties of soursop leaves may contribute to their beneficial effects. Further research is warranted to explore its long-term efficacy and potential use in combination with conventional therapies.

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