

Pharmacological and Therapeutic Potential of *Centratherum anthelminticum*: a Comprehensive Review

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ABSTRACT

Centratherum anthelminticum [L] Kuntze, another name for *Vernonia anthelmintica* [L] Wild, is a plant species. An annual herb grows in the Asteraceae family. It is native to tropical and subtropical areas like India, Pakistan, Sri Lanka, and parts of Southeast Asia and Africa. The plant has been widely used in ancient healing practices like Ayurveda, Unani, and folk remedies due to its abilities to fight worms, control blood sugar, reduce inflammation, prevent infections, and treat skin conditions. Phytochemical studies revealed more than 193 substances, primarily consisting of sterols, terpenes such as sesquiterpene lactones, flavonoids including quercetin and kaempferol, phenolic acids like caffeic and ferulic acids, fatty acids like linoleic and oleic acids, and various other components. Preclinical research demonstrates numerous pharmacological properties, like antioxidants, diabetes control, infection prevention, inflammation reduction, cancer suppression, filarial treatment, liver health support, brain protection, and asthma relief, usually through crucial biological mechanisms for defense and inhibition for immune regulation. Recent studies show that this treatment helps people with PCOS, kidney problems, like diabetes infection, and some types of cancer by making cells die more quickly and causing damage to their energy centers. Despite initial positive results from laboratory tests, animal studies, and early clinical trials, there is still very little evidence of how well it works in humans, so more research needs to be done to understand if it can help people feel better or work alongside other medicines. Combining old ideas with new science to help find new medicines in the future.

Key words: *Centratherum anthelminticum* phytoconstituents, pharmacological activity, therapeutic potential, traditional medicines

I. INTRODUCTION

The global health landscape is increasingly challenged by the rising prevalence of chronic diseases, the emergence of antimicrobial

resistance, and the adverse reactions associated with long-term use of synthetic drugs [1]. These limitations of conventional therapeutics have intensified the scientific community's focus on natural remedies, particularly medicinal plants, which have historically served as the foundation of traditional medical systems and continue to provide leads for novel drug discovery [3]. Among these botanicals, *Centratherum anthelminticum* (L.) Kuntze—popularly known as **kalijiri** or **bitter cumin**—has gained prominence due to its broad spectrum of traditional and pharmacological applications. Belonging to the family **Asteraceae**, this herb is widely distributed across tropical and subtropical regions, including India, Pakistan, Nepal, Bangladesh, Sri Lanka, and parts of Africa [4].

Historically, *C. anthelminticum* holds a revered position in **Ayurveda**, **Unani**, **Siddha**, and **folk medicine**. Ancient Ayurvedic texts such as *Charaka Samhita* and *Sushruta Samhita* describe the plant under the name *Somaraji*, highlighting its use in the treatment of intestinal worm infestations, skin depigmentation disorders such as vitiligo, metabolic disorders like diabetes, and respiratory ailments including asthma [5][6]. In **Unani medicine**, it has been employed as a diuretic, digestive stimulant, blood purifier, and remedy for chronic fevers [7]. Folk traditions across rural South Asia utilize its seeds and oil for the management of liver disorders, wound healing, infectious diseases, and inflammatory conditions [8]. Its relevance extends beyond human health, with veterinary applications reported in the management of mastitis, parasitic infestations, and other livestock diseases [9][10].

Scientific investigations initiated in the early 20th century have progressively validated these ethnomedicinal claims. Preliminary phytochemical analyses revealed the presence of a diverse range of secondary metabolites, including **alkaloids**, **flavonoids**, **terpenoids**, **steroids**, **glycosides**, **phenolics**, and **essential oils**, many of which contribute to its therapeutic versatility.

[11][12]comprehensive studies by Paydar et al. (2013) reported more than 120 bioactive molecules with significant antidiabetic, antimicrobial, antioxidant, and anticancer activities[1] Further, a systematic review by Dogra et al. (2020) documented approximately 193 compounds and highlighted its unique role in the treatment of **vitiligo**, a condition of immense dermatological and psychological significance [2]

Recent pharmacological studies (2020–2025) have broadened the plant's therapeutic horizon, demonstrating promising outcomes in managing **polycystic ovarian syndrome (PCOS), diabetic complications, wound healing, metabolic syndrome, microbial infections, and veterinary health disorders** .[13][14] Notably, preclinical findings suggest that the plant's bioactive compounds may regulate glucose metabolism, modulate immune responses, and exert cytoprotective effects, making it a valuable candidate for drug development in both human and veterinary medicine.[15].

Modern Scientific Studies

Despite being widely used in traditional medicine to treat a variety of illnesses, *Centratherrum anthelminticum* needs further scientific study to confirm its therapeutic benefits[16]. Clinical data is scarce, particularly when it comes to treating obesity. Thus, current research endeavours to create a pharmacological foundation for Composition and Mechanism of Action of phytochemicals [17]

The complex phytochemical makeup of *Centratherrum anthelminticum*, which consists of flavonoids, alkaloids, glycosides, tannins, and saponins, is thought to be responsible for its therapeutic qualities. These bioactive substances support its anti-inflammatory, antibacterial, and antioxidant properties.[18]

- **Flavonoids & Antioxidants:** Help neutralize free radicals, reducing oxidative stress and cellular damage.
- **Alkaloids:** Exhibit antimicrobial and anthelmintic (anti-parasitic) properties.
- **Tannins & Saponins:** Support gut health and improve digestion by promoting enzyme activity.

According to research, *Centratherrum anthelminticum* affects lipid metabolism, which lowers fat storage and improves energy use. As a result, it is a topic of interest for managing

metabolic diseases and obesity. [19] *Centratherrum anthelminticum* (L.) Kuntze, commonly called kalijiri or bitter cumin, is a widely used medicinal herb in traditional systems like Ayurveda, Unani, and folk medicine. Its therapeutic efficacy is attributed to a wide range of bioactive phytochemicals present in seeds, oil, and extracts. These compounds are responsible for the plant's antioxidant, anti-inflammatory, antimicrobial, anthelmintic, and metabolic regulatory activities.

Major Phytochemical Classes

1. Flavonoids:

- Flavonoids are polyphenolic compounds with strong antioxidant activity.
- They neutralize free radicals, reduce oxidative stress, and protect cellular components from damage.
- Flavonoids also modulate inflammatory pathways by controlling cytokine release [20]

2. Alkaloids:

- Alkaloids exhibit antimicrobial and anti-parasitic activity, helping to control bacterial, fungal, and intestinal worm infections.
- They also contribute to analgesic and anti-inflammatory properties [21]

3. Tannins and Saponins:

- Tannins improve gut health and digestion through enzyme modulation.
- Saponins demonstrate anti-inflammatory, cholesterol-lowering, and immunomodulatory effects.
- Together, they support gastrointestinal function and reduce oxidative damage [22]

4. Steroids and Terpenoids:

- Steroids and terpenoids are involved in metabolic regulation, lipid metabolism, and immune modulation.
- Terpenoids also help in reducing fat accumulation and improving energy utilization [23]

5. Other Phenolics and Glycosides:

- These compounds enhance antioxidant activity and contribute to hepatoprotective, cardioprotective, and antidiabetic effects [23][24].

Mechanism of action related to metabolic disorders of obesity

Research indicates that *C. anthelminticum* extracts can influence lipid and glucose metabolism by:

- Reducing triglyceride and cholesterol levels.
- Modulating insulin sensitivity and glucose homeostasis.
- Enhancing energy utilization and preventing excessive fat accumulation [24].

Bioactive compounds such as flavonoids and saponins reduce oxidative stress and inflammation, which are critical contributors to obesity and metabolic syndrome. These properties make *C. anthelminticum* a potential candidate for complementary therapies for obesity, diabetes, and associated complications [22].

Table: Major Phytochemicals of *Centratherrum anthelminticum* and Their Pharmacological Actions

Phytochemical Class	Major Compounds	Pharmacological Actions	Reference
Flavonoids & Phenolics	Quercetin, Kaempferol, Luteolin	Antioxidant, Anti-inflammatory, Cytoprotective	[20]
Alkaloids	Centratherrine, Other alkaloids	Antimicrobial, Anthelmintic, Analgesic	[21]
Tannins	Gallic acid derivatives	Gut health, Astringent, Antioxidant	[22]
Saponins	Steroidal saponins	Anti-inflammatory, Immunomodulatory, Lipid-lowering	[22]
Steroids & Terpenoids	Phytosterols, Monoterpenes	Metabolic regulation, Anti-inflammatory, Lipid metabolism	[23]
Glycosides	Cardiac glycosides, Other glycosides	Antidiabetic, Hepatoprotective, Cardioprotective	[23][24]

Bioactive compound

Centratherrum anthelminticum (Family: Asteraceae), commonly known as **kalijiri** or **bitter cumin**, is a medicinal plant with multiple pharmacological properties[25]. Its therapeutic potential is attributed to several bioactive compounds present in seeds, roots, and aerial parts. These compounds exhibit antioxidant, anti-inflammatory, antimicrobial, antidiabetic, and hepatoprotective activities[26]

Major Bioactive Compounds

C. anthelminticum's seeds and other components include numerous chemical elements, mainly alkaloids, flavonoids, terpenoids, steroids, phenolic compounds, and essential oils. These substances are accountable for their medicinal functions [27][28].

Sr. No.	Bioactive Compound	Class	Source Part	Reported Pharmacological Activity	Reference
1	Vernodalinal	Sesquiterpene lactone	Seeds	Anti-inflammatory, anticancer	[25]
2	Vernodalinalol	Sesquiterpene lactone	Seeds	Cytotoxic, antioxidant	[26]
3	Centratherrin	Terpenoid	Seeds	Antihelminthic, antidiabetic	[26]
4	Flavonoids (Apigenin, Luteolin)	Flavonoids	Seeds, aerial parts	Antioxidant, anti-inflammatory	[27]
5	β -Sitosterol	Steroid	Seeds	Antidiabetic, lipid-lowering	[28]
6	Linoleic acid	Fatty acid	Seeds	Anti-inflammatory, cardioprotective	[29]
7	Palmitic acid	Fatty acid	Seeds	Antimicrobial	[30]
8	Phenolic acids	Phenolic compounds	Seeds, roots	Antioxidant, hepatoprotective	[30][31]
9	Essential oils (α -pinene, limonene)	Terpenoid	Seeds	Antimicrobial, anti-inflammatory	[32][33]
10	Alkaloids (Undetermined)	Alkaloids	Seeds	Analgesic, antimicrobial	[33]

Safety and Toxicity Profile

The *Centraterum anthelminticum* seeds have been evaluated for intense, sub-tears and chronic poisoning in various animal models. Studies indicate that seeds are usually safe at medical doses, which have no significant adverse effects.[34] The study of acute poisoning in mice and mice showed that oral administration of seeds did not produce an extract of up to 600 mg/kg of

mortality or observable behavior change [35]. There was no significant change in hematological, biochemical or histopathological parameters in sub-teaching studies, suggesting that extracts are non-type and well tolerated. This conclusion c. Support the traditional medicinal use of antichelminticum and further provides a scientific argument for medicinal and clinical examination [36].

Table 2: Safety and Toxicity Profile of *Centraterum anthelminticum* Seeds

Study / Author	Extract / Fraction	Dose / Duration	Experimental Model	Observations / Result
Mudassir H A et al., 2015	Seed extract	200–600 mg/kg	Fructose-induced diabetic rats	No significant adverse effects; reduced glucose levels
Baig N et al., 2022	Seed oil & fractions	200 mg/kg, 4 weeks	High-fat high-fructose STZ-induced diabetic rats	No mortality or toxicity observed; biochemical and histology normal
Arya et al., 2012	Methanolic fraction (CAMFs)	50 mg/ml (in vitro)	β-TC6 cells, STZ-induced diabetic rats	Non-cytotoxic in β-TC6 cells; no adverse effects in vivo

Pharmacological Activities

Anthelmintic and Antifilarial Activity

The name of the plant suggests that it has been traditionally used to treat insects. When the seeds are soaked in alcohol, the liquid works well against some insects in the sheep. It paralysis of insects and kills them by messing with their body method to handle a chemical called glutathione and it changes how their proteins work [37]. In lab tests, the plant also prevents the movement of organisms such as small insects called microphillia. When used with another drug, called dythylcarbamazine, it works even better for the treatment of a type of worm infection called filalices [38] Some chemicals in the plant, such as Vardodod, damage the exterior covering of insects and the processes of making their energy When tested in animals, giving 500 mg per kg of body weight reduces the number of insects in the body, causing them to decrease in 70 to 80% [39]

Anti-inflammatory activity :

Ashok P et al (2010) repoted that *Centraterum anthelminticum* seed extracts (200 mg/kg) in petroleum ether and alcohol shown a significant reduction in inflammation with 46.15% and 41.54%, respectively. In contrast, at the third hour, 100 mg/kg petroleum ether and alcohol extracts demonstrated 36.92% and 33.85%, respectively, suppression of oedema. These

findings were comparable to the standard drug, sodium diclofenac, which had a percentage inhibition of 50.77%. [40]

Analgesic and anti-pyretic activity :

Purnima et al (2009) reported that When exposed to heat stimuli using the hot plate method, petroleum ether and alcohol extracts both significantly reduced the number of writhes in the acetic acid-induced writhing and increased the amount of time that the paws licked. Comparing both extracts to the matching control, a substantial suppression of increased body temperature was observed. According to these findings, the alcohol and petroleum ether extracts had analgesic and antipyretic effects.[41]

Antioxidant activity

Ani and Naidu (2011) reported that The antioxidant activity of various extracts (acetone, methanol and water) of *Centraterum anthelminticum* seeds was determined using the radical 1,1-diphenyl-2-picrylhydrazyl (DPPH), 2,2-azino-bis-3-ethylbenzothiazoline-6-sulfonic acid (ABTS) Phosphomolybdenum recovery and reduction test. The extract showed significant anti-oxidant activity against DPPH and ABTS radicals. The aqueous methanol-acetone extract showed the highest DPPH scavenging activity (IC₅₀ 20.8 ± 0.18 µg), ABTS

(IC₅₀ 8.3 µg) and phosphomolybdenum reducing capacity (IC₅₀ 0.31 µg). They found a remarkable relationship between the antioxidant activity and total phenolic content of *Centratherrum anthelminticum*, suggesting that phenolic compounds may be responsible for the antioxidant activity of the seeds.[42].

Melanogenesis Activity :

Zhou et al (2012) reported that In cell-line B16F10 (murine B16 melanoma cell line) and NHMC (normal human primary melanocytes), an ethanol extract of *Centratherrum anthelminticum* fruit was able to enhance the tyrosinase activity and melanin synthesis after a 48-hour treatment. This suggests that *Centratherrum anthelminticum* fruit extract could treat leucoderma by enhancing melanogenesis.[43].

Anti-Diabetic Activity

Arya et al (2012) reported that the methanolic fraction of *Centratherrum anthelminticum* seeds (CAMFs) has anti-diabetic effects utilizing a type 2 diabetic rat model and the mouse pancreatic cell line β-TC6. Comparing CAMFs to untreated control cells, they demonstrated a non-cytotoxic effect on β-TC6 cell growth at 50 mg/ml. Glucose uptake was increased by increasing the level of glucose transport protein and the expression level of Glut-2 and Glut-4 in CAMF-treated cells. In vivo studies on streptozotocin induced diabetic rat models revealed that CAMFs significantly reduced hyperglycemia by augmenting insulin secretion in type 2 diabetic rats. [44].

Mudassir H A et al (2015) reported that *Centratherrum anthelminticum* reduces the risk of insulin resistance in type 2 diabetes caused by fructose. All doses (200–600 mg/kg) of seed extract successfully reduced glucose levels by a percentage at 60 and 120 minutes in the oral glucose tolerance test. By comparison, its high doses (400 and 600 mg/kg) effectively reduced the postprandial blood glucose level after 30 minutes (from -10 to -11.9%). This was in contrast to the diabetic control group.[45]

Wound Healing Activity :

Sahoo et al (2012) reported the Healing properties of *Centratherrum anthelminticum* seeds on excision and incision wounds in albino Wistar rats. The methanolic aqueous extract of *Centratherrum anthelminticum* seeds was prepared as an ointment in two concentrations, 5% w/w ;and

10% w/w. The results showed that 10% w/w *Centratherrum anthelminticum* ointment and the standard drug nitrofurazone ointment showed complete wound healing on the 18th day with a wound area of $00 \pm 0.4 \text{ mm}^2$ and $00 \pm 0.0 \text{ mm}^2$, respectively. [46]

Anrti-Microbial Activity :

Patel et al (2012) reported that The ethanolic extract was effective against all bacterial strains except *V.cholerae*. among ;all the bacterial strains, *P.aeruginosa* and *K.pneumoniae* were considered extremely sensitive to the ethanolic extract as ;minimum inhibitory concentration (MIC) of the ethanolic extract for *P.aeruginosa* and *K. pneumoniae* were 2.5 (mg/ml) and the MIC value was the lowest among the remaining strains.[17] **D S Negi** et al (2014) reported that the findings showed that the *Centratherrum anthelminticum* seed extract exhibited strong antibacterial activity, with 0.0020 µg/ml against *E. Coli*, 0.006 µg/ml against *Pseudomonas aeruginosa*, and 0.0025 µg/ml against the employed fungus. The minimum inhibitory concentration of chloroform extract of the seeds and reference antibiotics were determined by microdilution techniques in nutrient broth media for bacteria and potato dextrose agar medium for fungus. [47]

Anticancer activity

Arya A et al (2011) reported that the Chloroform fraction of *Centratherrum anthelminticum* show cytotoxic effects on various human tumor cells , including A549, PC-3, and MCF-7 cells. Chloroform fraction of *Centratherrum anthelminticum* effectively inhibits the release of tumor necrosis factor alpha both in vitro and in vivo. The inhibitory effect of chloroform fraction of *Centratherrum anthelminticum* on tumor necrosis factor alpha secretion may be attributed to its ability to inhibit the activation of NF-Kb translocation.[48]

Looi et al (2013) reported that The growth of human breast cancer MCF-7 cells was suppressed by CACF. MCF-7 cells showed signs of apoptosis in response to CACF, including DNA breakage, cytoskeletal structural deformation, and decrease of the cell size. [49]

Other activities:

Baig N et al (2022) studied in-vivo anti-inflammatory ,anti-oxidant and antihyperglycemic potential of the *Centratherrum anthelminticum* seeds

fixed oil and its fractions in high fat high fructose streptozotocin induced type 2 diabetes mellitus rat model. The type 2 diabetes mellitus rat model was developed by giving a high fat and high fructose diet followed by a single intraperitoneal injection of streptozotocin (STZ 60mg/kg) on 28th day of the trial. After 72 hours of this injection, rats showing fasting blood glucose level > 230 mg/dl were recruited into 6 groups. These groups were orally administered distilled water (1 ml/kg), gliclazide (200mg/kg), Centrathurum anthelminticum seed and its hexane, chloroform and ethanol soluble fractions (200 mg/kg each), respectively for 4 weeks. Blood serum and kidney tissue samples of euthanized animals were used for biochemical,

pro-inflammatory and anti-oxidant markers and histology respectively[50]

Paydar M J et al (2013) work on the biological activities and the active compound derived from Centrathurum anthelminticum revealed that the pharmacological effects of Centrathurum anthelminticum range from antioxidant, antidiabetic, antimicrobial to anti-cancer property [51]

Ashok P et al (2013) reported the Effect of Centrathurum anthelminticum on ethylene glycol induced urolithiasis in rats. Petroleum ether, chloroform and alcoholic extracts of Centrathurum anthelminticum seeds were evaluated for antiurolithiatic activity [52]

Table 1: Pharmacological Activities and Therapeutic Potential of Centrathurum anthelminticum Seeds

Activity	Extract / Fraction	Dose / Concentration	Experimental Model	Result / Effect
Anti-inflammatory	Petroleum ether	200 mg/kg	Rat paw oedema	46.15% inhibition
Anti-inflammatory	Alcohol	200 mg/kg	Rat paw oedema	41.54% inhibition
Anti-inflammatory	Petroleum ether	100 mg/kg	Rat paw oedema (3rd hour)	36.92% inhibition
Anti-inflammatory	Alcohol	100 mg/kg	Rat paw oedema (3rd hour)	33.85% inhibition
Analgesic / Anti-pyretic	Petroleum ether	Not specified	Hot plate & acetic acid writhing	Reduced writhes, increased paw licking, decreased fever
Analgesic / Anti-pyretic	Alcohol	Not specified	Hot plate & acetic acid writhing	Reduced writhes, increased paw licking, decreased fever
Antioxidant	Acetone / Methanol / Water	IC50: 20.8 µg (DPPH), 8.3 µg (ABTS), 0.31 µg (Phosphomolybdenum)	In-vitro radical scavenging assays	Significant antioxidant activity; correlated with phenolic content
Melanogenesis	Ethanol (fruit)	Not specified	B16F10 & NHMC cell lines	Enhanced tyrosinase activity & melanin synthesis
Anti-diabetic	Methanolic fraction (CAMFs)	50 mg/ml (in-vitro), 200–600 mg/kg (in-vivo)	β-TC6 cells; STZ-induced diabetic rats	Increased glucose uptake, GLUT2/GLUT4 expression, reduced hyperglycemia
Anti-diabetic	Seed extract	200–600 mg/kg	Fructose-induced insulin resistant rats	Reduced glucose levels; postprandial glucose reduction 10–11.9%
Wound healing	Methanolic-aqueous ointment	5% & 10% w/w	Excision & incision wounds in rats	10% w/w showed complete healing on 18th day
Anti-microbial	Ethanol extract	MIC 2.5 mg/ml	Various bacterial strains	Effective except V. cholerae; P.

				aeruginosa & K. pneumoniae highly sensitive
Anti-microbial	Chloroform extract	MIC: 0.002–0.006 µg/ml	E. coli, P. aeruginosa, fungus	Strong antibacterial & antifungal activity
Anticancer	Chloroform fraction (CACF)	Not specified	A549, PC-3, MCF-7 cell lines	Cytotoxicity, TNF-α inhibition, apoptosis induction
Anti-inflammatory, Antioxidant, Antihyperglycemic	Seed fixed oil & fractions	200 mg/kg	High-fat high-fructose STZ-induced diabetic rats	Improved biochemical, pro-inflammatory & antioxidant markers
Antiurolithiatic	Petroleum ether / Chloroform / Alcohol	Not specified	Ethylene glycol-induced urolithiasis in rats	Reduced kidney stone formation

II. CONCLUSION

Centratherum anthelminticum, commonly known as kalijiri or bitter cumin, has demonstrated a wide spectrum of pharmacological and therapeutic properties supported by both traditional medicinal practices and modern scientific investigations. The plant contains a rich array of bioactive constituents, including flavonoids, alkaloids, terpenoids, saponins, and phenolic compounds, which contribute to its antioxidant, anti-inflammatory, antimicrobial, antidiabetic, hepatoprotective, and anticancer activities. Preclinical studies and experimental models provide substantial evidence of its efficacy in managing metabolic disorders, infectious diseases, inflammatory conditions, and even complex disorders like diabetes, vitiligo, and cancer.

Toxicological evaluations further indicate that *C. anthelminticum* extracts and oils are generally safe at therapeutic doses, with minimal adverse effects, thereby supporting its use in traditional systems of medicine. However, despite encouraging laboratory and animal data, clinical studies in humans remain limited. Rigorous, well-designed clinical trials are urgently required to validate its therapeutic claims, standardize dosage regimens, and ensure safety in long-term use.

Overall, *C. anthelminticum* represents a promising medicinal plant with significant potential for the development of novel phytopharmaceuticals. Integrating traditional knowledge with modern pharmacological insights could pave the way for its utilization as a complementary or alternative therapeutic agent, particularly in the management of chronic and lifestyle-related diseases.

III. FUTURE PROSPECTIVE

Centratherum anthelminticum is a traditional medicinal plant that shows significant potential for pharmaceutical use. However, most of the existing research has been conducted in laboratory settings or on animals, and there is limited evidence from human clinical studies. To fully understand and confirm its healing properties, future studies should focus on several important areas.

First, properly planned human clinical trials are necessary to determine how effective and safe *Centratherum anthelminticum* is for treating different health conditions. Second, in-depth studies are needed to identify the specific molecular targets and biological pathways involved in the action of its active compounds, including how they affect cell signals, enzymes, and gene activity. Moreover, creating better formulations and using advanced drug delivery methods, such as nanoparticle-based systems, extended-release options, and ways to improve how the body absorbs the medicine, will help improve treatment effectiveness. It is also important to investigate how this herb might work better when used together with modern medicines, especially in treating conditions like metabolic diseases and infections.

In addition, thorough safety assessments are necessary to check for long-term side effects, genetic damage, and impacts on different organs. Ensuring consistent quality and identifying key active components in the herb are also important for maintaining reliability and consistency in its use. Conducting research in these areas develop safe, effective treatments based on *Centratherum anthelminticum* for use in clinical settings.

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