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RESEARCH ARTICLE

# Optimization of physico-chemical parameters for the extraction of phenolic components from cinnamon species

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## Abstract

Cinnamon is one of the oldest spices and it contains cinnamaldehyde, eugenol, cinnamic acid and other compounds. In this study the extraction of phenolic compounds like cinnamaldehyde, and eugenol were carried out. Optimization of physico-chemical parameters namely effects of different solvents, soaking time, extraction time with hexane, particle size, different solvent percentages, different volumes of hexane with methanol and ethanol as solvents and pH for the extraction of cinnamaldehyde, total phenolic content and eugenol were studied. For the extraction of cinnamaldehyde, the optimum results were 3 d, 2 h, 125 microns, 50% (v/v), 1:1 ratio and pH 5 respectively. The highest cinnamaldehyde concentration for optimized conditions was 44.6 mg/L and for total phenolic content it was 13.5 mg/L. The highest eugenol concentration for optimized conditions was 14.6 mg/L.

**Keywords:** Cinnamon, cinnamaldehyde, eugenol, cinnamic acid, hexane, methanol, ethanol.

## Introduction

Cinnamon is a spice obtained from the inner bark of several trees from the genus *Cinnamomum* that is used in sweet and savoury foods. The word cinnamon comes from the Greek kinnamomon. Cinnamon contains Cinnamaldehyde, Eugenol, Cinnamic acid, cinnamyl acetate etc. (Meena Vangalapati *et al.,* 2012). Cinnamon has number of medicinal uses. It lowers the cholesterol and blood sugar levels and also used in treating type 2diabetes (Verspohl *et al.,* 2005). In Ayurvedic medicine, cinnamon oil is used for rheumatism (Mikaili *et al.,* 2012), aching joints and urinary problems. It contains unique healthy and healing property due the presence of active components. Cinnamaldehyde or cinnamic aldehyde is one of the major compounds in cinnamon. It is used as flavouring for chewing gum, ice cream, candy, and beverages and is also used in some perfumes of natural, sweet or fruity scents. Cinnamaldehyde is also known as a corrosion inhibitor for steel (Mattos *et al.,* 2012) and other ferrous alloys in corrosive fluids.

Eugenol is another component in cinnamon and it is used in perfumeries, flavourings, essential oils and in medicine as a local antiseptic and anaesthetic (Akbari *et al.,* 2010; Jaganathan and Supriyanto, 2012). They are used in formulating insect attractants, UV absorbers, analgesics, biocides, and antiseptics. They are also used in manufacturing stabilizers and antioxidants for plastics and rubbers. Eugenol is active against certain human cancer cell lines (Koppikar *et al.,* 2010). Phenolic compounds are well-known as a radical scavengers, metal chelators, reducing agents, hydrogen donors.

Phenolic compounds in plants possess strong antioxidant activity and may help to protect cell against the oxidative damage caused by free radicals (El-Baroty *et al.,* 2010). These phenolic constituents act against the damage of membrane lipids, DNA, protein and cellular organelles, early aging and etc (Moselhy *et al.,* 2009). Considering the above facts, this study was aimed to extract phenolic compounds like cinnamaldehyde and eugenol. Optimization of physico-chemical parameters namely effects of different solvents, soaking time, extraction time with hexane, particle size, different solvent percentages, different volumes of hexane with methanol and ethanol as solvents and pH for the extraction of cinnamaldehyde, total phenolic content and eugenol were carried out.

## Materials and methods

*Chemicals and reagents:* Folin-Denis reagent, sodium carbonate ($Na_2CO_3$), 1-nitroso-2-napthol solution, nitric acid ($HNO_3$), hydrochloric acid (HCl), cinnamon powder, methanol, ethanol, ethyl acetate, hexane and distilled water.

*Collection of plant material:* Bark of cinnamon was collected from a local market at Visakhapatnam, AP. The bark was cleaned and dried under sunlight for 24 h. The dried bark was powdered and used as a raw material and stored in an air tight container. Cinnamon powder was sieved by using different particle sizes ranging from 354 to 125 microns.

*Preparation of the extract:* Cinnamon powder (2 g) was added with ethanol (25%) and methanol (25%) in different flasks and the volume was made 50 mL.

The solution was soaked for 1 d and 3 d respectively. After the soaking time, the solution was filtered using Whatman No.1 filter paper and the filtrate solution was heated to 78°C and 65°C and made up to 50 mL with distilled water and hexane and incubated for 2 h.

*Estimation of the compounds:* Total phenolic content and cinnamaldehyde was estimated according to the method of Folin-Denis (Schanderl, 1970). Eugenol was estimated according to the method of (Olcay, 1968).

## Results and discussion

Different organic solvents such as methanol, ethanol, ethyl acetate and water were used to extract the optimum yield of cinnamaldehyde, total phenolic content and eugenol from cinnamon species. For cinnamaldehyde and total phenolic content, methanol showed best results and the concentrations were 23.625 mg/L, 9 mg/L respectively. For eugenol, ethanol showed best results and its concentration was 12.4 mg/L (Fig. 1). The samples were incubated under proper conditions at different time intervals viz., 1, 2, 3 and 4 d to investigate the influence on extraction of cinnamaldehyde and total phenolic content and eugenol. It was observed that 3$^{rd}$ was the best soaking time for the extraction of cinnamaldehyde and total phenolic content and the concentrations were 30.2 mg/L, 10.8 mg/L. Second day was suitable for the extraction of eugenol and its concentration was 12.5 mg/L (Fig. 2).

To investigate the influence of hexane on extraction of cinnamaldehyde, total phenolic content and eugenol different time intervals were taken viz., 1, 2, 3 and 4 h. Solvent-Solvent extraction was done with hexane as one of the solvent. The optimum concentrations were observed at 2$^{nd}$ h and concentrations were 30.4 mg/L, 10.9 mg/L and 12.6 mg/L respectively (Fig. 3). Different particle size viz., 354, 328, 250, 205, 149, 125 and 74 microns were used to find out the optimum concentrations of cinnamaldehyde, total phenolic content and eugenol. The present investigation suggests that the extraction of cinnamaldehyde, total phenolic content and eugenol at different particle sizes indicates that the optimum particle size was 125 microns for extraction of cinnamaldehyde, total phenolic content and eugenol. The optimum concentrations were 30.5 mg/L, 11 mg/L and 12.8 mg/L (Fig. 4). Percentage of the solvent plays a vital role for the extraction of components. Different solvent (methanol and ethanol) percentages namely 0%, 20%, 40%, 50%, 60%, 80% and 100% showed significant variations. Figure 4 showed that optimum solvent percentages were at 50% methanol for both cinnamaldehyde and total phenolic content and 80% ethanol for eugenol and the concentrations were 31 mg/L, 11.2 mg/L and 13.5 mg/L respectively. The observed results for eugenol were found to be coincidence with the results obtained by Kamaliroosta *et al.* (2012) for cinnamaldehyde. The total phenolic content results coincide with the findings of Kubo *et al.* (1996) (Fig. 5).

Fig. 1. Effect of different solvents for the extraction of phenolic components.

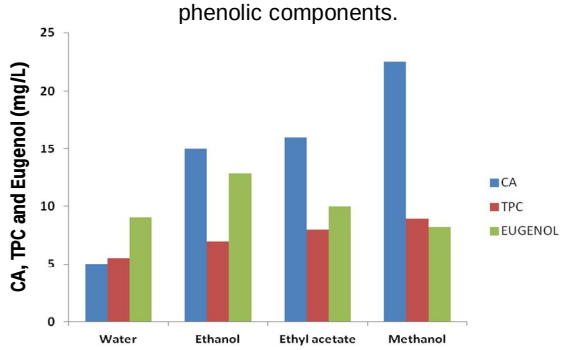



Fig. 2. Effect of soaking time for the extraction of phenolic components.

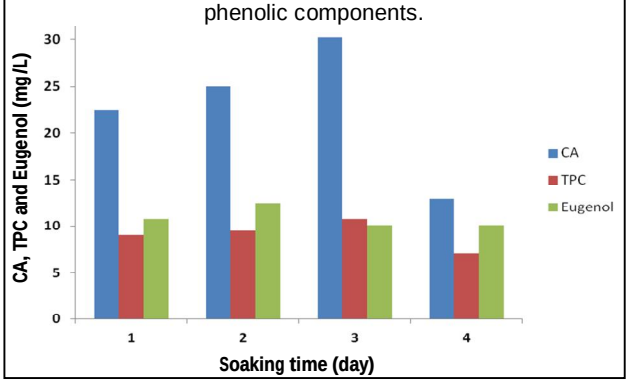



Fig. 3. Effect of extraction time with hexane for the extraction of phenolic components.

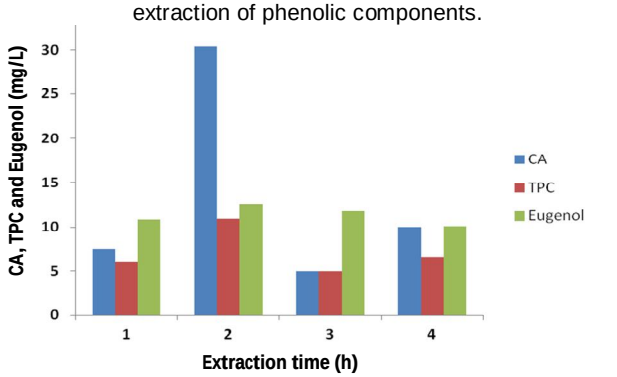
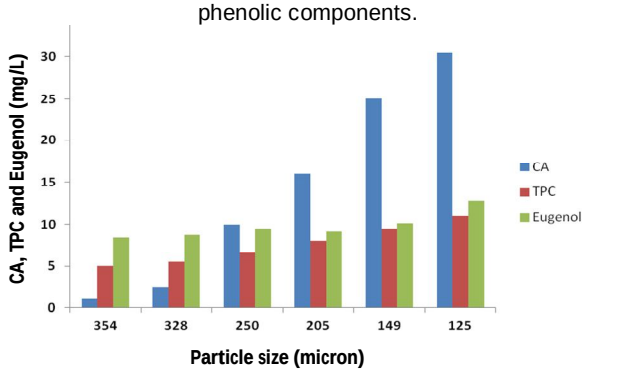



Fig. 4. Effect of different particle size for the extraction of phenolic components.



To determine the volume of hexane for the extraction of cinnamaldehyde, total phenolic content and eugenol, different volumes of hexane with solvent (methanol and ethanol) were made in the ratio 2:1, 1:1, 1:2 and 1:3. These different volumes and solvents (methanol and ethanol) showed a significant effect on the extraction. The optimum extraction of cinnamaldehyde and total phenolic content were achieved at 1:1 with methanol. The optimum concentrations were 32.5 mg/L, 11.8 mg/L. For eugenol, the optimum extraction was recorded at 1:1 with ethanol and the concentration was 14.2 mg/L (Fig. 6). The findings of the study are in corroboration with the report by Gulab *et al.* (2005). To determine the effect of pH on the extraction process, different pH values namely 5, 6, 7, 8, and 9 were used. It was observed that the extraction of cinnamaldehyde, total phenolic content were found to be optimum at pH 8.0 and optimum concentrations were 42.5 mg/L, 13.5 mg/L. The optimum pH for eugenol was 5 at an optimum concentration of 14.6 mg/L (Fig. 7). The observed results were in accordance with the findings of Mattos *et al.* (2012) and Baseri *et al.* (2009).

Fig. 5. Effect of solvent percentages for the extraction of phenolic components.

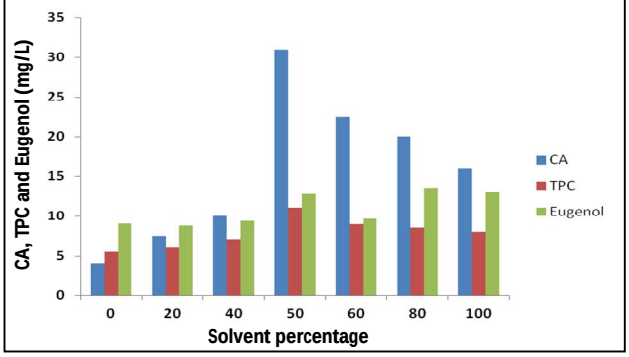
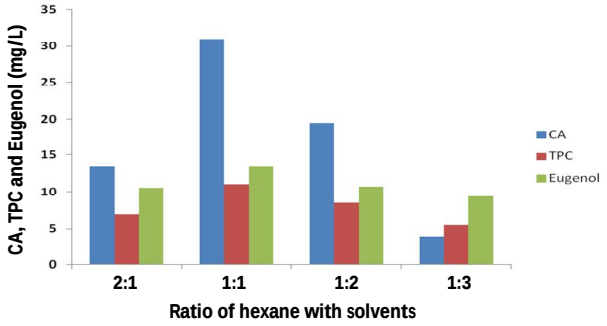



Fig. 6. Effect of different volumes of hexane with solvents for the extraction of phenolic components.




## Conclusion

In this study the extraction of phenolic compounds like cinnamaldehyde, and eugenol were carried out. Optimization of physico-chemical parameters namely effects of different solvents, soaking time, extraction time with hexane, particle size, different solvent percentages, different volumes of hexane with methanol and ethanol as solvents and pH for the extraction of cinnamaldehyde, total phenolic content and eugenol were studied. For the extraction of cinnamaldehyde, the optimum results were 3 d, 2 h, 125 microns, 50% (v/v), 1:1 ratio and pH 5 respectively. The highest cinnamaldehyde concentration for optimized conditions was 44.6 mg/L and for total phenolic content it was 13.5 mg/L. The highest eugenol concentration for optimized conditions was 14.6 mg/L.

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