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Aphrodisiac Effects of Ethanolic Extract from White Ginger Rhizome (*Zingiber officinale Rosc. var. officinarum*) on Male Wistar Rats

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ABSTRAK

Disfungsi ereksi (DE) adalah kondisi umum yang ditandai dengan kesulitan mempertahankan ereksi penis yang terkait dengan berkurangnya produksi oksida nitrat. Penelitian ini bertujuan untuk mengetahui sifat afrodisiak dari ekstrak etanol jahe putih (Z. officinale Rosc. var. officinarum) pada tikus jantan galur Wistar. Enam belas tikus jantan dan enam belas tikus betina dibagi menjadi empat kelompok: dua kelompok menerima ekstrak jahe dengan konsentrasi 25% dan 50%, satu kelompok sebagai kontrol negatif, dan satu kelompok kontrol positif menggunakan sildenafil. Rimpang jahe dikeringkan, dihaluskan, dan diekstraksi menggunakan etanol. Analisis fitokimia menunjukkan adanya alkaloid, flavonoid, tanin, saponin, dan terpenoid. Parameter perilaku yang diamati termasuk introduksi (pendekatan ke betina), menunggangi, dan koitus untuk mengevaluasi aktivitas seksual. Kelompok yang diberi perlakuan ekstrak jahe 50% menunjukkan frekuensi introduksi dan menunggangi tertinggi, sedangkan kelompok sildenafil menunjukkan frekuensi koitus tertinggi. Analisis statistik menggunakan uji Kruskal-Wallis menunjukkan adanya perbedaan signifikan dalam perilaku seksual di antara kelompok-kelompok tersebut. Penelitian ini menyimpulkan bahwa ekstrak jahe putih, terutama pada konsentrasi yang lebih tinggi diduga memiliki efek afrodisiak dengan meningkatkan perilaku seksual pada tikus jantan. Hal ini diduga karena senyawa bioaktifnya memengaruhi kadar hormon atau sistem saraf. Hasil ini menunjukkan potensi jahe putih sebagai pengobatan alami untuk DE, dengan penelitian lebih lanjut diperlukan untuk mengeksplorasi implikasinya pada manusia.

ABSTRACT

Erectile dysfunction (ED) is a common condition marked by difficulty maintaining a penile erection, often linked to reduced nitric oxide (NO) production. This study investigates the aphrodisiac properties of ethanolic white ginger extract (*Z. officinale Rosc. var. officinarum*) in male Wistar rats. Sixteen male and sixteen female rats were divided into four groups: two groups received 25% and 50% ginger extract, one served as a negative control, and the other as a positive control using sildenafil. Ginger rhizomes were dried, powdered, and extracted with ethanol. Phytochemical analysis revealed alkaloids, flavonoids, tannins, saponins, and terpenoids. Behavioral parameters, including introduction (approach to females), climbing, and coitus, were observed to evaluate sexual activity. The group treated with 50% ginger extract showed the highest frequency of introduction and climbing, while the sildenafil group exhibited the highest coitus frequency. Statistical analysis using the Kruskal-Wallis test indicated significant differences in sexual behavior across the groups. The study suggests that white ginger extract, especially at higher concentrations, may have aphrodisiac effects by enhancing sexual behavior in male rats. This could be due to its bioactive compounds affecting hormone levels or the nervous system. The findings propose white ginger as a potential natural treatment for ED, with further research required to explore its implications in humans.

1. INTRODUCTION

Erectile dysfunction (ED) is defined as the persistent inability to achieve or maintain a satisfactory penile erection for sexual performance, and it often begins to decline in males during the fifth decade of life, impacting desire, arousal, erectile function, and ejaculation/orgasm. This condition, commonly referred to as male impotence, is primarily associated with endothelial and nerve dysfunction, and one of its key indicators is a reduction in the production of nitric oxide (NO). The decrease in NO levels can impair the normal process of achieving and sustaining an erection, making ED a significant concern for men's health as it affects both physical and psychological well-being. Furthermore, sexual disorders are often linked to various declines in physical health, some of which are associated with chronic illnesses or prolonged medication use, underscoring the complex interplay between overall health and sexual function (De Leonardis et al., 2022; Pastuszak & Khera, 2016).

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Sexual disorders such as ED can be addressed through various treatments, one of which is the use of aphrodisiacs as a therapeutic alternative. Aphrodisiacs are substances that stimulate sexual arousal and enhance sexual performance. An ideal aphrodisiac should not only enhance sexual satisfaction throughout the sexual cycle but also increase desire, stamina, and excitement. Key parameters used to evaluate sexual performance include mount frequency, mount latency, intromission frequency, intromission latency, post-ejaculatory interval, copulatory rate, libido index, and overall male sexual behavior (Staines et al., 2023; Zulkarnain et al., 2022). Aphrodisiacs are substances, such as food, pills, perfumes, or devices, that stimulate sexual desire, increase erotic urges, and may enhance pleasure and performance. These substances are commonly derived from plants, animals, and minerals. Aphrodisiacs can also come from fruits, herbal drinks, plants, and medications, often containing compounds like flavonoids, alkaloids, and steroid saponins, which are known to boost sexual desire and performance (Ehigiator & Ozolua, 2024; Gunawan et al., 2020). Aphrodisiacs can be grouped into three types based on how they work: those that enhance sexual pleasure, those that increase libido (sexual desire and arousal), and those that improve sexual potency (effectiveness of erections). Each type focuses on a specific aspect of sexual function to improve the overall sexual experience. Sexuality plays a vital and sensitive role in family life, making aphrodisiacs particularly appealing, especially to men, due to their perceived ability to enhance sexual performance and contribute to family harmony (Goel & Maurya, 2020; Mutiara et al., 2024).

In Southwest Asia, extracts from various medicinal plants have been utilized to improve arterial blood flow as a remedy for erectile dysfunction (ED). Alongside this, oral medications such as vardenafil, sildenafil, and tadalafil are frequently prescribed to achieve similar results. The synergy of plant extracts and synthetic drugs aims to enhance blood circulation to the genital area, ultimately supporting erectile function, with sildenafil recently receiving approval as a synthetic treatment for ED (Goel & Maurya, 2020; Masuku et al., 2020). Unfortunately, the use of synthetic drugs frequently results in various side effects, such as aggravating heart conditions and causing bleeding issues. These medications can also lead to peptic ulcers and trigger hypersensitivity reactions. Consequently, people are increasingly turning to alternative options, particularly natural substances, which offer the desired outcomes with fewer side effects (Karunarathna et al., 2024; Romano et al., 2022).

The importance of plant-based resources, especially for medicinal applications, is considerable. Herbal remedies serve a vital role in both the prevention and treatment of ailments. Ginger, recognized and extensively used in Indonesia, is appreciated not only as a common cooking ingredient but also for its therapeutic qualities. Specifically, red ginger has traditionally been used to tackle issues related to sexual dysfunction due to its oleoresin compounds, which are thought to possess aphrodisiac properties that enhance sexual function, thus underscoring its significance in daily life and traditional medicine (Jayathavaj & Chuensumran, 2020; Zhang et al., 2021). Aqueous extracts of white ginger have shown potential in protecting sperm quality and hematological parameters in male rats subjected to lead acetate exposure. Moreover, studies reveal that ginger can improve sperm quality by enhancing key factors such as count, viability, motility, morphology, and DNA integrity. Its powerful antioxidant and androgenic properties effectively reduce oxidative stress and increase reproductive hormone levels. As a result, ginger leads to significant improvements in sperm biological parameters and fertility, yielding sperm with normal structures and better motility (Gholami-Ahangaran et al., 2021; Odo et al., 2020).

While White Ginger has traditionally been recognized as an aphrodisiac, scientific evidence supporting its effectiveness is limited, necessitating further research to evaluate its potential. This study aims to assess the aphrodisiac activity of ethanolic White Ginger rhizome extract in male Wistar rats by observing changes in sexual behavior, such as frequency of approaches, mounting, and copulation after administration. The anticipated results will not only enhance scientific understanding of White Ginger's aphrodisiac effects but also support the development of safe herbal alternatives for treating sexual dysfunction, addressing the growing demand for treatments with minimal side effects. Ultimately, this research aims to provide the public with reliable information on natural alternatives, promoting confidence in the use of White Ginger for sexual health without significant side effects, thus contributing to the fields of sexual health and natural medicine.

2. METHOD

The tools used in this research included writing instruments, a stirring rod, a blender, brown bottles, rat water bottles, porcelain dishes, glass funnels, beakers, measuring cylinders, a camera, rat cages with lids, filter paper, volumetric flasks, oral syringes, a stopwatch, an analytical balance, and CCTV (Closed Circuit Television). The materials used were rat drinking water, cage bedding made of wood shavings, white ginger extract (*Z. officinale* Rosc. *var. officinarum*), 96% ethanol, rat feed, a 1% Na-CMC suspension, sildenafil tablets, and 16 male white rats with an average weight of 200 g, along with 16 female white rats.

The white ginger (*Z. officinale* Rosc. *var. officinarum*) samples used in this study were 9 to 10 months old and were obtained from Pandeglang Regency in Banten Province. The ginger rhizomes were thoroughly washed under running water, drained, and weighed, amounting to 3 kg. They were dried under indirect sunlight for two weeks, covered with a black cloth to avoid direct exposure. Once dried, the ginger was ground into a fine powder using a blender and passed through a 40 mesh sieve for uniformity. The resulting simplicia powder was weighed and prepared for extraction. The extraction was conducted using the maceration method with 96% ethanol as the solvent. The ginger rhizomes were macerated in 96% ethanol for 3x24 hours at room temperature, with occasional stirring. Afterward, remaceration was performed by replacing the solvent and filtering the first macerate. The filtrates were collected and concentrated using a rotary evaporator at 55°C until a thick extract was obtained.

Phytochemical screening was conducted to test for the presence of alkaloids, flavonoids, tannins, saponins, and steroids/terpenoids in the extract. For the alkaloid test, the extract residue was dissolved in 2N HCl and tested with Dragendorff's and Mayer's reagents, where orange and white to yellowish precipitates indicated alkaloids. Flavonoid detection involved boiling the powdered sample in water, followed by the addition of magnesium powder and alcoholic hydrochloric acid, with a yellow amyl alcohol layer confirming flavonoids. The tannin test used ferric chloride, where a dark blue or greenish-black color indicated tannins. Saponins were identified by vigorous shaking of the extract in water, with the formation of a stable foam for at least 10 minutes confirming their presence. Lastly, steroids and terpenoids were tested by dissolving the extract in chloroform and acetic anhydride, then layering with sulfuric acid. A bluish-green color signified steroids, while a brownish or violet ring indicated terpenoids.

The aphrodisiac effects were tested by preparing various suspensions and administering them to male and female rats. First, a 1% w/v Na-CMC suspension was prepared by gradually adding 1 g of Na-CMC to preheated distilled water and stirring until fully dispersed. Sildenafil suspension was prepared by dissolving 36 mg of sildenafil powder in the Na-CMC solution, while the white ginger ethanol extract suspensions were made at 25% and 50% concentrations using the same Na-CMC solution. The test animals, consisting of male and female rats weighing around 200 grams, were quarantined for a week and then divided into four groups. Group I received a 25% white ginger extract, Group II a 50% extract, Group III a Na-CMC suspension as a negative control, and Group IV a sildenafil suspension as a positive control. The treatments were given orally for seven days, and behaviors such as introduction (approach), climbing (mounting), and coitus (mating) were observed 15 minutes after treatment for 2 hours each night using CCTV.

3. RESULT AND DISCUSSION

Result

The following tables present the results of the white ginger rhizome processing and extraction. Table 1 outlines the weight measurements at different stages of making white ginger rhizome powder. Specifically, it shows the weight of fresh white ginger rhizome, the weight after drying, and the final weight after processing into powder form. Table 2 provides details on the extraction process, including the weight of the dry powder used, the volume of 96% ethanol applied, the volume of the dilute filtrate obtained, the weight of the concentrated extract, and the resulting yield percentage. These data are crucial for understanding the efficiency of the processing and extraction methods used.

Table 1. Results of Making White Ginger Rhizome Powder

Weight of Fresh White Ginger Rhizome (g)	Weight of Dried White Ginger Rhizome (g)	Weight of Dried White Ginger Rhizome Powder (g)
4.000	1.500	1.200

Table 2. Results of White Ginger Rhizome Extraction

Weight of Dry Powder (g)	Volume of 96% Ethanol (mL)	Dilute Filtrate Volume (mL)	Concentrated Extract (g)	Yield (%)
1.000	6.000	5.200	55.23	5.523 %

Table 3 presents the results of the phytochemical screening of the white ginger rhizome ethanolic extract, conducted to identify various bioactive compounds. The table details the chemical contents tested, the methods used, and the results obtained. Alkaloids were confirmed by a red precipitate, saponins by persistent foam for over 10 minutes, and terpenoids by the appearance of a brown/violet ring. Flavonoids were identified through a color change from red to orange or purple-red, and tannins by a shift to greenish-

black. These findings underscore the presence of multiple bioactive compounds in the extract, which may contribute to its potential therapeutic properties.

Table 3. Phytochemical Screening of White Ginger Rhizome Ethanolic Extract

No.	Chemical Content	Testing Method	Result	
			+/-	Remarks
1	Alkaloid	Aquades + HCL 2M + Dragendorff	Positive	Red precipitate
2	Saponin	Hot aquades	Positive	Foam formed does not disappear for 10 minutes
3	Terpenoid-Steroid	Chloroform + Acetic Anhydride + Concentrated H_2SO_4 Ethanol (95%) + Magnesium powder + Hydrochloric acid	Positive Terpenoid	Brown/violet ring
4	Flavonoid	Ethanol (95%) + Magnesium powder + Hydrochloric acid	Positive	Red, orange, to purple-red color
5	Tanin	Aquadest + FeCl 3	Positive	Change in color to greenish-black

Table 4, Table 5, and Table 6 summarize the behavioral observations of subjects under different treatment conditions, focusing on the average number of specific actions: introductions, climbing, and coitus. These tables compare the effects of varying concentrations of a treatment against positive and negative controls. Table 4 shows the average number of introductions, where the 50% concentration treatment resulted in the highest mean number of introductions (24.00), followed by the positive control, 25% concentration, and negative control. In Table 5, which records the average number of climbing events, the 50% concentration treatment again yielded the highest mean (6.67), surpassing both the positive and negative controls. Table 6 details the average number of coitus events, with the positive control showing the highest mean (1.00), while both 50% and 25% concentrations, as well as the negative control, resulted in much lower means. These observations suggest a dose-dependent effect of the treatment on the subjects behavior, with higher concentrations generally leading to more activity.

Table 4. Average Number of Introduction

Parameter	Treatment	Mean	Min-Max
Introduction	Positive Control	21.00	15 - 31
	50% Concentration	24.00	17 - 28
	25% Concentration	16.63	13 - 19
	Negative Control	10.33	9 - 12

Table 5. Average Number of Climbing

Parameter	Treatment	Mean	Min-Max
Climbing	Positive Control	3.00	2 - 4
	50% Concentration	6.67	3 - 13
	25% Concentration	2.50	1 - 5
	Negative Control	1.33	0 - 3

Table 6. Average Number of Coitus

Parameter	Treatment	Mean	Min-Max
Coitus	Positive Control	1.00	1 - 1
	50% Concentration	0.33	0 - 1
	25% Concentration	0.33	0 - 1
	Negative Control	0.17	0 - 1

Table 7. Analysis Results of Treatment Effects on Introduction, Climbing, and Coitus

Treatment	Test Parameter	Significant Value (P) Kruskal-Wallis Test	Remarks
Positive Control 50% Concentration 25% Concentration Negative Control	Introduction	0.001	There is a difference in Introduction between each treatment group
Positive Control 50% Concentration 25% Concentration Negative Control	Climbing	0.006	There is a difference in Introduction between each treatment group
Positive Control 50% Concentration 25% Concentration Negative Control	Coitus	0.023	There is a difference in Introduction between each treatment group

Table 7 presents the analysis results of the treatment effects on introduction, climbing, and coitus behaviors, using the Kruskal-Wallis test to assess the statistical significance of differences between treatment groups. The significant P-values—0.001 for introduction, 0.006 for climbing, and 0.023 for coitus—indicate that there are statistically significant differences in these behaviors across the positive control, 50% concentration, 25% concentration, and negative control groups. These findings suggest that the treatments have a notable impact on the behaviors studied, with clear differences observed between the various treatment concentrations and the control groups.

Discussion

The preparation of white ginger simplicia in this study utilized rhizomes harvested from Pandeglang, Banten Province, Indonesia. The white ginger rhizomes, aged 9-10 months, were washed, thinly sliced, and carefully dried to obtain simplicia. As shown in Table 1, from 4,000 grams of fresh white ginger rhizomes, 1,500 grams of dried rhizomes were obtained, which, after being ground into powder, yielded 1,200 grams of dried ginger powder. The drying process was conducted with caution to protect the active compounds from damage caused by direct sunlight. The powdered simplicia was then extracted using maceration with 96% ethanol. From 1,000 grams of dried white ginger powder, 55.23 grams of a concentrated extract was obtained, with a yield of 5.523%, as indicated in Table 2. Similar extraction methods have been applied to other Zingiberaceae plants, such as *Boesenbergia rotunda*, which resulted in a higher extract yield of 9.0-11.5% (Mutripah & Badriyah, 2024; Saah et al., 2021), and *Z. officinale var. rubrum* (red ginger), which produced an extract yield of 9.52-12.91% (Cahyanto, 2022; Srikandi et al., 2020). The extraction process's effectiveness is determined by several key factors, including solvent type, solvent-to-material ratio, particle size, temperature, duration, and extraction method. Employing heating techniques like reflux can enhance extract yield by breaking down cell walls and increasing molecular movement, which improves solute-solvent interaction. Various processing techniques, especially drying methods, are crucial in influencing the chemical composition and bioactivity of the final extracts. The choice of solvent, including its polarity and boiling point, is vital for optimizing the bioactive profile, while the solvent-to-solid ratio significantly affects extraction efficiency and yield. Overall, a thorough understanding and strategic manipulation of these elements are essential for successfully obtaining bioactive enriched extracts (Pawarti et al., 2023; Ramesh et al., 2024).

Phytochemical screening, as shown in Table 3, revealed that the white ginger rhizome extract (*Z. officinale Rosc. var. officinarum*) contains various active compounds with potential pharmacological effects, including alkaloids, flavonoids, tannins, saponins, and terpenoids. Each of these compounds contributes to the biological activities of white ginger rhizome. A study on the phytochemical content of white ginger leaves revealed the presence of alkaloids, flavonoids, tannins, saponins, and steroids, differing from the compounds found in the rhizomes. These differences arise from the distinct roles of each plant part in growth and metabolism, with rhizomes acting as storage organs for secondary metabolites like terpenoids, crucial for defense and survival, while leaves focus on photosynthesis and produce compounds like steroids to combat environmental stress. Additionally, ginger's rhizomes, leaves, and flowers have been found to contain phenolic compounds, flavonoids, and flavonols, highlighting the diverse phytochemical profile across different plant parts (Munadi & Arifin, 2022; Tanweer et al., 2020).

Alkaloids detected in the white ginger extract were identified by a reddish to light brown precipitate in the Dragendorff reagent test, indicating the formation of potassium-alkaloid complexes. Alkaloids are known for their various biological activities, including aphrodisiac effects, through mechanisms that involve interaction with the central nervous system, leading to the release of neurotransmitters such as dopamine and serotonin. The increase in these neurotransmitters can stimulate the sexual centers in the brain, thereby enhancing sexual arousal and mating behavior in rats. Moreover, alkaloids possess vasodilatory effects, which improve blood flow to the genital organs, supporting better erections and sexual response (Babalola et al., 2024; Owaba et al., 2021).

Flavonoids, which can be identified by a color change to red or purple upon the addition of magnesium and hydrochloric acid, serve as potent antioxidants and may enhance levels of sexual hormones, including testosterone. They are believed to stimulate dopamine secretion by interacting with the hypothalamic region and medial amygdala, which contributes to improved sexual behavior in male rats. Additionally, the chemical structure of flavonoids, resembling cholesterol and other steroids, is vital for supporting testicular function, steroidogenesis, and androgen production in Leydig cells while also activating androgen receptors in Sertoli cells. Therefore, flavonoids present in white ginger rhizome may play a significant role in enhancing spermatogenesis, sperm quality, and overall sexual behavior (Alahmadi, 2020; Laoung-On et al., 2021).

Tannins are phenolic compounds known for their antioxidant properties, functioning as free radical scavengers and exhibiting astringent characteristics that can aid in treating conditions like hemorrhoids, commonly linked to sexual dysfunction. When reacting with $FeCl_3$, they produce a greenish-black color and are classified as polyphenolic compounds that can interact with proteins, influencing various biological processes. Beyond their antioxidant capabilities and ability to inhibit tumor growth, tannins also block the activity of specific enzymes, including reverse transcriptase and DNA topoisomerase. Additionally, they stimulate the growth and division of Leydig cells, resulting in a higher count of these cells within the testicular interstitial tissue, which is vital for testosterone production. By increasing testosterone levels, tannins may enhance sexual behavior and performance, highlighting their effect on Leydig cells as a crucial aspect of their potential as aphrodisiacs (Ismalia et al., 2021; Togola et al., 2020).

Saponins, recognized by their ability to produce stable foam that lasts for at least 10 minutes after shaking, have soap-like properties that reduce liquid surface tension. These compounds are known not only for their foaming ability but also for their potential to synthesize steroid hormones essential for libido and sexual function. Research shows that saponins can increase the frequency of mounting and intromission in rats, decrease the time needed to initiate these behaviors, and shorten the interval after ejaculation. They also boost intracavernosal pressure, which is vital for achieving and maintaining erections. By enhancing these aspects of sexual performance and responsiveness, saponins may serve as effective aphrodisiacs that improve overall sexual function (Jurbe et al., 2021; Van et al., 2024).

Certain terpenoids, such as linalool and limonene, can significantly impact neurotransmitter activity, potentially improving mood, increasing mental arousal, and enhancing sexual pleasure. These compounds are recognized for their ability to boost libido and sexual drive, highlighting their role as possible aphrodisiacs. By influencing neurotransmitter functions, terpenoids contribute to both the psychological and physiological dimensions of sexual performance, leading to an overall enhancement in sexual desire and satisfaction. Additionally, terpenoids act as fitoandrogens, stimulating androgen receptor expression and enhancing testicular function, particularly in terms of sperm production (Chaimontri et al., 2021; Dikwa et al., 2023).

Observations on the aphrodisiac effects of the ethanol extract of white ginger on rats showed that the group given the 50% concentration of ginger extract had the highest frequency of introduction and climbing behaviors (Tables 4 and 5). This suggests that this concentration was more effective in enhancing sexual activity compared to the 25% concentration or the negative control. Furthermore, in the coitus parameter (mating), although the group given sildenafil solution showed the highest results, the group given the 50% ginger extract still exhibited significant activity (Tables 6 and 7). These results are consistent with other studies in the Zingiberaceae family, such as those on *Panax ginseng*, where the antioxidant nitric oxide (NO) produced by endothelial cells, particularly in the perivascular neurons of the corpus cavernosum, is believed to enhance its aphrodisiac effects. Additionally, the combination of *Z. officinale* and *Chrysophyllum albidum* extracts, rich in bioactive compounds with antioxidant properties, is likely responsible for improving semen quality and boosting fertility by increasing sperm count, quality, and serum testosterone levels. Furthermore, the oral administration of methanolic extract (100 or 200 mg/kg BW) or aqueous extract (150 mg and 300 mg/kg BW) for 65 consecutive days was shown to significantly enhance sperm motility, sperm count, sexual serum testosterone levels, and fertility index in male rats with alloxan-induced diabetes (Benjamin et al., 2020; Nagansurkar et al., 2023).

This research on the aphrodisiac properties of white ginger significantly contributes to herbal medicine and sexual health by scientifically validating its traditional use as an aphrodisiac. The study identifies key active compounds, such as alkaloids, flavonoids, tannins, saponins, and terpenoids, elucidating their potential impact on sexual behavior and reproductive health. These findings enhance our understanding of white ginger's pharmacological properties and lay the groundwork for developing safe, natural alternatives for treating sexual dysfunction, catering to the rising demand for herbal remedies with fewer side effects compared to synthetic options.

Despite these contributions, the research has notable limitations, primarily relying on male Wistar rats as models, which may not fully represent human responses. Additionally, focusing on a specific concentration of ginger extract leaves gaps in understanding the dose-response relationship. Future research should include clinical trials with human participants to validate the safety and effectiveness of white ginger extracts as aphrodisiacs. Exploring a wider range of concentrations and extraction methods, as well as the long-term effects and interactions with other herbal compounds, could provide essential insights for developing combination therapies for sexual dysfunction, reinforcing the therapeutic applications of white ginger in promoting sexual health.

4. CONCLUSION

The research indicates that the ethanol extract of white ginger rhizome (*Z. officinale* Rosc. *var. officinarum*) demonstrates considerable aphrodisiac potential in male Wistar rats, particularly at a concentration of 50%, which improves sexual behavior. Important compounds such as alkaloids and flavonoids increase testosterone levels and enhance blood circulation. Future studies should focus on clinical trials to verify the safety and effectiveness in humans, while also investigating optimal dosages and possible combinations with other natural ingredients to further promote sexual health.

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