

Proximate Composition and Mineral Analysis of Cinnamon

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Abstract: A study was conducted to know the nutritive value of cinnamon in the Department of Human Nutrition, NWFP Agricultural University, Peshawar. The standard procedures of AOAC (2003) were followed to analyze the proximate composition and mineral analysis. The caloric value was calculated from crude protein, crude fat, crude fiber, carbohydrate, moisture and ash content. The iron (Fe), zinc (Zn), calcium (Ca), chromium (Cr), manganese (Mn) and magnesium (Mg) were determined by Atomic Absorption Spectrophotometer, sodium (Na) and potassium (K) by Flame Photometer and phosphorus (P) by Spectrophotometer. The results revealed that cinnamon contained ash (2.4%), crude protein (3.5%), crude fat (4%), crude fiber (33.0%), moisture (5.1%) and carbohydrate (52.0%). While the mineral determination gave the data that cinnamon contained iron (7.0 mg/g), Zinc (2.6 mg/g), Calcium (83.8 mg/g), Chromium (0.4 mg/g), Manganese (20.1 mg/g) and Magnesium (85.5 mg/g), sodium (0.0 mg/g), Potassium (134.7 mg/g) and Phosphorus (42.4 mg/g). This study concluded that the tested cinnamon contained highest amount of carbohydrate and lowest amount of ash. Similarly, among minerals the tested cinnamon contained highest amount of potassium and no sodium at all.

Key words: Cinnamon, carbohydrate, potassium, crude protein

INTRODUCTION

Cinnamon is one of the well known, oldest and most flavor filled spices. It belongs to the genus *Cinnamomum* of the Laurel family (Lauraceae). In Urdu, Persian and Hindi it is called as Darchini that means "China bark".

Cinnamon has many species that differ in smell, taste and color depending upon the native area or land but the important one are *Cinnamomum zeylanicum*, *Cinnamomum cassia*. *Cinnamomum zeylanicum* is known as Ceylon cinnamon or true cinnamon while cassia is the Chinese specie, both are relatively similar in characteristics and both feature a fragrant, sweet and warm taste, the flavor of the Ceylon variety is more refined and subtle. (Grieve, 1971).

Its bark is used as a spice which yields essential oil. Cassia oil is cheaper, heavier, less liquid and more abundant than the Ceylon variety. Its value depends on the percentage of cinnamic aldehyde, which it contains. There are also found in it cinnamyl acetate, cinnamic acid, phenylpropyl acetate and orthocumaric aldehyde, tannic acid and starch which is a powerful germicide, but being very irritant is rarely used in medicine for this purpose.

The cinnamaldehyde (active component) in cinnamon have health protecting effect that helps to prevent unwanted clumping of blood platelets by inhibiting the release of an inflammatory fatty acid called *arachidonic acid* from platelet membranes and reducing the formation of an inflammatory messaging molecule called *thromboxane A2* which puts it in the category of an "anti-inflammatory" food that can be helpful in lessening inflammation.

It is helpful in the treatment of several diseases including diarrhea, nausea, vomiting, flatulence, spasmodic afflictions, asthma, paralysis, excessive menstruation, uterus disorders and gonorrhoea. Its tincture is useful in uterine hemorrhage and menorrhagia. It also provides relief when faced with the onset of use during the rainy season prevents attacks of influenza. It also serves as a good mouth freshener. It is chiefly used to assist and flavor other drugs too.

Cinnamon helps people with type-II diabetes and improves their ability to respond to insulin, thus normalizing their blood sugar levels. (Khan *et al.*, 2003). Not only it improves the body's ability to utilize blood sugar, but also just smelling the wonderful odor of this sweet spice boosts brain activity. Furthermore it can also be used for natural birth control.

There are a number of uses for cinnamon in the kitchen, and cooking with it makes food a whole lot tastier. It is used often to flavor rice dishes and fish, chicken, or ham and its stick can be added to hot chocolate to give it an added cinnamon flavor. It can be used as an alternative to traditional food preservatives.

It also has other uses like dried cinnamon leaves and inner bark are used for flavoring cakes and sweets and in curry powder. They are also used in incense, dentifrices and perfumes. Cinnamon bark oil is used for flavoring confectionery and liqueurs. It is also used in pharmaceutical and dental preparations. Cinnamon leaf oil is used in perfumes and flavorings as also in the synthesis of vanillin.

As the spice, cinnamon has a prominent role in human health and we must know about its composition. The

present study was, therefore, initiated to know the proximate composition and mineral content of cinnamon to evaluate its nutritional importance.

MATERIALS AND METHODS

Collection of sample: A sample of cinnamon was collected from Qissa Khawani Bazar Peshawar for its proximate composition and mineral analysis to evaluate its nutritive value in human foods.

Grinding: The bark of cinnamon was taken and ground to powdered form by using a grinder.

Proximate composition: After bringing the samples to uniform size, they were analyzed for moisture, protein, fat, ash, fiber and nitrogen free extract by the methods of AOAC (2003) and conducted in Graduate Lab. Department of Human Nutrition, NWFP, Agricultural University Peshawar.

Determination of moisture: Moisture was determined by oven drying method. 1.5 g of well-mixed sample was accurately weighed in clean, dried crucible (W_1). The crucible was allowed in an oven at 100-105°C for 6-12 h until a constant weight was obtained. Then the crucible was placed in the desiccator for 30 min to cool. After cooling it was weighed again (W_2). The percent moisture was calculated by following formula:

$$\% \text{Moisture} = \frac{W_1 - W_2 \times 100}{\text{Wt. of sample}}$$

Where

W_1 = Initial weight of crucible + Sample

W_2 = Final weight of crucible + Sample

Note: Moisture free samples were used for further analysis.

Determination of ash: For the determination of ash, clean empty crucible was placed in a muffle furnace at 600°C for an hour, cooled in desiccator and then weight of empty crucible was noted (W_1). One gram of each of sample was taken in crucible (W_2). The sample was ignited over a burner with the help of blowpipe, until it is charred. Then the crucible was placed in muffle furnace at 550°C for 2-4 h. The appearances of gray white ash indicate complete oxidation of all organic matter in the sample. After ashing furnace was switch off. The crucible was cooled and weighed (W_3). Percent ash was calculated by following formula:

$$\% \text{Ash} = \frac{\text{Difference in Wt. of Ash} \times 100}{\text{Wt. of sample}}$$

Difference in wt. of Ash = $W_3 - W_1$

Determination of crude protein

Principle: Protein in the sample was determined by Kjeldahl method. The samples were digested by heating with concentrated sulphuric acid (H_2SO_4) in the presence of digestion mixture. The mixture was then made alkaline. Ammonium sulphate thus formed, released ammonia which was collected in 2% boric acid solution and titrated against standard HCl. Total protein was calculated by multiplying the amount of nitrogen with appropriate factor (6.25) and the amount of protein was calculated.

Reagents:

- C 0.1N HCl (standard)
- C Concentrated sulphuric acid
- C Sodium hydroxide solution 40% w/w
- C Digestion mixture: Potassium sulphate (K_2SO_4) and copper sulphate ($CuSO_4$).
- C Boric acid: Dissolved 40 g of boric acid in sufficient distilled water and made the volume up to 100 ml.
- C Indicator: Methyl red

Procedure: Protein in the sample was determined by Kjeldahl method. 0.5-1.0 g of dried samples was taken in digestion flask. Add 10-15 ml of concentrated H_2SO_4 and 8 g of digestion mixture i.e. K_2SO_4 : $CuSO_4$ (8: 1). The flask was swirled in order to mix the contents thoroughly then placed on heater to start digestion till the mixture become clear (blue green in color). It needs 2 hrs to complete. The digest was cooled and transferred to 100 ml volumetric flask and volume was made up to mark by the addition of distilled water. Distillation of the digest was performed in Markam Still Distillation Apparatus (Khalil and Manan, 1990). Ten milliliters of digest was introduced in the distillation tube then 10 ml of 0.5 N NaOH was gradually added through the same way. Distillation was continued for at least 10 min and NH_3 produced was collected as NH_4OH in a conical flask containing 20 ml of 4% boric acid solution with few drops of modified methyl red indicator. During distillation yellowish color appears due to NH_4OH . The distillate was then titrated against standard 0.1 N HCl solution till the appearance of pink color. A blank was also run through all steps as above. Percent crude protein content of the sample was calculated by using the following formula:

$\% \text{ Crude Protein} = 6.25 * x \%N$ (*. Correction factor)

$$\%N = \frac{(S - B) \times N \times 0.014 \times D \times 100}{\text{Wt. of the sample} \times V}$$

Where

S = Sample titration reading

B = Blank titration reading

N = Normality of HCl

D = Dilution of sample after digestion

V = Volume taken for distillation

0.014 = Milli equivalent weight of Nitrogen

Determination of crude fat: Dry extraction method for fat determination was implied. It consisted of extracting dry sample with some organic solvent, since all the fat materials e.g. fats, phospholipids, sterols, fatty acids, carotenoids, pigments, chlorophyll etc. are extracted together therefore, the results are frequently referred to as crude fat. Fats were determined by intermittent soxhlet extraction apparatus. Crude fat was determined by ether extract method using Soxhlet apparatus. Approximately 1 g of moisture free sample was wrapped in filter paper, placed in fat free thimble and then introduced in the extraction tube. Weighed, cleaned and dried the receiving beaker was filled with petroleum ether and fitted into the apparatus. Turned on water and heater to start extraction. After 4-6 siphoning allow ether to evaporate and disconnect beaker before last siphoning. Transferred extract into clean glass dish with ether washing and evaporated ether on water bath. Then placed the dish in an oven at 105°C for 2 hrs and cooled it in a desiccator. The percent crude fat was determined by using the following formula:

$$\%CrudeFat = \frac{Wt.of\ ether\ extract \times 100}{Wt.of\ sample}$$

Determination of crude fiber: A moisture free and ether extracted sample of crude fiber made of cellulose was first digested with dilute H₂SO₄ and then with dilute KOH solution. The undigested residue collected after digestion was ignited and loss in weight after ignition was registered as crude fiber.

Reagents:

- C Solution of sulphuric acid (0.128M) 7.1 ml, 96% per 1000 ml of distilled water
- C Solution of Potassium hydroxide (0.223M) 12.5 g per 1000 ml of distilled water
- C Acetone (foam suppresser)

Procedure: Weighed 0.153 g sample (W₀) weighed and transferred to porous crucible. Then placed the crucible into Dosi-fiber unit and kept the valve in "OFF" position. After that added 150 ml of preheated H₂SO₄ solution and some drops of foam-suppresser to each column. Then opened the cooling circuit and turned on the heating elements (power at 90%). When it started boiling, reduced the power at 30% and left it for 30 min. Valves were opened for drainage of acid and rinsed with distilled water thrice to completely ensure the removal of acid from sample.

The same procedure was used for alkali digestion by using KOH instead of H₂SO₄. Dried the sample in an oven at 150°C for 1 h. Then allowed the sample to cool in a desiccator and weighed (W₁). Kept the sample crucibles in muffle furnace at 55°C for 3-4 hrs. Cooled

the samples in desiccator and weighed again (W₂). Calculations were done by using the formula:

$$\%CrudeFiber = \frac{W_1 - W_2 \times 100}{W_0}$$

Determination of nitrogen free extract: Nitrogen Free Extract (NFE) was calculated by difference after analysis of all the other items method in the proximate analysis.

$$NFE = (100 - \% moisture + \% crude\ protein + \% crude\ fat + \% crude\ fiber + \% ash)$$

Energy calculation: The percent calories in selected samples were calculated by multiplying the percentage of crude protein and carbohydrate with 4 and crude fat with 9. The values were then converted to calories per 100gm of the sample.

Mineral determination: Mineral contents of cinnamon were determined by atomic absorption spectrometry, flame photometry and spectrophotometry according to the methods of AOAC (2003).

Wet digestion of sample: For wet digestion of sample, exactly (1.0000 g) of the powdered sample was taken in digesting glass tube. Twelve milliliters (12ml) of HNO₃ was added to the food samples and mixture was kept for overnight at room temperature. Then 4.0 ml perchloric acid (HClO₄) was added to this mixture and was kept in the fumes block for digestion. The temperature was increased gradually, starting from 50°C and increasing up to 250-300°C. The digestion completed in about 70-85 min as indicated by the appearance of white fumes. The mixture was left to cool down and the contents of the tubes were transferred to 100 ml volumetric flasks and the volumes of the contents were made to 100 ml with distilled water. The wet digested solution was transferred to plastic bottles labeled accurately. Stored the digest and used it for mineral determination.

Determination of Iron (Fe), Zinc (Zn), Calcium (Ca), Chromium (Cr), Manganese (Mn) and Magnesium (Mg) by Atomic Absorption Spectrometry

Principle: In this technique the atoms of an element are vaporized and atomized in the flame. The atoms then absorb the light at a characteristic wavelength. The source of the light is a hollow cathode lamp, which is made up of the same element, which has to be determined. The lamp produces radiation of an appropriate wavelength, which while passing through the flame is absorbed by the free atoms of the sample. The absorbed energy is measured by a photo-detector read-out system. The amount of energy absorbed is proportional to the concentration of the element in the sample.

Procedure: The digested sample was analyzed for mineral contents by Atomic Absorption Spectrophotometer (Hitachi model 170-10) in the Soil Science Laboratory, Agricultural University, Peshawar. The absorption measurement of the elements for cinnamon was read out and is given in the Table 2. Different electrode lamps were used for each mineral. The equipment was run for standard solutions of each mineral before and during determination to check that it is working properly. The dilution factor for all minerals except P and Mg was 100. For determination of Mg, further dilution of the original solution was done by using 0.5 ml original solution and enough distilled water was added to it to make the volume up to 100 ml. Also for the determination of Ca, 1.0 ml lithium oxide solution was added to the original solution to unmask Ca from Mg. The concentrations of minerals recorded in terms of "ppm" were converted to milligrams (mg) of the minerals by multiplying the ppm with dilution factor and dividing by 1000, as follows:

$$MW = \frac{\text{absorbency (ppm)} \times \text{dry wt.} \times D}{\text{Wt. of sample} \times 1000}$$

Note: Dilution factor for phosphorus is 2500, for magnesium 10000, and for other minerals including calcium, iron, potassium, sodium, manganese and chromium is 100.

Determination of Sodium (Na) and Potassium (K) by flame photometer

Principle: The flame photometer measures the emission of radiant energy when atoms of an element return to their ground state after their excitation by the high temperature of the flame. The degree of emission is related to the concentration of the element in the solution.

Procedure: Na and K analysis of the sample were done by the method of flame photometry. The same wet digested food sample solutions as used in AAS were used for the determination of Na and K. Standard solutions of 20, 40, 60, 80 and 100 milli equivalent/L were used both for Na and K. The calculations for the total mineral intake involve the same procedure as given in AAS.

Determination of Phosphorus (P) by spectrophotometry: Phosphorus in the sample was determined by the method of spectrophotometry as given below:

Principle: Colorimetric determination is based upon the principle that certain elements or compounds on reaction with suitable reagent develop color. The intensity of the color is measured with colorimeter or

spectrophotometer. The inorganic phosphorus reacts with ammonium molybdate. Ammonium phosphomolybdate is formed, which on reaction produce molybdenum blue. The blue color of the solution is measured and the amount of the phosphorus is determined.

Preparation of the mix reagent:

- C Twelve gram of the ammonium molybdate was taken and mixed with 250 ml-distilled water in a beaker (solution A).
- C 0.2908 gm antimony potassium tartarate was taken and dissolved in 500 ml H₂SO₄ (5N) solution in a volumetric flask. Enough distilled water was added to make the solution up to 1000 ml (solution B).
- C The two solutions (A and B) were mixed in a 2000 ml volumetric flask to get mix reagent. The volume of the mix reagent was made up to 2000 ml by adding distilled water.
- C 0.739 gm of ascorbic acid was mixed with 140 ml of the mix reagent in a beaker and left until dissolved to make color reagent.
- C One milliliter of wet digested duplicate food sample was taken in a plastic bottle labeled properly and to it was added 4.0ml distilled water to make a diluted volume of 5.0ml. Five milliliters (5.0ml) of color reagent was added to this volume and the total volume of this mixture (final solution) was made up to 25.0ml. The dilution factor of this solution was 2500 (100 x 25). After some time, the color of this final solution turned blue."

Phosphorus analysis: Sample from final blue solution was taken in a cuvette and introduced to spectrophotometer. The readings of the phosphorus were recorded in ppm.

Calculation of phosphorus: The calculations for the total mineral intake involve the same procedure as given in AAS.

RESULTS AND DISCUSSION

Organic constituents: This study was done to know the nutritive value of the locally available cinnamon spice. Using standard procedures, the proximate composition of the cinnamon spice were determined and presented in Table 1.

The Table 1 showed that proximate analysis of cinnamon, which is locally called as *Darchini* and revealed that it contained ash (2.4%), crude protein (3.5%), crude fat (4.0%), crude fiber (33.0%); moisture (5.1%) and nitrogen free extract i.e. carbohydrate (52%). This data was the average of the three determinations and the result obtained showed that cinnamon has high carbohydrate content. It was low in fat and protein contents as compared to carbohydrate content. It also

Table 1: Proximate Composition of the Cinnamon

Nutrient	% Composition
Moisture	5.1
Ash	2.4
Crude Protein	3.5
Crude Fat	4.0
Crude Fiber	33.0
Nitrogen Free Extract	52.0
Energy	258 Kcal/100g

Table 2: Mineral Composition of the Cinnamon

Minerals	Amount in "mg/g"
Iron	7.0
Zinc	2.6
Calcium	83.8
Chromium	0.4
Manganese	20.1
Magnesium	85.5
Potassium	134.7
Sodium	0.0
Phosphorus	42.4

provided dietary fiber. The moisture content is lower than the values reported by other scientists (Farhath *et al.*, 2001 and Hussain, 1985). The ash content, crude fiber, nitrogen free extract are almost close to the values reported by Hussain (1985). While the fat content is higher as compare to the values reported by (Farhath *et al.*, 2001 and Hussain, 1985). The energy content is slightly lower than the values reported by (Farhath *et al.*, 2001 and Hussain, 1985). The variation in results may be due to the difference in specie used and environmental conditions.

Inorganic constituents: Using standard procedures, the mineral contents of the cinnamon spice were determined and presented in (Table 2).

The Table 2 showed that tested cinnamon contained iron (7.0 mg/g), Zinc (2.6 mg/g), Calcium (83.8 mg/g), Chromium (0.4 mg/g), Manganese (20.1 mg/g), Magnesium (85.5 mg/g), sodium (0 mg/g), Potassium (134.7 mg/g) and Phosphorus (42.4 mg/g). Among the minerals cinnamon contained the highest amount of potassium and lowest amount of sodium. The calcium, iron and phosphorus contents are lower than the values reported by Hussain (1985). No other study has been found regarding mineral composition of cinnamon.

REFERENCES

- AOAC, 2003. Official methods of analysis of the association of official's analytical chemists, 17th edn. Association of official analytical chemists, Arlington, Virginia.
- Farhath, K., K.R. Sudarshanakrishna, A.D. Semwal, K.R. Vishwanathan and F. Khanum, 2001. Proximate composition and mineral contents of spices. *Ind. J. of Nutr. and Dietetics*, 38: 93-97.
- Grieve, M., 1971. The medicinal, culinary, osmotic and economic properties, cultivation and folk-lore of herbs, grasses, fungi, shrubs and trees with all their modern scientific herbs. *A Modern Herbal*, (Ed. C.f. Lyle 1985), London.
- Hussain, T., 1985. Food composition table for Pakistan. Department of Hum. Nutr.and Agric. Chem. NWFP. Agric. Uni. Peshawar.
- Khalil, I.A. and F. Manan, 1990. Text book of Chemistry I. *Bio.Analytical Chemistry 2nd Edn.* Taj Kutab Khana Peshawar.
- Khan, A., M. Safdar, M.M.A. Khan, K.N. Khattak and R.A. Anderson, 2003. Cinnamon improves glucose and lipids of people with Type II diabetes. *J. Diabetes Care*, 26: 3215-3218.