

DEVELOPMENT OF A FUNCTIONAL FOOD ADDITIVE FROM
CINNAMON BARK RESIDUE
(REMAIN AFTER OIL DISTILLATION)

By

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DECLARATION

“The work of this thesis was carried out by me at the Herbal Technology Section and Pilot Plant of Industrial Technology Institute, under the supervision of Dr G.A.S. Premakumara, Mr. K.R. Dayananda and Dr U.M. Senanayake and this has not been submitted in whole or in part to any University or Institution for another Degree/ Diploma”

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"We certify that the above statement made by the candidate is true and that thesis is suitable for submission to the University for the purpose of evaluation."

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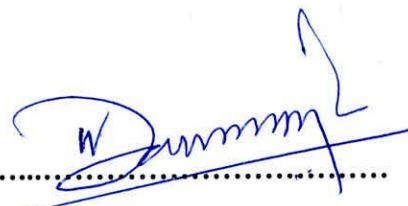
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ABBREVIATIONS

| | |
|-------|---|
| w /w | Weight basis |
| USDA | United State Department of Agriculture |
| BC | Before Christ |
| IDDM | Insulin-dependent diabetes mellitus |
| NIDDM | Non-insulin-dependent diabetes mellitus |
| LDL | Low density lipoprotein |
| HDL | High density lipoprotein |
| CE | Common Era |
| BCE | Before the Common "Christian", or "Current Era" |
| AD | <i>Ano Domini</i> |
| GRAS | Generally recognized as safe |
| FDA | Food and drug authority |
| USA | United State of America |
| MHCP | Methyl hydroxyl chalcone polymer |
| MPN | Most probable number |
| SLS | Sri Lanka Standard |
| DF | Dietary fiber |
| IP | Indigestible protein |

**DEVELOPMENT OF A FUNCTIONAL FOOD ADDITIVE FROM CINNAMON
BARK RESIDUE (REMAIN AFTER OIL DISTILLATION)**

BY Meemanage Sisira Nandana Perera

ABSTRACT

Cinnamomum zeylanicum (Family: Lauraceae) is one of the world's most popular spices. It is locally known as "Kurundu" and widely distributed in Galle and Matara districts in Sri Lanka. *C. zeylanicum* is known to possess a broad spectrum of pharmacological and medicinal properties. Water soluble polyphenol polymers and dietary fiber found in cinnamon exhibit cholesterol and triglyceride lowering effect, insulin stimulating activity, antioxidant activity and many other health benefits.

In Sri Lanka large quantities of cinnamon waste is accumulated in cinnamon oil distillation plants. Furthermore, bioactive polyphenolic compounds are remained in the cinnamon waste without any disturbances during the oil distillation process. At present, there is no process developed to give a value addition to the cinnamon waste in Sri Lanka. Therefore, the main objective of the present study was to develop a process to get an instant cinnamon powder from cinnamon bark waste that remains after oil distillation. In addition, development of functional food additives from cinnamon waste and determination of nutritional parameters such as polyphenol content, dietary fiber content and mineral content were also some of the other objectives.

In the present study, water soluble components were extracted to boiling water and concentrated under vacuum at 70-80 °C and the cinnamon concentrate was obtained. The total solid content in the cinnamon concentrate was found to be 12 % and this factor was

used as the standard parameter for the cinnamon concentrate. Further, cinnamon concentrate was subjected to spray drying and the instant cinnamon powder was obtained. In order to develop a nutraceutical, gelatin capsules were filled with instant cinnamon powder (approx. 300 mg each) and standardized by determining the polyphenol content. Each cinnamon capsule contained 14.3 % total polyphenols. Cinnamon tablet was formulated using cinnamon concentrate (containing 12 % total soluble solids) obtained from oil distilled cinnamon waste and ground cinnamon bark powder in a ratio of 3:1 (w/w). This tablet was rich in polyphenols (5.9% w/w), dietary fiber (72.2 % w/w) and minerals (Ca: 3239 mg, Mn: 11.3 mg, and Fe: 12.8 mg in Cu 2.9 mg and Zn 1.3 mg in 100g of tablet). Cinnamon enriched bread was formulated with addition of 2 % - 5 % blended powder and sensory quality was evaluated. The panel accepted the bread that incorporated 5 % cinnamon powder with the highest rating.

This is the first report of utilization of cinnamon waste to develop instant cinnamon powder in Sri Lanka. In addition, cinnamon capsules, tablets and value added products obtained from the same waste were also formulated which could be consumed as a functional food additive to improve general health.

CHAPTER 1

INTRODUCTION

Ceylon Cinnamon (*Cinnamomum zeylanicum*) is a genus indigenous to Sri Lanka. Cinnamon has been in use since at least 2700 B.C. and it is one of the world's most popular spices. In Sri Lanka, Dutch Settlers started commercial cultivation of Cinnamon in 1767 but market expanded during British period and large shipments moved to serve the European market. The traditionally known cinnamon was the peeled cinnamon bark (Wijesekera, 1978). After harvesting, the leaves and the tender stems are removed and the shoots are taken for 'peeling'. Peeling is a very specialized operation demanding the use of skilled labour. First, the soft outer bark is scraped off with a fine rounded rasp. Then two longitudinal cuts are made in the bark to enable a fine string of bark to be removed. The rest of the bark, which is in tubular form is gradually loosened and peeled off with a blunt knife. The peeled bark is then carefully rolled into another to form a packing of concentric tubes. Small pieces of the bark left after peeling are stuffed inside these tubes, which reach a length of about 1 m. They are allowed to dry initially 2 hours in the sun and then on coir rope racks in the shade. Periodically they are hand compressed to help acquire the tubular form, which is known in commerce as 'quills'. The 'quills' facilitate storage and transportation. These quills are exposed to smoke of Sulphur for about 24 hr for sterilization and prevent the growth of fungi and moulds during storage. These quills are graded according to the quill diameters, number of quills per kg, thickness and the colour. The finest and smoothest quality quills are said to be the best and name as "Alba". About

90% of cinnamon produce is exported as quills which count to ~15000 t annually (Wijesekera, 1978).

Broken pieces of quills of various grades are called quillings and marketed as “medium quality” cinnamon ‘Feather like’ short shavings and small pieces of bark left over in the process of making quills are called featherings and these are also marketed as “medium quality” cinnamon. Both quillings and featherings have the distinct aroma and taste similar to quills even though they fall into a lower grade and sold at lesser price. Both types use as the raw material for cinnamon bark oil industry (Wijesekera, 1978).

Cinnamon bark taken from cinnamon tree (*Cinnamomum zeylanicum*) is used as a spice, which is generally formed in to quills or as ground powder. There are more than one hundred varieties of cinnamon. Ceylon cinnamon (*Cinnamomum zeylanicum*) and Chinese cinnamon (*Cinnamomum aromaticum*) are the leading varieties consumed as spice. Ceylon cinnamon is also referred to as “true cinnamon”, while the Chinese variety is known as “cassia” or Chinese cinnamon while both are relatively similar in characteristics and both has a fragrant, sweet and warm taste. However, flavor of the Ceylon variety is more refined and subtle. Cinnamon has a long history both as a spice and as a medicine. Ceylon cinnamon is rare in EU market than the cassia, the less expensive variety, which is marketed in large quantity. It is reported that cassia contains significant amounts of coumarin (15%) as toxic compound where as Ceylon cinnamon contains trace amounts. Ceylon cinnamon is produced in Sri Lanka, India, Madagascar, Seychelles, Brazil and the Caribbean while cassia is mainly produced in China, Vietnam, Indonesia and several other Asian countries.