

# Wound Healing and Antimicrobial Activity of Cinnamomum Extract

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**Abstract** Plant extract exhibited unique therapeutic characteristics due to their high content of chemical formulas with multiple medical effects. The plant extracts have shown a great advancement in controlling cardiovascular and metabolic disorders, as well as, it was used as antibacterial, antifungal, anti-cancer, and anti-inflammatory agents. Cinnamomum has been used as a medical herb from ancient times along with its uses as a spice in food. Cinnamomum oil and extract have shown a great perspective in many areas of human health. We have aimed to prepare an ethanolic extract from dry cinnamomum powder, and investigate its influence *in vitro* against four types of bacteria and one fungal strain, and again *in vivo* as a wound healing agent in rats. The results have shown that cinnamomum extract in ethanol has exhibited a good effect in growth inhibition of *Escherichia coli*, *Klebsiella* sp., *Staphylococcus epidermidis* and *Staphylococcus aureus*, as well as *Candida albicans*. The greatest effect of cinnamomum extract was obtained against the Gram positive bacterial strains *S. epidermidis* and *S. aureus*. Furthermore, cinnamomum extract has shown to be a good wound healing agent, in which rats whom treated with cinnamomum extract have shown a faster healing compared to control rats starting from the day 7. These effects make cinnamomum to be very useful in the medical field generally, and in inflammation line specifically.

**Keywords:** cinnamon, antibacterial, antifungal, wound healing, phytochemicals.

## 1. Introduction

Multiple randomized trials and laboratory experimental investigations have shown that a diet rich in fruit, vegetable, and plant-derived ingredients is connected with a considerable reduced risk of many disorders, including various types of cancer [1-4]. This is the primary reason why nutritional phytoconstituents, particularly those with biological activity potential, are attracting more research attention than their synthetic analogues, especially given the rising cost of chemical precursors as well as the possibility of obtaining significant amounts of bioactive components from food wastes [5, 6].

Furthermore, when the concepts and principles of green analytical chemistry [7] as well as, specifically, those of green extraction, are pursued as well as applied, the extraction of natural products from plant matrices is typically considered cleaner and even more sustainable in

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comparison to the heavy chemical industries [8]. The dried bark of *Cinnamomum* with its leaves, are used as a spice all over the world. In Ayurvedic medicine the bark is described as having stimulant, anti-flatulent, antiemetic and antidiarrheal properties [9]. Both common and cassia cinnamon have long been regarded to be healthy when consumed; nevertheless, coumarin levels observed in cassia cinnamon have recently been explored as potentially dangerous. Coumarin is mildly toxic to the liver and kidneys, with an LD50 of 275 mg/kg [10], despite its medical importance as a precursor to various anticoagulants. With the exception of one case report reported by Westra et al. [11], data gained from clinical trials suggests that cinnamon may be deemed safe when ingested in amounts used for food preparation [12].

Cinnamon has anti-inflammatory, anti-oxidant, anti-microbial, and anti-diabetic properties (Lee et al. 2005). Cinnamon has recently been proven to have anti-tumor action *in vitro* [18] and *in vivo* [19]. Cinnamon is also high in essential oils and tannins, both of which are antimicrobial [20]. Volatile oils (cinnamaldehyde, eugenol, cinnamic acid, and weitherhin), mucilage, diterpenes, and proanthocyanidins are the chemical components of cinnamon that are most commonly used [21]. In this context, we have aimed to prepare an extract of the *cinnamomum* dry plant and then use the extract in an *in vitro* antimicrobial examination as well as *in vitro* anti-inflammatory test as wound healing agent in rats.

## 2. Materials and Methods

### 2.1. Preparation of cinnamomum extract

50g of dry *cinnamomum* powder (from local market) were dissolved in 250mL of 90% ethanol (Merck, Germany). The beaker was sealed and placed in a waterbath with shaker for 24h at moderate temperature (37 °C). After that, the mixture was filtered and the clear solution was stored at 4 °C.

### 2.2. Antimicrobial examination

The extracts of *cinnamomum* was examined against two Gram negative bacterial strains *escherichia coli* as well as *klebsiella* sp, also two Gram positive bacterial strains *Staphylococcus epidermidis* as well as *Staphylococcus aureus*, as well as one fungi (*Candida albicans*). In Petri dishes, well diffusion method was used. Two wells in the agar medium were made in a radius of 5mm, and 15µL or 30µL of the extract were added to the corresponded wells. The plates were incubated at 37 °C for one day, as well as the inhibition zones were determined.

### 2.3. Wound healing

A paraffin cream was prepared from the *cinnamomum* extract. The *cinnamomum* extract solution was evaporated and the precipitate was collected. 1g of *cinnamomum* extract powder were mixed with paraffin at 70 °C under continuous stirring for 2h.

Two sets of healthy laboratory rats were placed in a cage and pre-conditioned for the experiment for 2 days. Each set was contained 5 rats, and divided according to the treatment as control set, and *cinnamomum* extract set. The rat's dorsal area was circled, and the area was localized with a 10% lidocaine sprayer to produce a wound in a radius of 1.0 cm using a surgical knife, leaving the incision open until redness indicated acute inflammation. The rats were treated on a daily basis, and observations made during the treatment procedure were recorded. The diameter of wound was measured each day for 10 days, and the results were statistically processed by using independent test [22].

### 3. Results and Discussion

#### 3.1. In vitro antimicrobial

Table 1 contains the inhibition zones created by the presence of 15µL or 30µL extract of cinnamomum dry powder. The extract solution of cinnamomum has shown to have an antimicrobial effect against all of the strains that have been used in this study. The observations has indicated that at 15µL of cinnamomum extract *S. epidermidis* were the most affected strain with inhibition zone 10.1 mm, while the 30µL of cinnamomum extract has affected *S. aureus* more than other strains. Both *S. epidermidis* and *S. aureus* are Gram positive bacteria, accordingly the antimicrobial activity of cinnamomum extract could affect the Gram positive strains with high efficient. Nevertheless, the effect of cinnamomum extract was good against the other strains. The antimicrobial effect of cinnamomum extract was reported in several previous studies [23-26].

**Table 1:** Inhibition zones of cinnamomum extract.

| Type of microbe  | Inhibition zones |      |
|------------------|------------------|------|
|                  | 15µL             | 30µL |
| E. coli          | 7.9              | 9.5  |
| klebsiella sp.   | 6.2              | 6.8  |
| S. epidermidis   | 10.1             | 11.8 |
| S. aureus        | 9.4              | 12.5 |
| Candida albicans | 7.3              | 8.5  |

#### 3.2. Wound healing

Table 2 contains the information that obtained from the observations of rats post-injury. The significant ( $P<0.05$ ) effect of cinnamomum extract (1.84±0.055 cm) cream was started after 7 days from the treatment compared to control (1.90±0.071 cm). Furthermore, the effect of cinnamomum extract (1.60±0.071 cm) was observed to be highly significant ( $P<0.01$ ) after the 10<sup>th</sup> day from injury, which have shown an almost complete healing with no sign of inflammation.

**Table 2:** The effect of cinnamomum extract on wound healing in rats.

| Healing Period (day) |               | Control rats  | Cinnamomum rats | p-value |
|----------------------|---------------|---------------|-----------------|---------|
| 1 <sup>st</sup>      | Diameter (cm) | 2.0±0.0       | 2.0±0.0         | -       |
|                      | Observations  | Redness       | Redness         |         |
| 3 <sup>rd</sup>      | Diameter (cm) | 1.960±0.055   | 1.940±0.055     | 0.580   |
|                      | Observations  | Redness       | Light Redness   |         |
| 5 <sup>th</sup>      | Diameter (cm) | 1.90±0.071    | 1.840±0.055     | 0.172   |
|                      | Observations  | Inflamed area | Clot            |         |
| 7 <sup>th</sup>      | Diameter (cm) | 1.840±0.055   | 1.720±0.084     | 0.032   |
|                      | Observations  | inflammation  | Clogged         |         |
| 10 <sup>th</sup>     | Diameter (cm) | 1.740±0.055   | 1.60±0.071      | 0.008   |
|                      | Observations  | Clogged       | Small clot      |         |

Mean ± Standard deviation; \* Significant at  $P$  equal or less than 0.05

Because of their efficacy and safety, herbal medications are becoming increasingly popular globally. Cinnamon is a medicinal plant with a wide range of therapeutic benefits. Cinnamon essential oil has antioxidant activity, according to Faix et al. [27], and ceylon cinnamon

essential oil inhibits hepatic 3-hydroxy-3-methylglutaryl CoA (HMG-CoA) reductase activity in rats and suppresses lipid peroxidation by increasing hepatic antioxidant enzyme activity, according to another study [13]. Farahpour and Habibi, have attributed the wound healing effect of cinnamomum extract to the antioxidant characteristic of its phytochemicals [12].

## 4. Conclusions

The results have shown that a dry cinnamomum powder extracts in ethanol can be used in therapeutic fields. Cinnamomum extract have shown a good inhibitory effects against the growth of *escherichia coli*, *klebsiella* sp, *Staphylococcus epidermidis* and *Staphylococcus aureus*, as well as *Candida albicans*. The greatest effect of cinnamomum extract was obtained against the Gram positive bacterial strains *S. epidermidis* and *S. aureus*. Furthermore, cinnamomum extract has shown to be a good wound healing agent, in which rats whom treated with cinnamomum extract have shown a faster healing compared to control rats starting from the day 7. These effects make cinnamomum to be very useful in the medical field generally, and in inflammation line specifically.

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