



Bioactive compounds of *Eurycoma Longifolia* Jack and its potentials in pharmaceutical products and applications on The Global Market: A review

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Abstract

The aim of this study was to review the bioactive compounds of *Eurycoma longifolia* and examine its pharmacological effects, recent clinical applications, and commercial product usage in the global market. *E. longifolia*, commonly known as *Tongkat Ali* and belonging to the Simaroubaceae family, is a traditional medicinal plant native to Southeast Asia, including Malaysia, Indonesia, Thailand, and Vietnam, where it has been traditionally used to enhance vitality and treat a variety of ailments. The methods used involved a comprehensive review of current scientific literature and clinical trial data to identify the primary bioactive constituents of *E. longifolia*, as well as an overview of its pharmacological properties and commercial applications. The results showed that the root of *E. longifolia* is rich in diverse bioactive compounds, notably quassinoids (*Eurycomanone*, *eurycomanol*, and *eurycomalactone*), flavonoids, saponins, polysaccharides, and alkaloids. These compounds demonstrate multiple pharmacological activities, including hormonal regulation, antimicrobial, antiparasitic, anti-malarial, anti-inflammatory, and anti-diabetic effects. Recent clinical studies have provided evidence supporting its role in testosterone enhancement, athletic performance improvement, fertility support, and stress and metabolic syndrome management. As a result, *Tongkat Ali* is increasingly used in dietary supplements, functional foods, and global wellness products. The review contributes to a deeper understanding of *E. longifolia*'s therapeutic potential and its expanding role in modern health interventions. It highlights the scientific basis for its traditional uses and underscores its relevance in contemporary clinical and commercial contexts, offering insights for future research, product development, and integrative medicine practices.

Keywords: *Eurycoma longifolia*, bioactive compounds, traditional herbal medicine, pharmacological effects

Introduction

Eurycoma longifolia, commonly known as *Tongkat Ali*, is a flowering plant native to Southeast Asia and has a longstanding reputation as a medicinal herb, especially in countries such as Malaysia, Indonesia, Thailand and Vietnam. Traditionally, it is used as a natural remedy for enhancing energy, improving libido, and supporting overall health. The root of *Tongkat Ali* is the most commonly used part of the plant due to containing various bioactive compounds such as quassinoids, alkaloids, and flavonoids, which are believed to promote health benefits. *E. longifolia* also exhibits antioxidant, anti-inflammatory, and antimicrobial properties, making it a versatile medicinal plant (Bhat and Karim, 2010) [4]. Recently, there have been various studies investigating the potentials of *E. longifolia* in pharmaceutical fields as the interest is driven by its purported effects on testosterone levels, mood enhancement, and stress reduction, making it an ingredient in supplements aimed at men's health and wellness. Popular among athletes and those seeking natural remedies for hormonal balance and improved fertility, *Tongkat Ali* remains a cornerstone of traditional medicine and is gaining recognition in modern health and wellness practices (Rehman *et al.*, 2016) [38]. Commercial products containing *E. longifolia* are widely available in the market in various formulations, including capsules, powders, and liquid extracts. However, further intensive review and research are also needed to investigate and optimize its use in clinical settings and to fully understand its mechanisms of action in order to successfully intergrate its product into the current market.

Overview on *Eurycoma longifolia*

E. longifolia, a common conventional herbal remedy, is a flowering plant of the family *Simaroubaceae*, native to Southeast Asia. In Malaysia, this plant is referred to as *Tongkat Ali*, which translates to "walking stick" and indicates that it has long, twisted roots. It is sometimes referred to as one of Malaysia's three national treasures, along with tin and bird's nest (Ruan *et al.*, 2019) [39]. In several Asian nations, its roots are traditionally utilized as a remedy for many illnesses and ailments. In addition, *E. longifolia* has recently played a significant part in Western herbal medicines as an adjunctive and alternative medicine (Rehman *et al.*, 2016) [38]. Furthermore, the fruits are firm and oblong in shape. The blooms are hermaphrodite and have very fine pubescent petals. In order to develop the plant, the germinated seedlings are typically sown directly into well-drained soil that has enough organic matter. A yearly precipitation of 2000-3000 mm and temperature range of 25°C to 30°C is thought to be optimal for growth. Although the precise harvesting age is unknown, it is often harvested two to three years after cultivation (Wizneh and Asmawi *et al.*, 2014) [48]. *E. longifolia*'s adaptability to well-drained tropical soils and its medicinal significance make it a highly valued species in traditional and commercial herbal medicine practices.

Bioactive Compounds of *Eurycoma longifolia* Jack

E. longifolia is abundant in several different kinds of bioactive substances that contribute to its therapeutic properties (Rehman *et al.*, 2016) [38]. Among its most

prominent compounds are quassinoids such as *Eurycomanone*, eurycomanol, and eurycomalactone, which are known for their anti-inflammatory, antimalarial, and anticancer effects. Additionally, alkaloids like canthin-6-one exhibit antibacterial and cytotoxic activities, while flavonoids and tannins provide potent antioxidant benefits. The plant also contains saponins, bioactive peptides, and sterols that support hormone regulation and energy enhancement. These compounds collectively make *E. longifolia* a cornerstone of traditional medicine, particularly valued for its aphrodisiac, adaptogenic, and antimicrobial properties.

1. Eurycomaone

Quassinoids are the primary bioactive compounds in *E. longifolia* and have dynamic pharmacological properties. The major quassinoids identified in *Tongkat Ali* were eurycomaone, eurycomanol, eurycomalactone, 14,15- β -Dihydroxyklaineaneone, longilactone and eurycomadilactone. Among those, eurycomaone is the most abundant and well-studied quassinoid (Han *et al.*, 2015) [17]. It is structurally a C20 quassinoid, notable for its complex lactone rings and hydroxyl substitutions that contribute to its pharmacodynamic potential. Among more than 65 compounds identified in the plant, eurycomaone stands out due to its high abundance and wide-ranging biological activity (Kuo *et al.*, 2003) [24, 25]. Eurycomaone can be extracted and isolated by different methods including methanol or ethanol-based solvent systems. Advanced methods involving high-performance liquid chromatography (HPLC) (Chan *et al.*, 1998) [6] and liquid chromatography-mass spectrometry (LC-MS) are commonly employed for qualitative and quantitative analysis (Huynh *et al.*, 2021) [21]. The presence of *Eurycomanone* varies depending on plant maturity, environmental conditions, and processing techniques, which has implications for the consistency of herbal preparations. Recent efforts in metabolomic profiling and standardization aim to ensure the reproducibility of *Eurycomanone*-rich extracts for clinical and pharmacological research. Scientists revealed that this bioactive compound suppressed expression of lung cancer cell tumor markers (Wong *et al.*, 2011) [49]. Moreover, it also inhibited Jurkat and K562 cell viability and proliferation without strongly affecting the viability of healthy cells (Hajjouli *et al.*, 2014) [16]. In another study, quassinoids isolated from *E. longifolia* were reported to have the ability of anti-proliferation activities on human leukemia cells (Yang *et al.*, 2021) [50].

2. Saponins

The presence of phytochemicals such as saponins in the crude extract may contribute to the healing of wounds either singly or in combination. Saponin (glycosaponins) includes triterpenoid or steroidal aglycones that are replaced with a varying quantity of sugar moieties or organic acids. Because of their hydrophobic aglycone and hydrophilic sugar moiety, saponins function as biological detergents (Chua *et al.*, 2019) [9]. Malaysia has implemented a standard for *Tongkat Ali* which can be standardized to glycosaponin. Glycosaponin extracted by hot-water solvent from root was 35%, proven to be highly safe even at high doses and with long-term use (Talbot *et al.*, 2013) [43]. Saponins were also extracted by solvent fractionation using ethyl acetate or acetone as organic compounds to precipitate and partition

saponins. However, researchers suggested ethyl acetate be used to concentrate saponins from the highly complex crude extract of *E. longifolia* roots (Segaran and Chua, 2020) [41]. Another study revealed that the solvent fractionation coupled with acetone precipitation produced saccharide-containing compounds including saponins, which exhibited greater anti-proliferative activity against MCF-7 cells compared to the crude extract (Chua *et al.*, 2019) [9]. Besides deionized water, methanol was considered as a common solvent used for extracting phytochemicals such as saponins (Abirame *et al.*, 2016) [1]. Moreover, this solvent extraction technique was combined with ultrasound-assisted extraction, giving the result of higher saponin yield (Elhag *et al.*, 2018) [10].

3. Polysaccharides

While the polysaccharides from *E. longifolia* have not been studied as extensively as other compounds, it has been confirmed that they possess distinct biological function, including the ability to regulate the immune system and protect red blood cells from oxidative stress-related damage (He *et al.*, 2019). Scientists conducted research with *E. longifolia* from nine provenances across Peninsular Malaysia. The actual polysaccharide content was quantified using the phenol-sulfuric acid method, showing that the Terengganu provenance had the highest polysaccharide content at 1.06% of the 30g dried root extract (Mohd Zaki *et al.*, 2015) [32]. A study found that the ideal conditions for maximizing the yield of polysaccharides were a 40-day culture period using 40 g/L of sucrose, an initial root density of 5 g/L and an aeration rate of 0.05 v/m. Under these optimized conditions, the bioreactor successfully produced 2.4 g/L of polysaccharides (Fan *et al.*, 2021) [13].

4. Flavonoids

Flavonoids belong to a class of polyphenolic compounds that contribute to the plant's antioxidant and health-promoting properties. These compounds, though less researched compared to quassinoids like *Eurycomanone*, play a role in the plant's bioactivity. Some of the flavonoids identified in *Tongkat Ali* include luteolin, quercetin and kaempferol (Miean and Mohamed, 2001) [30]. These flavonoids are known for their antioxidant, anti-inflammatory, and potential anti-cancer activities. They work synergistically with other bioactive compounds in *Tongkat Ali*, enhancing its therapeutic effects. These bioactive substances have been traditionally used as wound-healing agents. Nowadays, flavonoids may be found in a lot of formulations, including dressings for wound healing, and they work in concert or synergistically. Flavonoids have antibacterial and anti-inflammatory properties because they prevent prostaglandin production (Al-Bayati *et al.*, 2022) [2].

5. Alkaloids

Alkaloids are among the key bioactive constituents identified in *E. longifolia*. These nitrogenous compounds contribute significantly to the plant's pharmacological activities. The most prominent group of alkaloids found in *E. longifolia* is the canthin-6-one class, which includes canthin-6-one, 9-methoxycanthin-6-one, and 9-hydroxycanthin-6-one. These compounds have demonstrated potent cytotoxic effects against various human cancer cell lines and have shown promise as natural anticancer agents (Chan *et al.*, 1998) [6]. Furthermore,

certain alkaloids from *E. longifolia* have shown substantial activity against Plasmodium species, underscoring their potential in malarial drug development (Kuo *et al.*, 2003) [24, 25]. A study also suggested that among the isolated compounds, canthin-6-one exhibited the strongest inhibitory effect on nitric oxide production with IC50 = 16.9 μM , whereas 5-Methoxycanthin-6-one and eurycomalide F exhibited weak inhibition with IC50 values of 23.4 and 32.7 μM , respectively (Nguyen *et al.*, 2019) [35].

Applications of *Eurycoma longifolia* In Pharmaceutical Industry

The root extract of *E. longifolia* has historically been employed in formulations aimed at improving hormonal health, particularly as a natural testosterone booster and treatment for male infertility. Its adaptogenic properties make it a valuable ingredient in anti-stress and energy-boosting supplements, while its anti-inflammatory, antioxidant, and antimicrobial effects expand its applications to general health and immune support. Additionally, promising research highlights its potential in cancer therapy and as an adjunct in treating malaria and parasitic infections (Rehman *et al.*, 2016) [38].

1. Effects on hormonal and reproductive health

E. longifolia is most known for its ability to boost sexual performance, though it has many traditional uses. Male fertility, including adequate spermatogenesis, depends on a hormone called testosterone while excess estrogen is one example of a hormonal imbalance that can impair testosterone production and disrupt testicular function (Mohamed *et al.*, 2015) [31]. The standardized F2 extract of *E. longifolia* appeared to enhance spermatogenesis in rats by influencing the hypothalamic-pituitary-gonadal axis, suggesting its potentials for further exploration (Low *et al.*, 2012) [29]. Moreover, it is revealed that an extract high in quassinoids can raise testicular testosterone levels and sperm concentration. This is because *Eurycomanone* promotes spermatogenesis by preventing phosphodiesterase and aromatase from acting during steroidogenesis (Low *et al.*, 2013) [28]. Another research showed that at therapeutically utilized doses (<2.5 $\mu\text{g}\cdot\text{ml}^{-1}$), the *Tongkat Ali* extract has no negative effects on sperm functioning. Nevertheless, it may be toxic in *vitro* at very high concentrations (Erasmus *et al.*, 2012) [11].

2. Anti-microbial and anti-parasitic capabilities

E. longifolia exhibits notable anti-microbial and anti-parasitic properties, largely attributed to its bioactive compounds, including quassinoids, alkaloids, and saponins. These effects make the plant a promising natural remedy for combating various infections. Study revealed that extract of *E. longifolia* leaves and stems by alcohol and acetone were active on both Gram-positive and Gram-negative bacteria except against 2 strains of Gram-negative bacteria (*Escherichia coli* and *Salmonella typhi*). Using water as solvent, leaves extract appeared to have antibacterial activity against *Staphylococcus aureus* and *Serratia marcescens* (Farouk and Benafri, 2007) [14]. It was also found that ethanol-based extract from root inhibited the growth of *S. aureus*, *B. cereus* and *S. typhi*; however, neither *E. coli* nor *P. aeruginosa* exhibited any signs of inhibition (Faisal *et al.*, 2015) [12]. In addition, extract of *E. longifolia* appeared to have the ability to prevent the growth of

Candida albicans and *Streptococcus mutans* at a concentration of 200 mg/ml with a zone of inhibition of 16.0 ± 3.0 mm and 7.0 ± 1.0 mm respectively. Conducting the MIC test, scientists suggested the MIC against these strains was 25 mg. mL^{-1} (Alloha *et al.*, 2019) [3]. In another study, scientists investigated the effects of ethanol root extracts on the growth of *Streptococcus mutans*, *Lactobacillus* and *Candida albicans* isolated from saliva of adult patients with high caries risk. The results showed that the growth of these microorganisms was inhibited by the extract, indicating the potentials of *E. longifolia* as antimicrobial (Ramzi *et al.*, 2021) [37].

3. Anti-malaria capability

E. longifolia roots were traditionally considered as an essential ingredient in Malay herbal medicine for malaria (Chan *et al.*, 1986) [7]. Scientists extracted bioactive compounds including alkaloids, quassinoids and eurycomaone to evaluate the activity of these compounds against a panel of cell lines (Kardono *et al.*, 1991) [23]. Results from the study showed that eurycomaone and 7-methoxy-beta-carboline-1-propionic acid demonstrated significant antimalaria activities with cultured *Plasmodium falciparum*. In addition, quassinoids in *E. longifolia* have been reported as active against the *in vitro* culture of malarial parasites, *Plasmodium falciparum*. This was judged by a study in which quassinoids extracted by methanol under reflux displayed potent antimalarial activity against the resistant *Plasmodium falciparum* (Kuo *et al.*, 2003) [24, 25].

4. Anti-inflammatory capability

Historically, *E. longifolia* root extract has been utilized as an anti-inflammatory medication. β -carboline alkaloids of *E. longifolia* help prevent or treat inflammatory illnesses (Nguyen *et al.*, 2015) [34]. During the inflammatory phase of wound healing, *E. longifolia* hydrogel greatly speeds up the healing process. Hydrogel significantly increased the percentage of wound contraction by 43.38% as compared to the other groups. Although in the later healing stages, *E. longifolia* hydrogel did not show statistically difference with the other groups yet it was comparable to medically certified wound healing agent (Al-Bayati *et al.*, 2022) [2]. *E. longifolia* demonstrated an anti-inflammatory activity in mice with edema caused by carrageenan (Han *et al.*, 2016) [18]. At all evaluation time points, high doses of *E. longifolia* extract (1200 mg/kg) efficiently inhibited the formation of hind paw edema, with the greatest inhibition occurring one hour after applying carrageenan (Subhawa *et al.*, 2023) [42].

5. Antidiabetic capability

In many South East Asian nations, diabetes mellitus, a metabolic condition of glucose metabolism, is the most common chronic illness (Tsai *et al.*, 2020) [45]. It is crucial to recall that *E. longifolia* may have amazing antidiabetic potential. Treating diabetes mellitus is to use plants with strong antioxidant capacities. Therefore, *E. longifolia* is a medicinal plant that is said to have potent antioxidant properties. The rat groups administered with ethanol extract of longjack leaf (176.4mg/200g body weight) experienced a reduction in blood glucose and malondialdehyde levels. Therefore, the *E. longifolia* leaf ethanol extract worked well as an anti-diabetic (Panjaitan *et al.*, 2021) [36]. Adult rats that were made hyperglycemic by streptozotocin showed a

reduction in blood glucose following treatment with aqueous extracts of *E. longifolia*. For two distinct *E. longifolia* preparations, blood-glucose levels dropped by 38% and 47%. When the same extracts were administered to normoglycaemic rats, no discernible decrease was observed.

***Eurycoma longifolia* Applications in Clinical Trials**

E. longifolia has been the focus of several clinical trials exploring its therapeutic potential, particularly in areas such as hormonal health, physical performance, and general well-being. Multiple trials have examined its ability to increase testosterone levels in men with late-onset hypogonadism, showing significant improvement in total and free testosterone levels (Leisegang *et al.*, 2022) [26]. The root of the *E. longifolia* is believed to increase semen quantities, sperm concentrations, the proportion of normal sperm morphology, and sperm motility; hence, improving male fertility. These patients' sperm quality was considerably increased by the exclusive *Eurycoma longifolia* Jack extract, resulting in 11 spontaneous pregnancies, accounted for 14.7% of the participants (Tambi *et al.*, 2010) [44]. Researchers evaluated the capacity of polyherbal formulation (PHF) containing roots of *E. longifolia* in enhancing the spermatogenic potential of oligospermic patients. This study randomized male patients either to treatment (n = 23) with PHF (750 mg. d⁻¹ in three doses for 90 days) or to placebo (n = 13) in the same protocol in 90 days. At the end of study, there was a 256% increase in sperm concentration ($9.59 \pm 4.37 \times 10^6$ per mL to $25.61 \pm 8.6 \times 10^6$ per mL; $P \leq 0.001$), 154% increase in semen volume (1.7 ± 0.14 mL to 4.32 ± 0.38 mL; $P \leq 0.001$), and 215% increase in sperm motility ($15.43 \pm 2.40\%$ to $48.65 \pm 5.10\%$; $P \leq 0.001$) on day 90 from baseline. Moreover, a significant improvement and regulation in serum hormone levels were also reported with PHF treatment as compared to the placebo group (Hussain *et al.*, 2018) [20]. Scientists also investigated the impact of *E. longifolia* on the hypothalamic-pituitary-gonadal and hypothalamic-pituitary-adrenal axes in thirty-two healthy young males by treating them with 600 mg of *E. longifolia* per day or placebo for two weeks. The result showed significant interaction and time effects for testosterone free testosterone and oestradiol levels in favour of the treatment group, while luteinising hormone, follicle-stimulating hormone and sexual hormone-binding globulin did not (Chan *et al.*, 2021) [5]. Under the 6-month study evaluating the effect of *Tongkat Ali* and concurrent training on erectile function and testosterone levels in androgen deficiency of aging males, 45 men (47.38 ± 5.03 years) were randomized into 4 groups (G1: control + placebo; G2: control + *Eurycoma longifolia*; G3: concurrent training + placebo; G4: concurrent training + *Eurycoma longifolia*). Twenty-two volunteers received a 200 mg supplement of *Eurycoma longifolia* and another 23 underwent the intervention with concurrent training, 3 times a week for 60 min at progressive intensity. The result revealed that the most significant erectile function improvements were observed in men allocated to concurrent training and *E. longifolia* (Leitão *et al.*, 2020) [27].

Besides, there were certain clinical trials carried out to evaluate the effect of Physta® which is a proprietary product containing a freeze-dried water extract of *E. longifolia*. A study was conducted with 109 men between 30 and 55 years treated with 300 mg of water extract of *E. longifolia* (Physta®) or placebo. At the end of treatment,

compared to the placebo group, the EL group showed higher scores in the overall Erectile Function domain, sexual libido (14% by week 12), with sperm motility at 44.4%, and semen volume at 18.2%. Surprisingly, there was significant fat mass lost in subjects with BMI ≥ 25 kg per m², indicating the anti-obesity of *E. longifolia* extract (Ismail *et al.*, 2012) [22]. Physta® was also used in combination with *Polygonum minus*, an antioxidant associated with men's sexual performance. The outcomes suggested that twelve weeks of supplementation with *P. minus* and the proprietary *E. longifolia* extract, Physta®, was proved to be more effective than a placebo in improving sexual performance in healthy volunteers. Moreover, there was no clinically significant abnormality in liver and kidney function testing (Udani *et al.*, 2014) [48]. Research also delved into the effects of Physta® on testosterone: epitestosterone (T: E) ratio, liver and renal functions in male recreational athletes when they consumed 400 mg/day for 6 weeks. It was observed that supplementation of *E. longifolia* at this dosage did not affect the urinary T:E ratio, highlighting the safe and not violation of doping policies of the International Olympic Committee (Chen *et al.*, 2014) [8]. Additionally, this extract investigated the capacity to modulate human immunity in a middle-aged Japanese population in a 4-week study. The findings revealed that Scoring of Immunological Vigor and immunological grade were significantly higher in the TA group than those in placebo group ($P < 0.05$) whereas there were no severe adverse events, suggesting that consumption of the root water extract of TA (Physta®) boosts overall immunity in both middle-aged men and women (George *et al.*, 2016) [15]. Not only that, Physta® was reported to have an effect on quality of life of perimenopausal and postmenopausal women aged 40-55 years (Muniandy *et al.*, 2023) [33].

Despite promising findings, there are limitations and drawbacks to clinical trials of *E. longifolia*. Several studies have small sample sizes and short treatment durations which limit the relevance and durability of the outcomes. There is also a lot of variability in dosage, formulation (pure extract versus polyherbal formulations), and treatment protocols which complicate direct comparisons. There also are several studies that are not viewed as methodologically sound, for example, wrong controls (placebo), or lack of double-blinding, increasing risk of bias. Also, most studies have only focused on male subjects, particularly for hormonal health and fertility, which is limiting in terms of looking broadly at other demographics, and importantly women and other sub-populations. Finally, while safety has been reported in the short term, we do not have enough data from studies that have evaluated long-term safety, and more appropriately conducted trials are warranted before any widespread recommendations can be made.

Commercial Products from *Eurycoma longifolia* On the Global Markets

Products derived from *E. longifolia* are now widely accessible in the global market, primarily as supplements promoting vitality, energy, and male health. These products often target consumers looking for natural remedies for fatigue, libido enhancement, or stress management. According to business data, commercial products available worldwide could be dietary supplements, energy drinks and beverages.

E. longifolia extract supplements typically come in capsule, tablet, or powder form, with varying concentrations of

active ingredients. Popular supplements include *Standardized Tongkat Ali* (Herbalab) and *Tongkat Ali* (Satoomi), which often combine *Tongkat Ali* with other herbal ingredients for broader health benefits. Among those, Physta®, recognized as the world's first patented *Tongkat Ali* extract and marketed as LJ100 in the United States, is a freeze-dried root extract powder. The extract is typically standardized to contain 1.5% *Eurycomanone*, ensuring high levels of bioactive compounds. Physta® is known for its exceptional potency, safety, and health benefits, delivering the most effective concentration of bioactive compounds, which was proved by several clinical trials (Sambandan *et al.*, 2000) [40]. *Tongkat Ali* is also incorporated into ready-to-drink energy beverages for an easy-to-consume format. These often combine the herb with other adaptogens for enhanced effects. Due to the bitter taste of the original extract, honey may be added into the final product to diminish the bitterness such as *Extra Power Root Tongkat Ali and Honey* (Jaya Grocer) and *Royal Tongkat Ali* (MHP-Miracle). Other products listed are *Jus Tongkat Ali* (Jamu Jelita), *Lipovitan Tongkat Ali*, *Arjuna Maxx Extra Power Juice with Tongkat Ali*, *Ginseng* (D Herb) and *Tongkat Ali Enzyme Vinegar* (Edibee), etc.

While *E. longifolia* is primarily associated with traditional herbal medicine, some food products incorporate extracts from this plant such as herbal teas or coffee blends. When *E. longifolia* extract was added into tea, the average liking score of the product was 6.6 ± 0.9 points, according to the results of the sensory evaluation. The *E. longifolia* herbal tea sample was rated as rather favorable, with a liking score between six and seven points (Vo *et al.*, 2021) [47]. Common products available in the market are *Tongkat Ali tea* (Cameron Valley Tea), *Tongkat Ali tea* (Khang Shen Herbs), *Tongkat Ali Dan Ginseng* (Alitéa), etc. Besides, many energy-boosting coffee products include *Tongkat Ali* extract, targeting consumers looking for stamina and vitality improvements. Scientists suggested that coffee with the addition of *E. longifolia* extract has the average taste score assessed by testers ranges from 6 to 7, which is still relatively good. The taste of pure extract is considerably diminished when honey extract is added to coffee items. Some popular products are *Black coffee Eurycoma* (Smart & Rich), *Kobi Vitamins* (Kobi Bio Herbs) and *OOTEA Eu Caf  Mix* (DXN).

Conclusion

In conclusion, *E. longifolia* is a medicinal plant employed for its bioactive compounds, including quassinoids, alkaloids, flavonoids and saponins. These compounds exhibit diverse pharmacological activities, such as boosting testosterone levels, enhancing athletic performance, and possessing anti-inflammatory, antimicrobial, antimalaria and antidiabetic effects. *E. longifolia* and its derivatives are widely applied in traditional medicine and modern nutraceuticals, particularly for promoting male reproductive health, managing stress, and improving overall vitality. Current products in the global market are increasingly gaining attention due to their valuable natural resources with promising applications in health and wellness.

Competing Interests

The authors declare no conflicts of interest.

Author Contributions

Phu H. Le conceived the idea, provided support, and critically revised the manuscript. Phuc N.T. Le structured the contents. Phuc N.T. Le and Anh N. Nguyen wrote the manuscript. Nhi B.P. Nguyen and An D.X. Nguyen contributed to the finding of materials and proofreading. All authors read and approved the final manuscript.

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