ANTIHISTAMINE POTENTIAL OF *Cassia fistula* L. (GOLDEN SHOWER) LEAVES BASED ON CLONIDINE-INDUCED CATALEPSY AND ITS FORMULATION AS A SYRUP

Christian Kurt R. Alindada, Andrei Jhasper D. Cortez, Rhina Ezra T. Uchayan
Christopher M. Fianitog, Zohra Fatima B. Zafar, Cathelyn C. Mariano, LPT, MA

Bachelor of Science in Pharmacy

ABSTRACT

Cassia fistula (golden shower) has long been valued for its pharmacological properties, yet its antihistaminic potential remains largely unexplored. With growing concerns about the side effects of synthetic antihistamines, natural alternatives are increasingly sought. This study aimed to evaluate the prophylactic antihistaminic potential of *C. fistula* leaf extract and develop an herbal syrup using the most effective dose. A descriptive-experimental design was employed using Swiss albino mice. Catalepsy was induced using a prophylactic clonidine model, and antihistaminic potential was assessed through muscular rigidity and postural fixity tests at doses of 100, 200, and 300 mg/kg. Results revealed that the 200 mg/kg dose demonstrated the greatest reduction in cataleptic values, with no signs of toxicity or mortality during a 14-day safety observation. Since *C. fistula* is non-lethal in acute oral exposure, a syrup was successfully formulated using this dose. Overall, this study supports the potential of *C. fistula* as a natural antihistamine, offering a promising alternative to synthetic drugs while advancing sustainable plant-based therapeutics and public health innovation.

Keywords: Bar test, movement observation, muscular rigidity, physical resistance test, postural fixity

INTRODUCTION

Background of the Study

Allergies are common, and many people experience reactions to things like pollen, dust, certain foods, or pet dander. Symptoms can include sneezing, itching, skin rashes, or breathing problems, depending on the trigger. While some allergies are mild, others can be more serious and require medical attention or ongoing management. For this reason, antihistamines are an essential part of allergy treatment, as they help control symptoms and prevent potentially severe reactions, such as anaphylaxis. Antihistamines work by blocking histamine receptors, providing rapid relief and stopping symptoms from getting worse. Without timely treatment, allergic reactions can significantly affect a person's health and quality of life, highlighting the need for accessible and effective antihistamine options.

The World Health Organization (2024) reports that around 220 million people worldwide are affected by food allergies, and this number continues to rise, highlighting the increasing importance of allergic diseases as a public health concern. According to the Global Allergy and Airways Patient Platform (2024), allergic conditions like asthma and allergic rhinitis affect 30–40% of the population, placing significant strain on healthcare systems and reducing quality of life. Davidson *et al.* (2019) note that histamine-induced allergic reactions are a global health challenge, contributing to various conditions, including allergic rhinitis, asthma, and atopic dermatitis. The situation in the Philippines shows how environmental exposures and genetic predispositions interact in the development of allergy. Navarro-Locsin and Lim-Jurado (2018) identified common allergens like dust mites and Bermuda grass, with many allergic rhinitis patients showing sensitivity to both indoor and outdoor triggers, often alongside asthma or urticaria. Similarly, Punay *et al.* (2024) reported high rates of allergic rhinitis, atopic

dermatitis, and asthma, linking these conditions to allergens such as *Zea mays* (corn) and *Mangifera indica* (mango). Their community-based study found that 38.24% of participants reported symptoms of allergic rhinitis, 32.70% had atopic dermatitis, and 30.02% experienced allergic asthma.

There are several plants known for their antihistamine properties, and another promising candidate for biological sourcing of antihistamine drugs is *Cassia fistula*. Aiubi *et al.* (2015) determined that preliminary studies have suggested that some bioactive compounds present in plant species, such as flavonoids and alkaloids, could act as natural antihistamines, presenting a potential pathway for further investigation into *C. fistula.* In addition to its anti-inflammatory properties, Mishra *et al.* (2024) disclose that *C. fistula* is recognized for numerous medicinal benefits, including liver protection, antifungal, antioxidant, and antibacterial qualities. It has also been used traditionally to treat many diseases, both internal and external, and is known for harmonizing the body's *doshas* in Ayurvedic medicine. With the plant's rich phytochemistry—including flavonoids, acids, anthraquinones, and glycosides—there is growing evidence supporting further research into its potential as a natural antihistamine agent.

Despite extensive studies on *Cassia fistula*'s pharmacological properties, its antihistamine potential remains underexplored, especially for the treatment of allergic reactions and the development of a patient-friendly syrup. Synthetic antihistamines offer predictable relief, but *C. fistula* may provide a natural alternative with fewer side effects, as noted by Mwangi *et al.* (2021). Lastly, promoting its use encourages sustainable harvesting, integrates traditional knowledge into modern medicine, and offers benefits for both the environment and local communities.

Although *C. fistula* is well studied for its pharmacological properties, its antihistamine potential remains largely unexplored, particularly for allergy treatment. The formulation of antihistamine syrup could serve as a natural alternative to synthetic antihistamines while also promoting sustainable practices and benefiting both the environment and local communities. This research supports Sustainable Development Goals (SDGs) such as SDG 3—Good Health and Well-Being—by exploring natural antihistamine alternatives; it may potentially provide an effective and safer herbal option for managing allergic reactions or histamine-related conditions; and SDG 9—Industry, Innovation, and Infrastructure—by fostering innovation within the healthcare industry through the development of a herbal syrup formulation, potentially leading to new products in the pharmaceutical field. Overall, this research not only aims to uncover the health benefits of golden shower leaves but also contributes to a broader framework of goals related to health, sustainability, and innovation, promoting a holistic approach to well-being that leverages natural resources.

Statement of the Objectives

This study aimed to determine the antihistaminic potential of *Cassia fistula* leaves and its formulation as a syrup. It was conducted from January to May 2025. Specifically, it aimed to:

1. To assess the antihistaminic potential of *C. fistula* in terms of:
    a. Optimal dose
        a.1. 100 mg/kg
        a.2. 200 mg/kg
        a.3. 300 mg/kg

    b. Cataleptic Values:
        b.1. Muscular Rigidity via Physical Resistance Test and Movement Observation.
        b.2. Postural Fixity via Bar Test at 15, 30, 60, 90, 120, 150, and 180 minutes.

2. To formulate an antihistamine syrup utilizing the optimal dose and cataleptic values.

METHODOLOGY

Research Design

The study employed a combined descriptive and experimental research design to evaluate the antihistaminic potential of *C. fistula*. The experimental component was essential for assessing the dose-dependent effects of the crude extract administered at 100 mg/kg, 200 mg/kg, and 300 mg/kg, using established laboratory methods to measure cataleptic responses. The inclusion of a positive control group treated with chlorpheniramine maleate at 10 mg/kg provided a benchmark for expected antihistaminic effects. Meanwhile, the negative control group receiving distilled water at 10 mL/kg established a baseline to distinguish the extract's effects from natural or placebo responses. The descriptive aspect of the study complemented this by characterizing the optimal dose of *C. fistula* extract based on its ability to prevent or reduce cataleptic values, thereby offering detailed insight into its potential as a prophylactic antihistamine.

Study Site and Sample Collection

The study was conducted at Saint Mary's University (SMU), Bayombong, Nueva Vizcaya. The plant specimen, *C. fistula*, was collected around the campus, specifically at UB Park, JVD Park, and along the senior high school. The extraction process and the determination of the Approximate Lethal Dose (ALD) were carried out at the Center for Natural Sciences (CNS) laboratory. At the same time, the catalepsy assay took place in the pharmacy laboratory. The Swiss albino mice were sourced from C&A Pet Shop and Veterinary Services, a registered veterinary medical clinic located at Don Domingo Maddela, Bayombong, Nueva Vizcaya, and housed at the CNS animal facility.

Plant Identification

The *C. fistula* plant was submitted to the College of Forestry at Nueva Vizcaya State University (NVSU), Bayombong, Nueva Vizcaya, for botanical certification, which confirmed it as *C. fistula*.

Animal Identification

The Swiss albino mice were procured from C&A Pet Shop and Veterinary Services, a registered veterinary medical clinic, located at Don Domingo Maddela, Bayombong, Nueva Vizcaya. They could be contacted at 0917-892-5235. The animals' certification was conducted with the assistance of Dr. Cyrus C. Sipol, a registered veterinarian at the same clinic.

Swiss albino mice (*Mus musculus*), a common rodent model, were used in this study for their genetic uniformity, white fur, and well-documented sensitivity in behavioral and pharmacological research, particularly to catalepsy. Their established drug responses ensured a reliable assessment of movement and behavior, improving reproducibility. Widely used in immunological and pharmacological studies, they were also suitable for evaluating immunomodulatory effects, as highlighted in the Journal of Research in Ayurveda (2024) and the Journal of Ayurveda and Integrative Medicine (2024).

Data Gathering Procedure

Collection and Preparation of C. fistula Leaves

Five kilograms of healthy and fresh leaves were collected from the *C. fistula* tree. The leaves were thoroughly washed under tap water and wiped with a clean cloth to ensure cleanliness. After cleaning, the leaves were oven-dried at 50-55°C, a temperature range considered effective for preserving the plant's nutritional and phytochemical content, as reported by Abdul Razak *et al.* (2016). Once dried, the leaves were pulverized using a blender, and the resulting powder was sifted through a number 60 sieve to obtain particles of uniform size.

Extraction Process

Leaf extraction was performed by maceration, in which the powdered plant material was soaked in ethanol for at least 3 days. Following the soaking period, the mixture was filtered using filter paper to separate the liquid extract. The resulting filtrate was then concentrated by evaporating the solvent in a water bath.

Administration of Treatments

Various doses of the paste-like *Cassia fistula* extract were prepared by accurately measuring 100 mg, 200 mg, and 300 mg of the extract, each dissolved in 5 mL of distilled water to create stock solutions used for administering doses of 100 mg/kg, 200 mg/kg, and 300 mg/kg, respectively.

A stock solution for the positive control, chlorpheniramine maleate, was also prepared. Nine 4 mg tablets were dissolved in 20 mL of normal saline solution to achieve a concentration of 10 mg/kg. Similarly, a clonidine stock solution was prepared by dissolving twenty-one 150 mcg tablets in 20 mL of normal saline solution to obtain a concentration of 1 mg/kg.

Following the methodologies of Nirmal *et al.* (2011) and Dinesh Kumar *et al.* (2011), Swiss albino mice were selected for the study. The animals were divided into five groups, each consisting of three mice. The first group received 10 mg/kg chlorpheniramine maleate intraperitoneally as the positive control. The second group received 10 mL/kg of distilled water orally as the negative control. The third, fourth, and fifth groups received 100 mg/kg, 200 mg/kg, and 300 mg/kg of *C. fistula* leaf extract, respectively, administered orally.

Administration of Clonidine

Clonidine was administered subcutaneously at a dose of 1 mg/kg one hour after the treatments, following the protocols of Nirmal *et al.* (2011) and Dinesh Kumar *et al.* (2011). Clonidine, an adrenergic agonist, induces catalepsy by promoting histamine release from mast cells, resulting in an immobilized state marked by muscular rigidity and prolonged postural fixity due to impaired voluntary motor control. Importantly, the extract was given before the induction of catalepsy to assess whether it could prevent or reduce the severity of clonidine-induced symptoms. In the absence of clonidine, mice exhibited normal responses in the Physical Resistance Test (PRT), Movement Observation (MO), and Bar Test. Following clonidine administration, these same tests were used to evaluate whether pre-treatment with *Cassia fistula* reduced the onset or intensity of cataleptic signs. Reductions in immobility and improved voluntary movement indicated a potential prophylactic antihistaminic effect of the extract.

Catalepsy Measurement for Selecting the Optimal Dose

The study evaluated the effects of *Cassia fistula* leaf extract on prophylactic clonidine-induced catalepsy in mice, following the methods of Gupta et al. (2020), Sanberg et al. (1988), and Klockgether et al. (1985). Baseline measurements of muscular rigidity, spontaneous movement, and postural fixity were taken before induction using the Physical Resistance Test (PRT), Movement Observation (MO), and Bar Test, respectively. These baseline values served as references for post-induction evaluation. All tests and behaviors were systematically recorded for each mouse using CCTV to ensure precise and consistent monitoring.

Treatment groups received oral doses of *C. fistula* leaf extract at 100, 200, and 300 mg/kg, while control groups received either 10 mg/kg chlorpheniramine maleate intraperitoneally (positive control) or 10 mL/kg distilled water orally (negative control). Using a prophylactic clonidine-induced catalepsy model, treatments were administered before clonidine injection to evaluate preventive effects on catalepsy onset and severity. Post-induction assessments of muscular rigidity, postural fixity, and movement were conducted at 15 to 180-minute intervals to monitor catalepsy progression.

Catalepsy severity was quantified using Gupta *et al.*'s (2020) formula:

$$Total\ value = 0.5 + [0.5 \times time\ (in\ s)\ of\ front\ right\ paw\ on\ 3\ cm\ long\ bar] + [0.5 \times time\ (in\ s)\ of\ front\ left\ paw\ on\ 3\ cm\ long\ bar] + [1 \times time\ (in\ s)\ of\ front\ righ$$

In the Bar Test, a mouse's forepaws were placed on an elevated bar, and the time taken to remove them indicated postural fixity—a sign of catalepsy. Following Gupta et al. (2020), scoring began at 0.5 (minimal catalepsy), with additional points awarded for the time the forepaws remained on 3 cm and 5 cm bars, with longer durations reflecting greater severity. As described by Sanberg et al. (1988), prolonged posture-correction times indicated greater catalepsy intensity. The *C. fistula* extract's effectiveness was assessed by tracking total catalepsy scores over time; recovery, indicated by values returning to baseline, suggested potential antihistaminic activity.

Formulation of Antihistamine Syrup

The preparation process integrated methods described in Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems (2014) and Olayemi *et al.* (2020). Initially, 51 g of sucrose was weighed, and 28 mL of distilled water was heated to a boil. The sucrose was gradually added to the boiling water while stirring continuously. Heating and stirring continued until the sucrose fully dissolved. The final volume was adjusted with distilled water to make a 60 mL simple syrup, and was allowed to cool.

For the herbal syrup, 200 mg of *Cassia fistula* leaf extract was mixed with a portion of the simple syrup, and 60 mg of Methyl paraben was then added as a preservative. The mixture was continuously stirred as the remaining simple syrup was gradually added. The solution was then filtered through gauze until a clear solution was obtained. The final syrup was then transferred to a suitable container and labeled as the finished product. All procedures conducted have been supervised by the CNS laboratory staff.

Treatment of Data

The *C. fistula* extract was administered at three different doses: 100 mg/kg, 200 mg/kg, and 300 mg/kg. Using a prophylactic clonidine-induced catalepsy model, the effects of each dose were evaluated individually to determine which most effectively reduced cataleptic symptoms. The optimal dose was identified as the one that demonstrated the most consistent reduction in cataleptic responses across all tests and time intervals.

Descriptive statistical analysis was used to evaluate cataleptic responses in mice through the Physical Resistance Test (PRT), Movement Observation (MO), and Bar Test. Muscular rigidity was assessed in PRT and MO using a binary scoring system, with normal movement scored as 1 and abnormal as 0. The mode and frequency of normal responses were analyzed to identify the dose that most consistently reduced muscular rigidity. Postural fixity in the Bar Test was assessed by calculating the mean and standard deviation of paw-holding times at 15, 30, 60, 90, 120, 150, and 180-minute intervals. Lower average times indicated better postural recovery, aiding in identifying the optimal dose.

The formulation of the antihistamine syrup included a 14-day safety observation conducted after the experiments. The absence of mortality and adverse behavioral changes during this period confirmed the extract's suitability for formulation. The final syrup was prepared using the optimal dose, identified as the one that consistently produced the highest frequency of normal responses and the lowest average paw-holding time in the respective tests.

Ethical Considerations

The study was approved by Saint Mary's University Research Ethics Board (SMUREB) for ethics review. It is located on the 2nd floor of Rev. John Van Bauwel Hall, SMU Main Campus, Ponce Street, Don Mariano Marcos, Bayombong, 3700 Nueva Vizcaya, Philippines. The contact details include the email address reb@smu.edu.ph and the cellphone number 09177053041.

RESULTS AND DISCUSSIONS

Section 1. Antihistaminic Potential of *C. fistula* in Terms of Optimal Dose and Cataleptic Values

The table presents a descriptive assessment of muscular rigidity in mice using the Physical Resistance Test (PRT) and Movement Observation (MO) over 180 minutes, evaluating the prophylactic potential of *C. fistula* against clonidine-induced catalepsy. Responses were recorded using a binary scoring system, where normal behavior was scored as 1 and abnormal behavior as 0.

Table 1

Assessment of Muscular Rigidity via Physical Resistance Test and Movement Observation

Group	Muscular Rigidity													
	15 min		30 min		60 min		90 min		120 min		150 min		180 min	
	PRT	MO	PRT	MO	PRT	MO	PRT	MO	PRT	MO	PRT	MO	PRT	MO
Positive control	1	1	1	1	0	0	0	0	0	0	1	0	1	1
Negative control	1	1	0	0	0	0	0	0	0	0	0	0	0	0
100 mg/kg	1	1	0	0	0	0	0	0	0	0	0	0	0	0
200 mg/kg	1	1	1	1	1	1	0	1	1	1	1	1	1	1
300 mg/kg	1	1	1	1	0	0	0	0	0	0	0	0	0	0

Legend: Positive Control (Chlorpheniramine maleate) - 10 mg/kg;
Negative Control (Distilled water) - 10 mL/kg

Results showed that the 200 mg/kg dose demonstrated the most potential preventive action, maintaining normal muscular tone and movement in six of the seven time intervals. Only at 90 minutes did mice exhibit resistance (PRT=0), though spontaneous movement remained

normal (MO=1). This dose potentially prevented histamine release, preserving normal functions throughout most of the observation period. The 100 mg/kg dose exhibited moderate resistance and progressive movement impairment from 30 minutes onward, failing to sustain prophylaxis beyond the initial 15 minutes. The 300 mg/kg dose showed early efficacy but developed strong resistance and reduced movement. The positive control (chlorpheniramine 10 mg/kg) exhibited initial protection but inconsistent rigidity reduction at mid-intervals. The negative control (distilled water) confirmed clonidine's histaminic effects, with progressive rigidity and immobility continuing after 15 minutes.

According to Klockgether *et al.* (1985), normal mouse movement involves fluid walking and grooming. Any deviation from these behaviors, such as stiffness or immobility, was classified as abnormal. The frequent normal PRT and MO scores at the 200 mg/kg dose align with this observation, indicating potential prophylactic potential against histamine-induced effects.

These findings indicate that the 200 mg/kg dose demonstrates potential prophylactic antihistaminic effects. The use of mode helped identify which dose consistently reduced muscular rigidity. This positions *C. fistula* as a potential natural alternative for preventive allergy management.

Table 2

Assessment of Mean and Standard Deviation of Postural Fixity Scores via the Bar Test

Time Interval (Minutes)	Postural Fixity (Bar Test) $\bar{x}$ ± SD				
	Positive control	Negative control	100 mg/kg	200 mg/kg	300 mg/kg
15	2±0	2.5±0.87	2±0	3.17±1.15	3±0.87
30	3.92±2.45	72.17±57.27	155±202.4	2.33±0.29	4±1.32
60	20±14.24	99.5±119.53	151±151.82	37.67±60.005	80.83±37.17
90	12.83±7.75	302.5±437.37	217.33±270.9	2±0	119.83±41.93
120	15.17±1.15	113.5±26.23	87±105.09	34.17±55.71	329.17±321.89
150	9.5±5.29	181.67±138.26	132.33±120.79	28.5±63.22	398.17±430.48
180	11±4.92	250.5±223.3	136±116.83	29.17±47.05	172.5±24.98

Legend: $\bar{x}$ ± SD (mean ± standard deviation)

The table presents the mean ($\bar{x}$) ± standard deviation (SD) of postural fixity scores for each treatment group at 15, 30, 60, 90, 120, 150, and 180 minutes. The mean was used for the *average time the* mice held an unnatural posture across the three replicates, and the standard deviation was used to measure variability in individual mice's responses around the mean. Based on the results, the 200 mg/kg dose showed a notable reduction in postural fixity, with scores decreasing to 2.00 ± 0 at 90 minutes and 34.17 ± 59.18 at 120 minutes. The 100 mg/kg dose had higher scores of 217.33 ± 270.90 at 90 minutes and 87.00 ± 143.04 at 120 minutes. The 300 mg/kg dose recorded 119.83 ± 150.62 at 90 minutes and increased to 329.17 ± 321.89 at 120 minutes. The Positive Control (chlorpheniramine maleate 10 mg/kg) maintained low fixity scores throughout, with values of 2.00 ± 0.00 at 15 minutes and 20.00 ± 14.24 at 60 minutes. Meanwhile, the Negative Control (distilled water 10 mL/kg) exhibited elevated fixity scores, including 302.50 ± 437.37 at 90 minutes.

The Bar Test assessed the antihistaminic potential of *Cassia fistula* by measuring the time mice took to remove their forepaws from an elevated bar, with prolonged holding indicating postural fixity, a hallmark of catalepsy. According to the formula by Gupta *et al.* (2020), a score of 2.0 indicated a normal response in mice, who immediately removed their forepaws during the Bar Test. Higher points were assigned based on the duration the mouse held onto 3 cm and 5 cm bars, with longer times on the 5 cm bar indicating more severe

cataleptic states. Sanberg *et al.* (1988) further emphasized that delayed posture correction indicates greater cataleptic intensity. Shorter test durations reflected reduced postural fixity, suggesting potential histamine inhibition and the extract's ability to reduce prophylactic clonidine-induced catalepsy. The extract's effectiveness was evaluated by tracking catalepsy values over time across treatment and control groups, with recovery indicated by values returning to or nearing pre-induction levels, supporting the antihistaminic potential of *C. fistula* leaf extract.

These findings indicate that the 200 mg/kg dose demonstrates potential prophylactic antihistaminic effects. The use of measuring the mean and standard deviations helped identify which dose consistently reduced postural fixity. This suggests that C. fistula may be a natural option for preventing allergies.

Section 2. Formulation of Antihistamine Syrup Utilizing the Optimal Dose and Cataleptic Values

The formulation of the *C. fistula* antihistamine syrup was based on the optimal dose, determined to be 200 mg/kg, as this dose consistently showed the highest frequency of normal responses and the lowest average paw-holding times in the respective tests. This dose was selected for syrup preparation.

As part of the preliminary safety evaluation, a 14-day observation period for doses and controls was conducted under continuous CCTV surveillance, during which no deaths were recorded, resulting in no mortality and supporting the extract's suitability for an antihistamine syrup formulation. Toxicity signs such as tremors, convulsions, salivation, diarrhea, lethargy, and coma were monitored following Ishido's (2022) method, alongside behavioral responses including drowsiness, hyperactivity, exaggerated grooming, exploratory activity, and polydipsia (excessive drinking potentially linked to antihistaminic effects). Observations were carried out as outlined by Smith *et al.* (2016), within the first 30 minutes post-administration, periodically over 24 hours (with special attention during the first four hours), and daily for 14 days. According to Kumar *et al.* (2022), the absence of mortality at the highest dose indicates low acute oral toxicity.

Figure 1

Formulated Herbal Antihistamine Syrup Derived from C. fistula Leaves

In preparing the simple syrup, 51 g of sucrose was added to 28 mL of distilled water while heating and stirring continuously. The final volume was adjusted with distilled water to make a 60 mL syrup. After preparation, the syrup was allowed to cool before use. For the herbal syrup, 200 mg of *Cassia fistula* leaf extract was mixed with a portion of the simple syrup, and 60 mg of methylparaben was then added as a preservative. The mixture was continuously stirred as

the remaining simple syrup was gradually added. The solution was then filtered through gauze until a clear solution was obtained. The final syrup was then transferred to a suitable container and labeled as the finished product.

The formulated herbal antihistamine syrup from *C. fistula* had a sweet taste, attributed to its sugar content, and a distinct leafy, herbal aroma.

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

This study evaluated the antihistaminic potential of *Cassia fistula* leaves using a prophylactic clonidine-induced catalepsy model and formulated the extract into an herbal syrup. Results revealed that the 200 mg/kg dose consistently produced the greatest reduction in muscular rigidity and postural fixity in mice, identifying it as the optimal dose. For the formulation, an herbal antihistamine syrup was successfully developed using a 200 mg dose. It was selected based on both toxicity assessments: no mortality or signs of acute toxicity at any tested dose, and cataleptic values that demonstrated its potential. Overall, the study supports the potential of *C. fistula* as a safe and effective natural antihistamine, warranting further pharmacological and clinical evaluation for therapeutic use. These findings also suggest that *C. fistula* extract can be safely formulated into an antihistamine syrup, provided that additional studies on long-term toxicity, dosage optimization, and clinical efficacy are conducted to ensure its safety for human consumption.

Recommendations

1. Further pharmacological and long-term toxicity studies should be conducted to assess the long-term effects, drug interactions, and mechanism of action of *Cassia fistula*.
2. Dosage form alternatives, such as capsules or tablets, should be explored to provide more options for administration.
3. Stability and shelf-life testing should be conducted to determine storage conditions and product longevity.

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