Research Article

Estimation of the Effect of Drying on the Chemical Composition and Antioxidant Activity of the Fruits of *Momordica charantia* (Karela)

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ABSTRACT

In the present investigation, fresh and dried fruits of *Momordica charantia* (Karela), extracted with acetone, ethanol and water were used to evaluate total phenolics, flavonoids and ascorbic acid content. Their antioxidant activities were determined by the 2, 2'-Diphenyl-1-picrylhydrazyl (DPPH$^{\bullet}$) free radical scavenging method, β-carotene bleaching method (BCBT) and Ferric Thiocyanate (FTC) method. In fresh fruits total phenols (12.08 ± 0.23 mg GAE/g) and ascorbic acid (1.01 ± 0.02 mg/g) were high in acetone extract while flavonoid content (7.61 ± 0.21 mg CAE/g) was high in ethanol extract. While these components decreased in the acetone, ethanol and water extracts of the dried fruits. In dried fruits also total phenolics (6.83 ± 0.12 mg GAE/g), flavonoids (4.78 ± 0.14 mg CAE/g) and ascorbic acid (0.27 ± 0.01 mg/g) were high in acetone extract. In the case of fresh fruits, according to DPPH method, antioxidant activity of water extract was found to be maximum (91.21 ± 0.65%) while by FTC method and β-carotene bleaching method, antioxidant activity of acetone extract was found to be maximum (62.06 ± 0.81% and 67.16 ± 0.96% respectively). According to DPPH and FTC method, antioxidant activity of acetone extract was found to be maximum (86.41 ± 1.11% and 80.53 ± 1.25% respectively) and by β-carotene bleaching method, it was maximum for acetone extract (85.51 ± 0.96%). The acetone extracts in general showed maximum antioxidant activity and can be used as antioxidant in foods and medicines. The antioxidant activity of the acetone extract of the dried fruits of Karela increases in all the test methods hence dried fruit extracts can be used as rich source of antioxidants.

Keywords: *Momordica charantia*, phenolics, flavonoids, ascorbic acid, antioxidant activity.

INTRODUCTION

Crude extract of fruits, herbs, vegetables and other plants materials rich in phenolics are of increasing interest in the food industry because they retard oxidative degradation of lipids and thereby improve the quality and nutritional value of food. The preservative effect of many plant and herbs suggests the presence of antioxidative and antimicrobial constituents in their tissue.[1] Many food plants contain large amounts of antioxidants other than vitamin C, vitamin E and carotenoids.[2]

The antioxidative effect is mainly due to phenolic components, such as flavonoids, phenolic acids and phenolic diterpenes.[3] The antioxidant activity of phenolic compounds is mainly due to their redox properties, which can play an important role in absorbing and neutralizing free radicals, quenching singlet and triplet oxygen, or decomposing peroxides.[4]

The approach of phytochemicals in medicinal plants is mainly concentrated on their role in preventing diseases caused as a result of oxidative stress.

Oxidative stress releases free oxygen radicals in the body which result in damage to membrane lipids, proteins, nucleic acids, and carbohydrates, which can result in cancer, neurological diseases, lung diseases, diabetes, vascular diseases, autoimmune diseases, premature aging, and eye diseases.[5]

Momordica charantia commonly known as bitter gourd (Karela) is a member of the Cucurbitaceae family. All parts of the plant, especially roots, leaves, fruits and seeds are widely used as traditional medicine throughout Asia, East Africa and South America. Charantin or momocharin, is a typical cucurbitane-type triterpenoid (steroidal glycoside) in *M. charantia* and is a potential substance with antidiabetic properties because of its insulin like chemical effects.[6] It was reported that total phenolics in *M. charantia* were 126 ± 0.14 mg GAE/100g fresh weight.[7] The main phenolic acids, which were present in bitter melon flesh, were gallic acid, gentisic acid, catechin, chlorogenic acid, and epicatechin. Survey of the literature revealed that no systematic work has been done on the effect of drying on chemical composition and antioxidant activities of fruits of *M. charantia*.

Therefore, the objective of present study was to evaluate the effect of drying on chemical composition and antioxidant potential.

MATERIALS AND METHODS

Fresh fruits were procured from local market of Hisar (Haryana) during July-August, 2012. These were cleaned with water and external moisture wiped out with a dry cloth. The cleaned fruits were then cut into small pieces, 100g portions were homogenised at room temperature in a mortar with 50ml of distil water, ethyl alcohol and acetone as extracting medium. 500g chopped samples in triplicate were shade dried for 4-days and then were oven dried at 55°C for 2-days. These dried fruit slices were then

crushed in a grinder into fine powder form. The powdered samples were then extracted separately with acetone, ethyl alcohol and distilled water and the extract were used for determination of total phenols, flavonoids, ascorbic acid and the antioxidant activity using various methods.

Chemicals

The commercially available chemicals from Sigma-Aldrich, Qualigens, Merk and Ranbaxy of high purity, were used for various experimental procedures.

Extraction of Plant Materials

500gm fresh (40gm dried) fruits samples were extracted separately with acetone, ethyl alcohol and distilled water by refluxing for six hours and the process was repeated three times. The solvent was removed to get extractives. These extracts were filtered and concentrated under reduced pressure and used for estimation of following parameters:

Total Phenols

Flavonoids

Ascorbic acid

Antioxidant activity by

2, 2'-Diphenyl-1-picrylhydrazyl (DPPH) method

Ferric Thiocyanate (FTC) method

β-carotene bleaching method

Preparation of Extracts

The water extracts were prepared by boiling 100g of fresh fruit sample with 200ml of distilled water for 6 hours and 40 g of dried fruit sample with 100ml of distilled water, then leaving overnight at room temperature for further extraction. The mixtures were subsequently filtered and centrifuged at 6000 rpm for 10 minutes and the filtrates were stored in deep freeze.

Ethyl alcohol and acetone extracts were prepared under reflux conditions using ethyl alcohol and acetone for a period of 6 hours. The extracts were filtered and the residues were extracted again with fresh ethyl alcohol and acetone, respectively under the same conditions. The solvent of the combined filtrates was evaporated using a rotary evaporator.

Determination of Total Phenolics Content

The total phenolics were determined by the Folin-Ciocalteu reagent method using gallic acid as standard for which a calibration curve was obtained with solutions of 0.1, 0.08, 0.06, 0.04, 0.02, and 0.01 mg/ml of gallic acid.[8] A 1.0ml of diluted extract (all fraction were diluted with methanol to adjust the absorbance within the calibration limits), 1.0ml of 1mol/L Folin–ciocalteau reagent (diluted to 1:2 ratio) and 2.0ml of Na_2CO_3 (20% w/v) were mixed and the volume was made to 50ml. After 8 minutes, the mixture was centrifuged at 600 rpm for 10 minutes. Then the absorbance of supernatant solution was measured at 730nm using Spectronic 20 (Milton Roy Company) spectrophotometer and against a blank prepared similarly with the same solvent but omitting the extract. The concentration of phenolics thus obtained was multiplied by the dilution factor and the results were expressed as the equivalent to milligrams of gallic acid per gram of extract (mg GAE/g).

Determination of Flavonoid Content

Flavonoids content of extracts was estimated according to the aluminium chloride colorimetric assay.[9] Briefly, 1ml of extracts or obtained solution of catechin (0.02, 0.04, 0.06, 0.08 and 0.1 mg/ml) was added to test tubes containing 4ml of double distilled water. To the mixture was added 0.3ml 5% $NaNO_2$. After 5 minute, 0.3ml 10% $AlCl_3$ was added. Immediately, 2ml 1M NaOH was added and the total volume was made up to 10ml with double distilled water. The solution was mixed thoroughly and the absorbance of both the samples, blank and standard was read at 510 nm using UV visible spectrophotometer Model Spectronic 20 (Milton Roy Company). Total flavonoid content was expressed as mg catechin equivalents per gram of the extract (mg CAE/g).

Determination of Ascorbic Acid Content

Ascorbic acid content was determined by titrimetric method.[10] A known weight of sample is titrated with 2, 6 dichloro phenol-indophenol dye. Ascorbic acid reduces the 2, 6 dichloro phenol-indophenol dye to a colourless leuco-base and itself gets oxidised to dehydroascorbic acid. Though the dye is a blue coloured compound, the end point is the appearance of pink colour. The dye is pink coloured in acidic medium. Oxalic acid was used as the titrating medium.

Method

Dye solution: weigh 42mg sodium bicarbonate in to a small volume of distilled water. Dissolve 52mg 2, 6 dichloro phenol-indophenol in it and make up to 200ml with distilled water. Standard stock solution: Dissolved 100mg ascorbic acid in 100ml 4% oxalic acid solution. Then different test sample are titrated against dye by adding 10 ml 4% oxalic acid solution.

Calculation

Amount of ascorbic acid mg/100g sample = (0.5mg/V_1 ml) × (V_2/5ml) × (100ml/Wt. of the sample) × 100

V_1 = vol. of dye used for standard solution

V_2 = vol. of dye used for sample.

2, 2'-Diphenyl-1-Picrylhydrazyl (Dpph) Free Radical Scavenging Method

The antioxidant activity of the extracts was evaluated by DPPH free radical scavenging method.[11] 2, 2'-Diphenyl-1-picrylhydrazyl (DPPH) is a stable free radical that shows a maximum absorption at 517 nm in methanol. When DPPH encounters proton donating substances such as an

antioxidant and a radical species, the absorbance at 517nm disappears because the DPPH radical is scavenged. On the basis of this principle, the radical scavenging effect of each fraction was measured. Briefly 0.3, 0.6, 0.9, 1.2, 1.5 mg of extract was added to 2.5ml of 2,2'-diphenyl-2-picrylhydrazyl radical (DPPH: 0.025gL^{-1} in methanol) final volume made to 10 ml with methanol and mixed by vortex for 5 minute. The absorbance of the sample was measured at 517nm every 10 minutes till a steady state is reached (2 hrs) using the UV visible spectrophotometer. Similarly, a control sample was also prepared. For each sample, three separate determinations were carried out. The antioxidant activity was expressed as the percentage of decline of the absorbance after 2 hrs, relative to the control, corresponding to the percentage of DPPH that was scavenged.

Calculation

The percentage of DPPH, which was scavenged (%DPPH*$_{sc}$) was calculated using:

$$\%\ DPPH^{*}_{sc} = \left\{\frac{\left(A_{cont} - A_{samp}\right)}{A_{cont}}\right\} \times 100$$

Where A_{cont} is the absorbance of control and A_{samp} is the absorbance of sample.

Ferric Thiocyanate (Ftc) Method

The FTC method was used to evaluate the antioxidant activity of the extract.[12] Linoleic acid emulsion was prepared by mixing linoleic acid (0.28g), Tween 20 (0.28g) and phosphate buffer (50ml, 0.2M, pH 7.0). Test samples were prepared in ethanol-water (6: 4 v/v). Different test samples of conc. 0.3, 0.6, 0.9, 1.2,1.5 mg were mixed with 5ml of Linoleic acid emulsion and final volume made to 10ml with phosphate buffer (0.2M, pH 7.0) and incubated at 37°C for 96 hours (4 days). The mixture prepared as above without the test sample served as control. Aliquots (0.1ml) were drawn from the incubation mixture at intervals of 24 hour and mixed with 0.1ml of 30% ammonium thiocyanate, 0.1 ml of 20mM ferrous chloride in 3.5% HCl and final volume made to 10 ml with 75% ethanol and allowed to stand at room temperature for 3 minutes. The colour developed was measured at 500 nm in a spectrophotometer. This method depends on peroxide formation in the aqueous emulsion of linoleic acid. In this method, the higher the absorbance increase is, the higher the concentration of peroxide formed and hence, the lower the antioxidant activity of the sample tested.

Calculation

Antioxidant activity was expressed as

Antioxidant activity (%) = (100 - increase in abs. of sample/ increase in abs. of control) x 100

B-Carotene Bleaching Method

The β-carotene bleaching method of was used to evaluate the antioxidant activity of the extract.[13] β-carotene (0.2mg), linoleic acid (20mg) and tween 20 (200mg) were mixed in 0.5ml of chloroform. The solvent was subsequently removed at 40ºC in a vacuum evaporator and the mixture was diluted with 50ml of triply distilled water. Aliquots (4ml) of this emulsion were transferred into test tubes, to which were then added 0.3, 0.6, 0.9, 1.2, 1.5 mg of aliquots of test samples in ethanol. A control containing 0.2ml of ethanol and 4ml of emulsion was also used. The test tubes were covered with aluminium foil and placed in a water bath at 50°C. The absorbance at 470nm was recorded with UV visible spectrophotometer at intervals of 30 minute, until the colour of β-carotene has disappeared from the control tubes. The above mixture without β-carotene served as blank. All determinations were carried out in triplicate.

Calculation

The antioxidant activity was expressed as percentage inhibition relative to the control using the equation:

$$AA\ (\%) = 100 \times \left[1 - \left\{\frac{(A_0 - A_t)}{(A_0^0 - A_t^0)}\right\}\right]$$

Where A_0 and A_0^0 are the absorbance values measured at zero time of incubation for the test sample and control respectively and A_t and A_t^0 are the corresponding values at the end of the reaction time.

RESULTS AND DISCUSSION

The results of estimation of total phenols, flavonoids and ascorbic acid in different extracts of fresh and dried fruits of Karela and evaluation of their antioxidant activity by using three testing methods: 2,2'-diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging activity, FTC method and β-carotene bleaching method have been presented under.

Moisture Content and Extract Yield

The moisture content in Karela was found to be 90.57 ± 0.97%. Extract yield of fruit in the tested solvents is given in Table-1. It was found that the yields of acetone, ethanol and water extract of fresh fruits were 1.96 ± 0.21%, 2.25 ± 0.15% and 2.37 ± 0.22% respectively. The yields of acetone, ethanol and water extract of dried fruits were 6.75 ± 0.27%, 12.25 ± 0.38% and 27.75 ± 0.39% respectively on dry weight basis.

Total Phenolic Content

Natural polyphenols have chain-breaking antioxidant activities. It is well known that phenolic substances contribute directly to the antioxidant activity of plant materials. In fact, phenolic compounds exhibit considerable free radical-scavenging activities (through their reactivity as hydrogen-donating or electron-donating agents) and metal ion-chelating properties. Therefore, the amounts of total phenols in the extracts were determined (Table 2 and 3). Total phenolic content of fresh and dried fruit extracts in three solvents varied considerably from 9.18 ± 0.29 mg GAE/g (water extract)

to 12.08 ± 0.23 mg GAE/g (acetone extract) in fresh fruits (Table-2), and 0.57 ± 0.06 mg GAE/g (water extract) to 6.83 ± 0.12 mg GAE/g (acetone extract) in dried fruits (Table-3). There is a decrease in phenolic content in acetone, ethanol and water extract on drying. The antioxidant activity of fractions may not only be due to the presence of phenolic compounds but also related to the presence of some individual active components in the extracts. The unclear relationship between the antioxidant activity and total phenolic content may be explained by the fact that the total phenolic content does not incorporate all the antioxidants. In addition, the synergism between the antioxidants in the mixture makes the antioxidant activity not only dependent on the concentration but also on the structure and interaction between the antioxidants. Phenolic groups play an important role in antioxidant activity.[14,15]

It is well known that the antioxidant activity of phenols is affected by their chemical structure and can be decreased or increased depending upon the group attached to a basic aglycon.

Flavonoids Content

Flavones and flavonols are the subgroups of flavonoids. Flavonols are known to act as antioxidant, both as radical scavengers and as metal chelators.[16,17] The aglycone of these flavonols were reported to be more active than their glycosides.[18] Flavonoids have the ability to scavenge active oxygen radical, superoxide and hydroperoxide by single electron transfer. Superoxide is a biologically important substance which can be decomposed to form stronger oxidative species such as singlet oxygen and hydroxyl radicals.[19]

The highly reactive hydroxyl radicals can cause oxidative damage to DNA, lipids and proteins.[20] In the present study the flavonoid content in fresh fruits (Table 2) varied from 1.28 ± 0.24 mg CAE/g (water extract) to 6.86 ± 0.31 mg CAE/g (acetone extract) and in dried fruits (Table-3), it varied from 0.27 ± 0.04 mg CAE/g (water extract) to 4.78 ± 0.14 mg CAE/g (acetone extract).

Ascorbic Acid Content

Ascorbic acid is a well-known antioxidant compound. It reacts not only with H_2O_2 but also with O_2, OH radical and lipid hydroperoxide.[21]

Ascorbic acid is an important molecule in plant tissues and protects plants against oxidative damage from the oxidant metabolites of photosynthesis and aerobic processes.[22] Vegetables are poor resources of ascorbic acid as compared to fruits but abundance of vegetables in local diets contributes to a significant portion of ascorbic acid requirement of human body. In the present study the ascorbic acid content in Fresh fruits (Table-2) varied from 0.54 ± 0.01 mg/g (water extract) to 1.01 ± 0.02 mg/g (acetone extract). In dried fruits (Table-3), it varied from 0.05 ± 0.01 mg/g (water extract) to 0.27 ± 0.01 mg/g (acetone extract).

Table 1: Extract Yield of Different Extracts of Fresh and Dried Fruits of Karela

Fruit Samples	Acetone Extract (%)	Ethanol Extract (%)	Water Extract (%)
Fresh Karela	1.96 ± 0.21	2.25 ± 0.15	2.37 ± 0.22
Dried Karela	6.75 ± 0.27	12.25 ± 0.38	27.75 ± 0.39

Values are mean of three replicates ± standard error

Table 2: Total Phenolic, Flavonoids and Ascorbic Acid Contents of Different Extracts of Fresh Fruits of Karela

Constituents	Acetone Extract	Ethanol Extract	Water Extract
Total Phenols (mg GAE/g)	12.08 ± 0.23	10.21 ± 0.36	9.18 ± 0.29
Flavonoids (mg CAE/g)	6.86 ± 0.31	7.61 ± 0.21	1.28 ± 0.24
Ascorbic acid (mg/g)	1.01 ± 0.02	0.78 ± 0.01	0.54 ± 0.01

Values are mean of three replicates ± standard error

mg GAE/g - milligrams gallic acid equivalent/g of the extract

mg CAE/g - milligrams catechin equivalent/g of the extract

Table 3: Total Phenolic, Flavonoids and Ascorbic Acid Contents of Different Extracts of Dried Fruits of Karela

Constituents	Acetone Extract	Ethanol Extract	Water Extract
Total Phenols (mg GAE/g)	6.83 ± 0.12	3.18 ± 0.08	0.57 ± 0.06
Flavonoids (mg CAE/g)	4.78 ± 0.14	2.64 ± 0.10	0.27 ± 0.04
Ascorbic acid (mg/g)	0.27 ± 0.01	0.18 ± 0.01	0.05 ± 0.01

Values are mean of three replicates ± standard error

mg GAE/g - milligrams gallic acid equivalent/g of the extract

mg CAE/g - milligrams catechin equivalent/g of the extract

Table 4: Percent Increase (+) / Decrease (-) In Concentration of Various Chemical Constituents of Fruits of Karela on Drying

Constituents	Acetone Extract	Ethanol Extract	Water Extract
Total Phenols (mg GAE/g)	- 43.41 ± 2.01	- 68.61 ± 1.11	- 93.53 ± 0.86
Flavonoids (mg CAE/g)	- 30.36 ± 0.91	- 65.56 ± 1.12	- 78.31 ± 1.49
Ascorbic acid (mg/g)	- 72.61 ± 1.15	- 76.11 ± 1.75	- 92.61 ± 1.65

Values are mean of three replicates ± standard error

Table 5: Antioxidant Activities (%) of Different Extracts of Fresh Fruits of Kerala by Different Methods

Extract	Dpph	Ftc	B-carotene
Acetone extract (1.0 mg/ml)	86.11 ± 0.55	62.06 ± 0.8	67.16 ± 0.96
Ethanol extract (1.0 mg/ml)	86.51 ± 0.60	50.43 ± 0.83	56.41 ± 0.78
Water extract (1.0 mg/ml)	91.21 ± 0.65	51.11 ± 1.31	47.11 ± 0.75
BHA (Standard) (1.0 mg/ml)	86.11 ± 0.40	65.41 ± 1.15	72.46 ± 1.15
BHT (Standard) (1.0 mg/ml)	87.21 ± 0.35	76.46 ± 1.17	82.03 ± 0.85

Values are mean of three replicates ± standard error

Table 6: Antioxidant Activities (%) of Different Extracts of Dried Fruits of Karela by Different Methods

Extract	Dpph	Ftc	B-carotene
Acetone extract (1.0 mg/ml)	86.41 ± 1.11	80.53 ± 1.25	85.51 ± 0.96
Ethanol extract (1.0 mg/ml)	86.21 ± 1.11	65.21 ± 1.22	72.11 ± 0.91
Water extract (1.0 mg/ml)	61.21 ± 1.77	77.43 ± 1.11	84.21 ± 0.63
BHA (Standard) (1.0 mg/ml)	86.11 ± 0.40	65.41 ± 1.15	72.46 ± 1.15
BHT (Standard) (1.0 mg/ml)	87.21 ± 0.35	76.46 ± 1.17	82.03 ± 0.85

Values are mean of three replicates ± standard error

Antioxidant Activity

Antioxidants affect the process of lipid oxidation at different stages due to differences in their mode of action.[23] Oxidation of lipids is a very complex process resulting in a great variety of oxidation products. Many factors particularly temperature, light and the presence of initiators (metal enzymes) influence the oxidation process and resulting products. For this reason different methods are needed for monitoring oxidation processes to assess primary or secondary oxidation changes and the efficiency of antioxidants. The results obtained by different methods can also differ distinctly, as they involve different conditions, reaction phases and reaction systems. Therefore, to obtain more comprehensive information on antioxidants, the present study is aimed at the evaluation of the antioxidant activity of different extracts of fresh and dried fruits of Karela by using three testing methods.

2,2'-diphenyl-1-picrylhydrazyl radical (dpph) method

ferric thiocyanate method

β-carotene method

Antioxidant Activity By Dpph Method

Comparatively stable organic radical DPPH has been widely used in determination of the antioxidant activity of different plant extracts as well as purified compounds. The free radicals produced during oxidation of unsaturated lipids which affects human health.[24] All the above described extracts were screened for radical scavenging activity against $DPPH^{\bullet}$.

The antioxidant activity exhibited by acetone, ethanol and water extracts of fresh fruits were 86.11 ± 0.55%, 86.51 ± 0.60%, and 91.21 ± 0.65% respectively at the concentration of 1.0 mg/ml of the extract. The corresponding values of dried fruits at the same concentration were 86.41 ± 1.11%, 86.21 ± 1.11% and 61.21 ± 1.77% respectively.

The opposite trend in the phenolic content and antioxidant activity of extracts of fresh fruits can be explained by the fact that the Folin – Ciocalteu method measures other constituents than phenolics.

The Folin – Ciocalteu reagent detect all phenolic groups found in the extracts.[25] This indicates also that factors other than total phenolics may play a role in the antioxidant activity of water extracts. Moreover, all the phenolics do not have the same antioxidant activity, some are powerful, others are weak and they develop antagonistic or synergistic effects with themselves or with

the other constituents of the extracts.[26-28] This fact could mean that either their components do not possess, good hydrogen donating properties or that some kinetic factors influenced their reaction with the radical, or that their components interfere with the radical scavenging process.

It was found that the radical scavenging activity of a particular antioxidant depends on structure as well as on the type of reaction kinetics.[29]

Antioxidant Activity by Ferric Thiocyanate Method

During peroxidation of linoleic acid at 37°C in an incubator, the absorbance values increased owing to the oxidation products, which react to form a blood red coloured ferric thiocyanate.[30]

Antioxidants can hinder the oxidation and, consequently, the increase in absorbance will be less.

The antioxidant activity exhibited by acetone, ethanol and water extracts of fresh fruits were 62.06 ± 0.81%, 50.43 ± 0.83%, and 51.11 ±1.3% respectively at the concentration of 1.0 mg/ml of the extract. The corresponding values of dried fruits at the same concentration were 80.53 ± 1.25%, 65.21 ± 1.22% and 77.43 ± 1.11% respectively.

Antioxidant Activity by B-Carotene Method

In β-Carotene method, the oxidation of linoleic acid generates free radicals by removing of hydrogen atom from diallylic methylene groups of linoleic acid.[31]

Highly unsaturated β-carotene will be oxidised by generated free radical. Degradation of the orange coloured chromophore of β-carotene could be monitored spectrophotometrically.

However the presence of antioxidant constituents could prevent the bleaching of β-carotene due to their ability to neutralize the free radicals.[32,33]

Our results showed that the antioxidant activity of fresh fruits varied from 47.11 ± 0.75% (water extract) to 67.16 ± 0.96% (acetone extract) and from 72.11 ± 0.91% (ethanol extract) to 85.51 ± 0.96% (acetone extract) in dried fruits at the concentration of 1.0 mg/ml of the extract.

CONCLUSION

The contents of total phenols, flavonoids and ascorbic acid decreased in the acetone, ethanol and water extracts of the dried fruits of Karela.

The antioxidant activity of the acetone extract of the dried fruits of Karela increases in all the test methods. But the ethanol and water extracts shows decrease in antioxidant activity by DPPH method and increase in antioxidant activity by FTC and β-carotene bleaching method.

The increase is due to enzymatic hydrolysis of polyglycosylated flavonoids during drying and the aglycones gets free from sugar moiety and ester linkages. The free aglycone becomes more soluble in acetone and hence its concentration increases in the acetone extract.

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