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Comparative Analysis of Medicinal Properties of Different Condiments Daily Used in Indian Food

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ABSTRACT

The hot continuous extraction (Soxhlet extraction) was carried by using different solvents from daily used condiments such as garlic, ginger, turmeric, cinnamon and clove. Those extracts were qualitatively screened for the presence of the secondary metabolites by standardized method. The extracts were quantitatively analyzed for the presence of Flavonoids and Phenolic compounds where the highest concentration of both the compounds were 432.19* and 395.04^ respectively in 70% ethanolic (v/v) extract of clove. Likewise the antioxidant activity of the acetonic extract of garlic 60.58 ± 1.596% of scavenging effect was the highest whereas succeeding highest extract for the activity was for the 95% ethanolic extract of Turmeric with 59.93±1.600% of scavenging effect. There was a trend of relatedness for the concentration of Flavonoids and Phenolic compound with the antioxidant activity. The extracts from cinnamon, clove and turmeric gave a good anti-microbial property against pathogenic bacteria and fungus. In turmeric crude we get 3 bands this shows there are 2 secondary metabolite in it but in purified sample we get 3 band as we use petroleum ether instead of hexane in purified sample so it may be the reason that as petroleum ether is slightly polar it break curcuminoid into curcumin, demethoxycurcumin and bis-demethoxycurcumin. "Out of all samples analyzed, it was confirmed that turmeric, cinnamon and clove have the higher potential for antimicrobial property followed by garlic and ginger." (*- equivalent to mM quercetin; ^- equivalent to mM Gallic acid).

Keywords: Soxlet apparatus, organic solvents, phytochemical screening, antioxidant assay, antimicrobial assay, Thin layer Chromatography**,** Minimal Inhibitory Concentration.

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INTRODUCTION

Condiments are regarded as one of the indispensable ingredients in Indian cuisine. They are added up mostly for increasing the flavor and taste of the food we consume. The uses of spices in food is from ancient times and are scripted in many old age civilizations and literatures. Right from the Indian medicinal scripture of Ayurveda to the ancient Egyptian and Chinese scriptures, they have mentioned the medicinal and nutritional properties of these condiments[1-5]. Functional foods have been defined as "foods that provide benefit beyond basic nutrition." The definition applies to foods rather than drugs and implies a benefit beyond that supplied from calories or basic nutrition alone, including the provision of minimum required levels of vitamins and minerals. The Dietary Guidelines have recognized the concept of foods being eaten not only for the prevention of deficiencies, but to provide optimal health and to reduce the risks of common age-related chronic diseases. These benefits are likely to result from healthy dietary patterns, and the interaction of multiple compounds found in foods such as fruits, vegetables, nuts, grains, and spices. This is a relatively new area of nutrition science investigation but one that holds great promise.

MATERIALS AND METHOD

Sample Collection

The good and healthy samples such as garlic (*Allium sativum)*, ginger (*Zingiber officinale)*, turmeric (*Curcuma longa)*, clove (*Syzgium aromaticum*) and cinnamon (*Cinnamomum zeylanicum*) were purchased whole from the local market in Secunderabad, Telengana State, India.

Chemicals requirement

Different chemicals such as Fehling solution A and Fehling solution B, ethanol, Hydrochloric acid, Iodine, Sodium Hydroxide, Sulphanillic acid, Sodium Carbonate, Ferric chloride, Lead Acetate, Ammonium Hydroxide, Mercuric chloride, methanol, acetone, chloroform, concentrated sulphuric acid, Ammonia solution, picric acid, Hexane, Di-Methyl Sulphoxide, 2,20 - diphenyl-1-picrylhydrazyl (DPPH), quercetin, Gallic acid, tolox were procured from Sigma Aldrich of all Analytical grade (A.R). The double distill water was used from the unit set up in the laboratory.

Sample Processing

The selected condiments such as Garlic, Ginger, Turmeric, Clove and Cinnamon were all subjected to soxlet extraction method[6] with different solvents. Garlic: The whole garlic bulb was taken, peeled off, washed with distill water and then by 70% ethanol. The garlic bulb were shade dried and powdered using Mortar and Pastle. The dried powder was then put to the thimble subjected to Soxlet extractor using Acetone as solvents for 10 cycles.

Ginger: The rhizome of the ginger was first washed with distill water to remove soil and other particles. Then the rhizome was shade dried and it was powdered by using Mortar and Pastle. Dried powder was then put into the thimble subjected to Soxlet extractor using methanol as extraction solvent for 10 cycles. The methanolic extract was then desiccated using a silica gel dessicator. Likewise the powdered ginger was also extracted using Soxlet Extraction method for Acetone and Chloroform as the solvents for 10 cycles each.

Turmeric: The rhizome of the turmeric was shade dried, and then it was powdered using mortar and pastle. The dried powder was then put into the thimble of the soxlet extractor and the solvent used was 95% ethanol (v/v) for 10 cycles.

Clove: The cloves were dried and made to powder. The dried powder was then put into the thimble of the soxlet extractor and the solvent used was 70% ethanol (v/v) for 10 cycles.

Cinnamon: The cinnamon were dried and made to powder. The dried powder was then put into the thimble of the soxlet extractor and the solvent used was n-Hexane for 10 cycles.

Extract Preparation

All the extracts of sample after soxlet extraction were subjected to dessication or removal of solvents and concentrate the extract by using silica gel Dessicator.

Qualitative Screening for secondary metabolites

The extracts were further screened qualitatively for the presence of different secondary metabolites by different methods[7-16].

Quantitative Screening for Presence of Flavonoids and Phenolics

Determination of total phenolic compounds: 100 mg of the extract of the sample was weighed and dissolved in 100 ml of triple distilled water. 1 ml of this solution was transferred to a test tube, then 0.5 ml 2N of the Folin-Ciocalteu reagent and 1.5 ml 20% of Na_2CO_3 solution was added and the volume was made upto 8 ml with Triple Distill Water followed by vigorous shaking. This was allowed to stand for 2 hours. The absorbance was measured at 765nm in a calibrated UV-Visible Spectrophotometer. The total phenolic content was estimated using a standard calibration curve of gallic acid. (50 mM, 100 mM, 150 mM, 200 mM, 250 mM, 300 mM, 350 mM, 400 mM, 450 mM and 500 mM concentration of gallic acid working solution was prepared in 50% aqueous methanol)[17].

Determination of total flavonoids:

For estimation of total flavonoids content, quercetin (50, 100, 150, 200, 250, 300, 350, 400, 450 and 500 µL of 1 M stock solution in distilled water) was used for the calibrating standard curve. 100 µL of extract was taken in a 10 ml test tube containing 4 ml distilled deionized water and 0.3

ml 5% sodium nitrite. After 5 min 0.3 ml of 10% aluminium chloride was added. Then after 5 minutes, 2ml of 1M NaOH was added and total volume was made upto 10 ml with distilled water. This solution was then mixed well and absorbance was measured against a prepared reagent blank at 415 nm. It was observed that the yellow colour was intensified on addition of aluminium chloride and the colour changed to pink on addition of sodium hydroxide[18].

Thin Layer Chromatography

The slurry of silica gel for TLC was prepared by dissolving it with distill water. The slurry was spreaded over the TLC plate or slide from center to the end and allowed to evaporate the water for 3 hrs. It was then baked at 110°c for 15 minutes. About 10µl of the plant extract was loaded on TLC plate about 1cm above. Then it was kept in a TLC buffer tank containing mobile phase buffer. Different buffers were made for different extracts such as for garlic extract – Hexane : Isopropanol (3:1), for ginger extract - Hexane : Ethyl acetate (2:1), for turmeric extract - chloroform : methanol (48: 2), for cinnamon extract - hexane: dichloromethane (1:9) and for clove extract Chloroform: methanol: water (10:10:3). After TLC is finished, the TLC plates were analyzed for bands as colour bands or Chromatogram. They were also analyzed in UV trans illuminator at 254 nm and 366 nm for some illuminates bands or by iodine charring or by sulphuric acid charring (80% cold methanol+20% Sulphuric acid). The movement of the analyze was expressed by its retention factor (Rf).

R f = Distance travel by solute / Distance travel by solvent

Column Chromatography

Silica gel for column chromatography (200-600 mesh) was first baked at 150^0C for 1 hour. Then it was dissolved in Dimethyl sulphoxide (DMSO). This mixture was then put into the glass column without making any voids in the stationary phase of silica gel and the DMSO was elutes 2-3 times to maintain the equilibrium. The mobile phase for garlic was used a mixture of petroleum ether and ethyl acetate in ratio- first elute petroleum ether: ethyl acetate (1:1), second elute Petroleum ether: ethyl acetate (1:2). Likewise for ginger the elutes used as a mixture of toluene: ethyl acetate (93:7) and the second elute as n-hexane: petroleum ether (40:60). For turmeric the elutes used a mixture of solvents in ratio- first elute chloroform: formic acid (15:1), second elute chloroform: acetone: formic acid (1:1:1). The mobile phase for clove extract were used as toluene: dichloromethane (9:1) and the second elute as benzene: chloroform (9:1). For the Cinnamon extract the elutes used as petroleum ether: ethyl acetate (5:1) and the as second elute ethyl acetate: petroleum ether (10:1). Each elute were then subjects twice to the column for each plant extract sample. The extracts for the column chromatography was prepared by dissolving in Dimethyl sulphoxide (DMSO).

Antimicrobial Assay Pathogenic Organism Isolation and identification

The blood sample of jaundice patient and cow dung was collected and serially diluted[19]. 100µl of the diluents from both the samples were taken and then they were spread plated on Nutrient Agar Media[20], and Sabouraud Dextrose agar (containing 0.1% Streptomycin antibiotics**)**[21]. The Nutrient Agar Medium was incubated in incubator at 37^0C for 24 hours. The Sabouraud Dextrose agar plates were incubated at 30^0C for 96 hours. The organisms isolated from Nutrient Agar Media were first screened by their colony morphology and then were gram stained[22] to identify their structure. Then they were identified by different biochemical test by *Bergey's Manual of Determinative Bacteriology*, 9th Edition[23]. The unknown bacteria were identified by different staining methods and biochemical tests[24-27] such as Endospore staining, Acid Fast staining Catalase test, Starch Hydrolysis test, Methyl Red, Voges Proskauer test, Citrate utilization test, sugar fermentation test, 6.5% NaCl test. The fungus were identified as in James, G. C. and Natalie, S. (2001)[28].

Antimicrobial activity

The different desiccated extracts were then dissolved in Di-Methyl Sulphoxide (DMSO) solution with final concentration of 3% (w/v). The antibacterial activity of the different extracts was determined in accordance with agar-well diffusion method described by Rious et al. (1988)[29]. The bacterial isolates were first grown in a Beef Extract Peptone broth for 18 hours before use and standardized to 0.5 McFarland standards (106 cfu/ml). Two hundred microlitre of standardized cell suspensions were spread on a Mueller-Hinton agar. Wells were then bored into the agar using a sterile 6mm diameter cork borer. Approximately 100 µl of the extracts were introduced into the wells, allowed to stand at room temperature for about 2 hours and then incubated at 37°C. Controls were setup in parallel using the solvents that were extracted. The plates were observed for zone of inhibition after 24 hours. Likewise, for fungal isolates Potato Dextrose Broth was prepared and was incubated at 30^0C for 72 hours. 200µL of standardized cell suspensions were spread on a Potato Dextrose Agar plates. Wells were then bored into the agar using a sterile 6mm diameter cork borer. Approximately 100 µl of the extracts were introduced into the wells, allowed to stand at room temperature for about 2 hours and then incubated at 30°C. Controls were setup in parallel using the solvents that were extracted. The plates were observed for zone of inhibition after 96 hours.

Anti-oxidant Activity

The free radical scavenging activity of the fractions was measured *in vitro* by 2,20 - diphenyl-1-picrylhydrazyl (DPPH) assay according to the method described earlier by Brand-Williams W et

al, (1995), Bursal E, et al (2011)[30-31]. The stock solution was prepared by dissolving 24 mg DPPH with 100 ml methanol and stored at 20°C until required. The working solution was obtained by diluting DPPH solution with methanol to attain an absorbance of about 0.98±0.02 at 517 nm using the spectrophotometer. 3 ml aliquot of this solution was mixed with 100 µl of the sample at various concentrations (10 - 500 µg/ml). The reaction mixture was then shaken well and incubated at room temperature in the dark condition for 15 minutes. Then the absorbance was taken at 517 nm. The control was prepared as above without any sample. Antioxidant capacity was evaluated in terms of trolox equivalent (400mM stock solution was prepared in methanol). The scavenging activity was estimated based on the percentage of DPPH radical scavenged as the following equation and Gallic acid was used as positive control.

Scavenging effect (%) = [(control absorbance **-** sample absorbance) **/ (**control absorbance)] **x** 100

RESULT AND DISCUSSION

The Soxlet extracts such as ethanolic extract of garlic, acetonic extract of ginger, chloroformic extract of ginger, Methanolic extract of ginger, 95%(v/v) ethanolic extract of Turmeric, 70%(v/v) ethanolic extract of clove and Hexane extract of Cinnamon were subjected to phytochemical screening to determine the presence of different phytochemicals in the given samples (Table 1)

Table 1: Phytochemical Screening of soxlet extracts for different samples

Plant extract	Steroid	Alkaloid	Flavonoid	Tannin	Saponin	Quinone	Coumarin	Protein	Phenol	Gum
Garlic- Acetone	-ve	+ve	+ve	+ve	+ve	-ve	-ve	+ve	+ve	-ve
Ginger-Acetone	+ve	+ve	+ve	-ve	-ve	-ve	+ve	-ve	-ve	-ve
Ginger-Chloroform	-ve	-ve	-ve	+ve	+ve	+ve	+ve	+ve	-ve	+ve
Ginger-Methanol	-ve	+ve	+ve	-ve	-ve	-ve	+ve	-ve	+ve	-ve
Turmeric 95%Ethanol	-ve	+ve	-ve	-ve	-ve	+ve	-ve	-ve	+ve	-ve
Cinnamon- Hexane	-ve	-ve	+ve	+ve	+ve	-ve	-ve	-ve	-ve	+ve
Clove- 70% Ethanol	+ve	+ve	+ve	+ve	-ve	-ve	+ve	-ve	+ve	-ve

+ve – present; -ve – absent

The next step was to estimate the Quantitatively the concentration of Flavonoids and Phenolic compound (Table 2, Figure 3) using the standard graph total flavonoid content (Figure 1) and total phenolic compound (Figure 2) respectively

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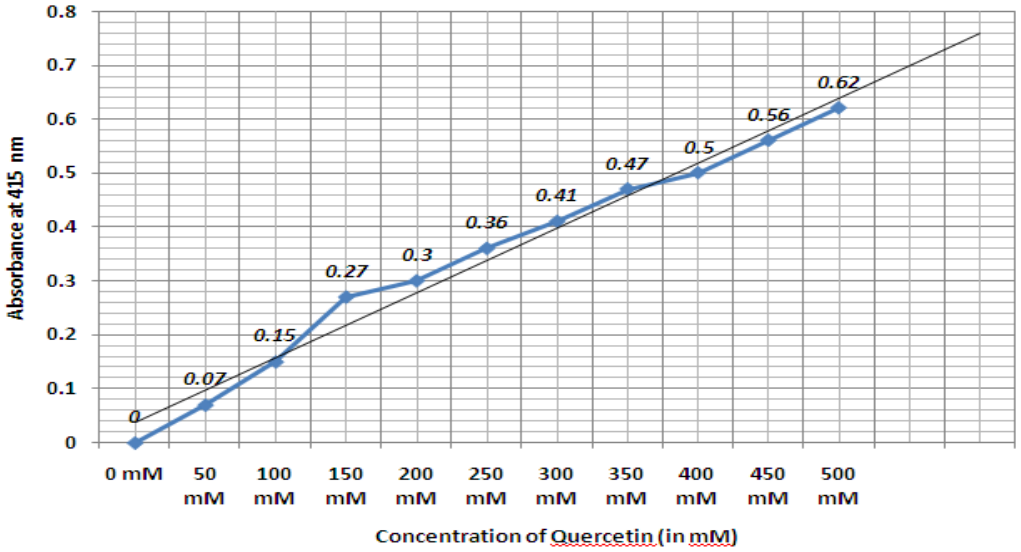

Figure 1: Standard curve for total Flavonoid content.

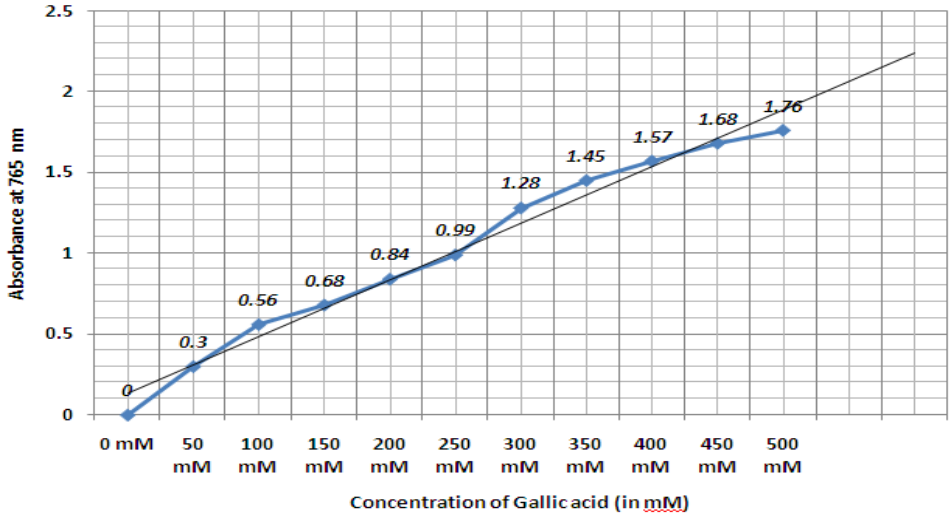

Figure 2: Standard curve for total phenolic content.

Table 2: Quantitative Estimation of Flavonoids and Phenolic Compounds in different soxlet extracts.

Sample	Total Flavonoid Content*	Total Phenolic Content^
Garlic – Acetone	357.56	279.64
Ginger- Acetone	67.67	N.A.
Ginger - Chloroform	N.A.	N.A.
Ginger- Methanol	83.45	60.63
Turmeric- 95% Ethanol	N.A.	85.40
Cinnamon- Hexane	207.56	129.64
Clove – 70 % Ethanol	432.19	395.04

N.A. = not required/ adapted (data derived from Table 1 for absence of the particular compound)

*****- equivalent to mM quercetin; ^- equivalent to mM Gallic acid.

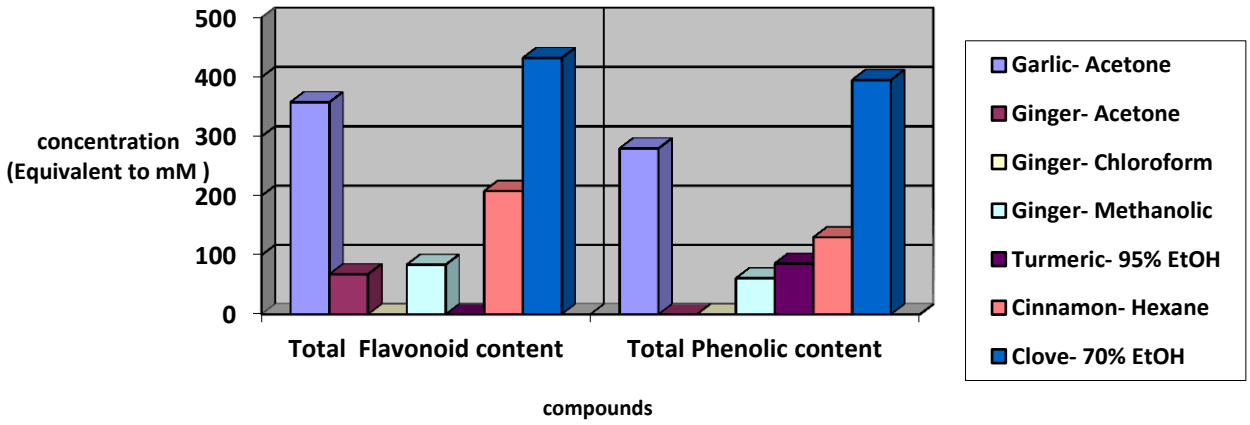

Figure 3: Comparative study for Total Flavonoid and Total Phenolic content in extracts.

The antioxidant property of the Soxlet extracts was then analyzed by using standard DPPH method. (Table 3, Figure 5). Figure 4 shows the DPPH radical scavenging activity with increase in trolox concentration.

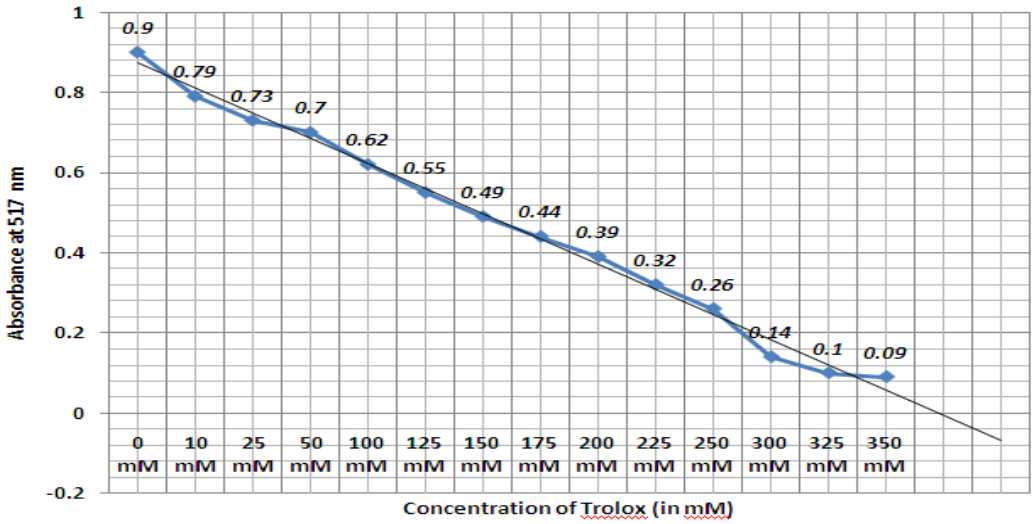

Figure 4: Standard curve of DPPH radical scavenging activity with increase in trolox concentration.

Table 3: Scavenging Effect of different soxlet extracts by standard DPPH method.

SAMPLE	Scavenging Effect (in %)
Garlic – Acetone	60.58 ± 1.596
Ginger- Acetone	28.16 ± 1.516
Ginger - Chloroform	N.A.
Ginger- Methanol	34.87 ± 1.516

Turmeric- 95% Ethanol	59.93 ± 1.600
Cinnamon- Hexane	37.22 ± 0.159
Clove – 70 % Ethanol	53.35 ± 0.718

N.A. = not required/ adapted (data derived from Table 1 & 2 for absence of the particular compound)

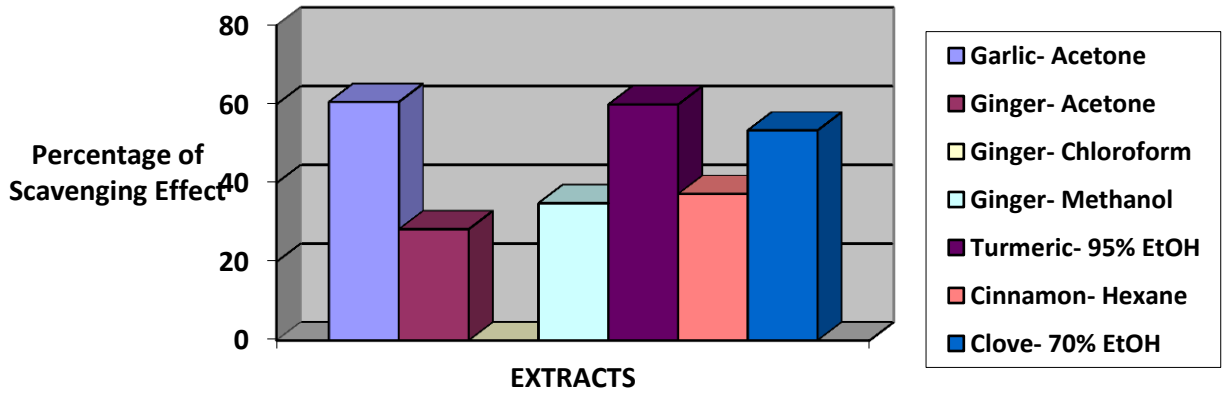

Figure 5: Comparative analysis for scavenging effect of different extracts.

The pathogenic organisms were isolated from different clinical samples collected and are identified by gram staining and different biochemical tests (Table 4). Different bacteria that were isolated were confirmed by different biochemical tests were *Staphylococcus aureus, Corynebacterium xerosis, Bacillus cereus, Escherichia coli, Bacillus macerans, Micrococcus roseus* . Different pathogenic fungus that were isolated were *Candida sp. Aspergillus flavus,* and *Aspergillus niger.*

Table 4: Biochemical Test Results for identification of unknown bacteria.

	C1	C2	C3	C4	C5	C6
Gram Staining	**Gram positive cocci, cluster**	**Gram positive rod**	**Gram Positive rod**	**Gram negative rod**	**Gram Positive rod**	**Gram Positive cocci, cluster**
Endospore staining	#NA	Negative	Positive	#NA	Positive	#NA
Acid – Fast Staining	#NA	Negative	#NA	#NA	#NA	#NA
Starch Hydrolysis	#NA	Negative	Positive	#NA	Positive	#NA
Oxidase Test	#NA	#NA	#NA	Negative	#NA	#NA
Indole Test	#NA	#NA	#NA	Positive	#NA	#NA
Voges Proskauer (VP test)	#NA	#NA	Positive	#NA	Negative	#NA
Citrate Utilization test	#NA	#NA	#NA	Negative	#NA	#NA
Motility test	#NA	#NA	Positive	#NA	#NA	#NA
6.5% NaCl growth	#NA	#NA	#NA	#NA	Positive	#NA
Arabinose Fermentation	#NA	#NA	#NA	#NA	Positive	#NA
Lactose Fermentation	#NA	#NA	#NA	Positive	#NA	#NA
Glucose fermentation with Gas production	#NA	#NA	#NA	#NA	Positive	Positive
Mannitol Fermentation	Positive	#NA	#NA	#NA	#NA	Negative
Catalase Test	Positive	Positive	#NA	#NA	#NA	Positive
Yellow pigmented colony	#NA	#NA	#NA	#NA	#NA	Positive
Pink coloured colony	#NA	#NA	#NA	#NA	#NA	Positive
IDENTIFIED MICROBES	*S. aureus*	*C. xerosis*	*B.s cereus*	*E. coli*	*B.macerans*	*M.roseus*

#NA: Procedures or Biochemical Test not adapted/not done. The fungus were identified by their morphology and staining by Lactophenol cotton blue staining. Three fungal species were identified as *Aspergillus niger, Aspergillus flavus and Candida sp.* The different extracts were screened for antimicrobial properties against pathogenic bacteria ad fungus. (Table 5 & 6)

Table 5: Anti-bacterial properties of different Plant soxlet extract.

Plant extract	***S.aureus***	***C. xerosis***	***B.cereus***	***B. macerans***	***M. roseus***	***E.coli***
Garlic- Acetone	24 mm	19 mm	06 mm	08 mm	03 mm	11 mm
Ginger-Chloroform	04 mm	02 mm	03 mm	08 mm	04 mm	05 mm
Ginger-Methanol	11 mm	18 mm	06 mm	06 mm	07 mm	12 mm
Turmeric 95%Ethanol	18 mm	27 mm	37 mm	18 mm	25 mm	22 mm
Cinnamon- Hexane	27 mm	38 mm	29 mm	27 mm	32 mm	31 mm
Clove- 70% Ethanol	19 mm	13 mm	16 mm	17 mm	25 mm	18 mm

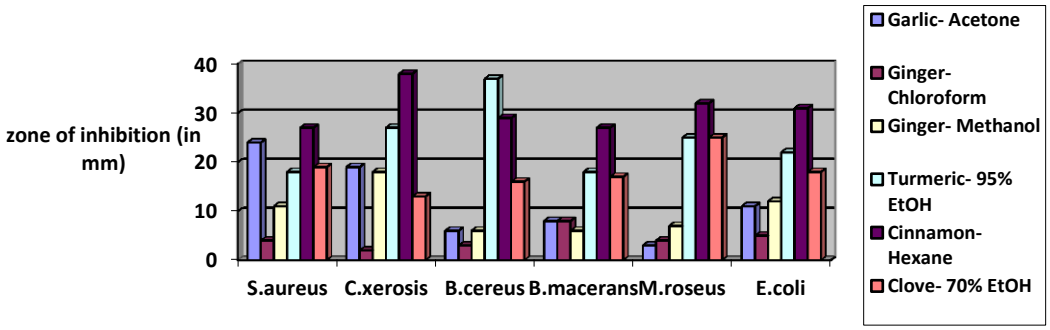

Figure 6: Zone of inhibition (in mm) of different extracts against pathogenic bacteria.

Table 6: Anti-fungal properties of different Plant soxlet extract.

Plant extract	*Candida sp*	*Aspergillus flavus*	*Aspergillus niger*
Garlic- Acetone	13 mm	09 mm	07mm
Ginger-Chloroform	06 mm	03 mm	15 mm
Ginger-Methanol	18 mm	09 mm	07 mm
Turmeric 95%Ethanol	23 mm	07 mm	10 mm
Cinnamon- Hexane	59 mm	41 mm	18 mm
Clove- 70% Ethanol	36 mm	45 mm	42 mm

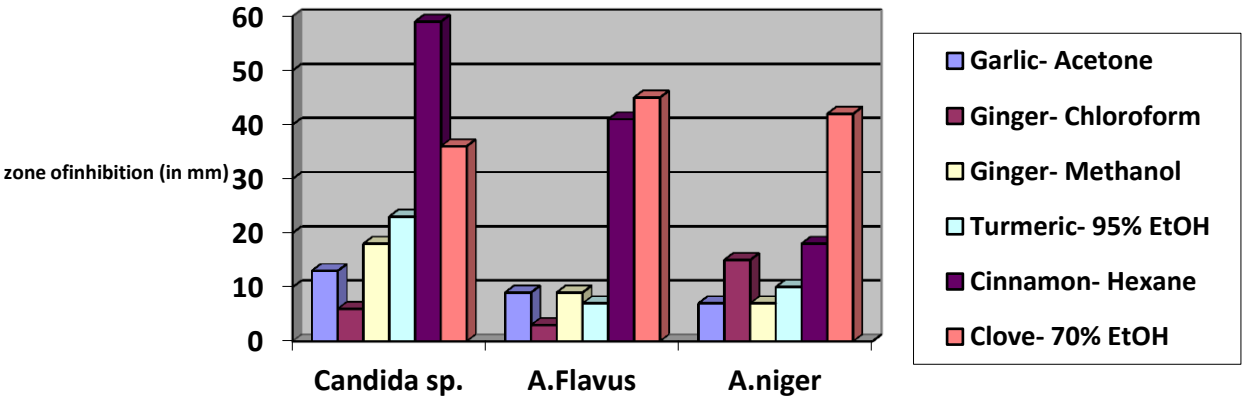

Figure 7: Zone of inhibition (in mm) of different extracts against pathogenic fungus.

The Soxlet extracts were then subjected to silica gel column chromatography and they were then analyzed by using Thin Layer Chromatography (TLC). (Table 7)

Table 7: Thin Layer Chromatography of Different extracts.

Sample	Soxlet extraction		Column - Elute 1		Column - Elute 2	
	BANDS	Rf	BANDS	Rf	BANDS	Rf
Garlic- Acetone	1	0.76	1	0.16	1	0.88
Ginger-Methanol	1	0.61	1	0.61	1	0.43
Turmeric 95%Ethanol	2	0.53, 0.63	2	0.63, 0.65	3	0.65,0.5,0.7
Cinnamon- Hexane	1	0.76	1	0.91	1	0.8
Clove- 70% Ethanol	1	0.61	1	0.76	1	0.8

For minimal inhibitory concentration prediction, different working solution ranging from 2.5µg/mL to 500µg/mL with a range of 2.5. were made and were tested against the pathogenic organisms. The mid-value of inhibitory concentration was the IC_{50} which represent the effectiveness of the drug against pathogens represents the concentration of a drug that is required for 50% inhibition. The IC_{50} was determined by plotting the dose response curve of each sample with each pathogenic micro-organism. (Table:8)

Table 8: Minimal inhibitory concentration of extracts against pathogenic micro-organisms.(IC_{50}) (µg/mL).

	Staphylococcus aureus	***Corynebacterium xerosis***	***Bacillus cereus***	***Bacillus macerans***	***Micrococcus roseus***	***E.coli***	***Candida sp***	***Aspergillus flavus***	***Aspergillus niger***
Garlic Acetone	17.5	12.5	22.5	20.0	27.5	22.5	30.0	35.0	27.5
Ginger-Acetone	10.0	22.5	30.0	17.5	22.5	25.0	37.5	30.0	47.5
Ginger Chloroform	32.5	40.0	42.5	27.5	30.0	35.0	35.0	42.5	37.5
Ginger-Methanol	22.5	30.0	15.0	17.5	12.5	27.5	30.0	45.0	27.5
Turmeric-95% Ethanol	12.5	7.5	17.5	10.0	7.5	15.0	15.0	17.5	27.5
Cinnamon-Hexane	15.0	17.5	22.5	20.0	25.0	12.5	7.5	12.5	35.0
Clove – 70 % Ethanol	12.5	20.0	*22.5*	30.0	17.5	27.5	17.5	10.0	12.5

The extracts of Turmeric had a good inhibitory property, followed by cinnamon and clove extract. Those extracts were having a good effectiveness at lower concentration against the pathogenic micro-organism isolated and tested. (Figure: 8)

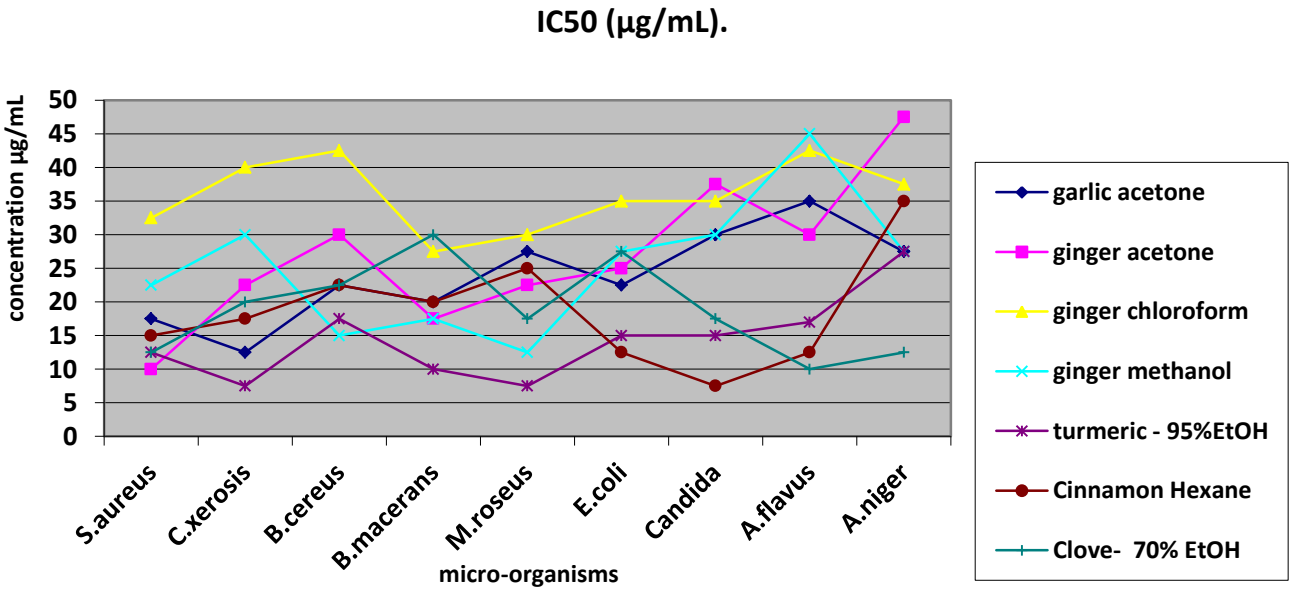

Figure 8: Effectiveness of different extracts against different pathogenic microbes at their IC_{50}.

The different regularly used condiments in Indian foods are garlic (*Allium sativum)*, ginger (*Zingiber officinale)*, turmeric (*Curcuma longa)*, clove (*Syzgium aromaticum*) and cinnamon (*Cinnamomum zeylanicum*), that add suitable flavours to the food that we eat. But these have an additional property of having antimicrobial, anti inflammatory and antioxidant activities. The present studies show that the hot continuous process helped us extracting some valuable bioactive components that are present in these condiments. Acetonic extract of Garlic, hexane extract of cinnamon and 70% ethanolic extract of clove contains most bioactive compounds by soxlet procedure. From these extracts, the total flavonoid and total phenolic compounds are quantified wherein we got highest concentration of 70% ethanolic extract of clove with 432.19 equivalents and 395.04 equivalents of their standards respectively. The succeeding high concentration of flavonoids were in acetonic extract of garlic, Hexane extract of cinnamon and succeeding concentration of phenolic were in acetonic extract of garlic, Hexane extract of cinnamon. The anti-oxidant property was highest in acetonic extract of garlic succeeded by 95% ethanolic extract of turmeric and 70% ethanolic extract of clove. There was a significant relationship between the total phenolic and flavonoid content with that of anti-oxidant property. In the antimicrobial assay, the extracts of Turmeric, Cinnamon, Clove show good results against both pathogenic bacteria and fungus. TLC is done to know how many secondary metabolites are present in the sample and also for purification. In turmeric crude we get 3 bands this shows there are secondary metabolite in it

but in purified sample we get 3 band as we use petroleum ether instead of hexane in purified sample so it may be the reason that as petroleum ether is slightly polar it break curcuminoid into curcumin, demethoxycurcumin and bisdemethoxycurcumin we know this by comparing the rf value with standard rf value. Ginger contain gingerol, Garlic contain allicin, The high activity may be attributed to the presence of eugenol, linalool, methyl chavicol and β-caryophyllene in cinnamon and eugenol, β-caryphyllene, vanillin, crategolic acid, tannins and flavonoids in cloves.

CONCLUSION

The condiments are found to be most good resource of bioactive compounds for better health prospect and these can be also harnessed for potential pharmaceutical molecule that can be converted into a drug against many serious ailments such as cancer.

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