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Phytochemical screening of red cabbage (*Brassica oleracea*) powder and juice - A comparative study

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Abstract

Cruciferous vegetables are one of the dominant food crops worldwide. Cruciferous vegetables are vegetables of family *Brassicaceae* (also called cruciferae). They are good source of many health promoting and potentially protective phytochemicals including folic acid, phenolics, carotenoids, selenium, glucosinolates and vitamin c. Incorporating these potent plant based compounds in daily food is a safe, effective and easily available way to guard against many of today's most common diseases. The Red cabbage (*Brassica oleracea*) is cool season cruciferous vegetable. Present study was conducted to assess the qualitative phytochemical analysis of red cabbage powder and juice. The extract of powder and juice of red cabbage reveals the presence of many phytochemicals such as alkaloids, glycosides, flavonoids, saponin, tannin, steroids, terpenes and phytosterols. The compounds isolated from this vegetable possess very important biological activities including anti-diabetic, antioxidant, hypolipidemic, antihyperglycemic, Cardioprotective and Anti-cancer.

Keywords: Flavonoids, saponin, tannin, steroids, phytosterols, anti-diabetic and antihyperglycemic

1. Introduction

Cruciferous vegetables are “vegetables of the *Brassicaceae* family also called as cruciferae”. Generally consumed cruciferous vegetables are broccoli, brussels sprouts, kale, mustard, cabbage, turnips, cauliflower, boy choy and Chinese cabbage (Jane V. Higdon *et al.* 2007) [1]. Almost all parts of some species are used as food, including stem (kohlrabi), root (turnips, rutabaga), leaves (cabbage, collard greens), seeds (mustard seed and oil- producing rapeseed) and flower (broccoli, cauliflower). “Cruciferous vegetables are one of the prevailing food crops worldwide”. Brassica vegetables are greatly regarded for their nutritional value, they are rich source of vit. C, soluble fiber as well as contain multiple nutrients and phytochemicals. Phytochemicals are the compounds derived from plants hypothesized to be responsible for much of the disease protection in our body they are present in diet high in fruits, vegetables, cereals and plant based beverages (Arts, I.C. *et al.* 2005) [2]. Recent studies reveal that cruciferous are the good source of natural antioxidants because they contain carotenoids, tocopherols and ascorbic acid. Epidemiological studies show these compounds may help to protect the human body against free radicals. Principal are their antioxidants effects, which are responsible for scavenging free radicals from our body and prevent body against its harmful effects (Sharique Ahmed and Seerat Hussain Beigh, 2009) [22].

The cruciferous vegetables have glucosinolates and also contain myrosinase an enzyme in a different area of the cell. Myrosinase hydrolyzes glucosinolates, into secondary metabolites, such as isothiocyanates and indoles, which are considered to be responsible for the anticarcinogenic action of cruciferous vegetables of cruciferous vegetables. Brassica vegetables contain “indole-3-carbinol, a chemical which helps in DNA repair in cells and helps to obstruct the growth of cancer cells” (Fan *et al.* 2006 and Wu *et al.* 2010) [4, 25]. These vegetables are also a good source of carotenoids with broccoli containing higher level of carotenoids (Farnham *et al.* 2009) [5]. “Brassica vegetables are a potent modulator of the innate immune response system with potent antiviral, antibacterial and anticancer activity, (Vivar *et al.* 2009) [24] however, it also is an antiandrogen”. (Le *et al.* 2003).

Red cabbage is the member of *Brassicaceae* family. It is a cool season cruciferous vegetable. Red cabbage (*Brassica oleracea var. capitata f. rubra*) is type of cabbage, also well-known as purple cabbage, blue kraut, or red kraut and is widespread in the Mediterranean region (Lynn *et al.* 2006) [17]. Red Cabbage is a herbaceous, biennial, dicotyledonous flowering plant. Its leaves are red or purple in colour and are normally consumed as coleslaw, salad and beverage (Maha A *et al.* 2012) [18].

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The principle “bioactive components of red cabbage are isothiocyanates, vitamins A, B, C and anthocyanins” (Fowke JH *et al.* 2003 [6], Repetto MG *et al.* 2002 [21] and Jagdish singh AK *et al.* 2006) [10]. Anthocyanins, a natural pigment present in Red cabbage, were found to have the strongest antioxidant power of 150 flavonoids (Sterling M., 2000) [23]. They are water soluble pigments it can be red, blue or purple depending on the pH. They are dominant antioxidants that have anti-inflammatory properties which help to protect cells.

Along with the “substances that seem to be responsible for the biological activities of red cabbage, are polyphenols” (Hassimotto NM *et al.* 2005) [8]. “Polyphenols are antioxidants that are helpful in reversing the problems caused by oxidative stress to the walls of arteries. Create a heart healthy environment by curbing the oxidation of LDL cholesterol and they help to relieve chronic pain, as seen in condition like rheumatoid arthritis, due to their anti-inflammatory properties.”

Red Cabbage contains many bioactive substances. Therefore, it has greatly therapeutic importance for humans. Red cabbage is an excellent source of both types of fibers. Insoluble fibers help to prevent from constipation and reduce colorectal risk. Soluble fiber present in red cabbage helps to lower blood sugar and blood cholesterol therefore helps in reducing risk of heart diseases and diabetes. (Neelufar *et al.* 2012) [19]. “Many studies conducted on red cabbage extract reveal its ability to suppress the oxidative stress *in vivo* (Igarashi k. *et al.* (2000) [9] and Lee K. *et al.* (2002) [14]. Park YJ. *et al.* (2004) [20] has reported anticancer properties in red cabbage”. Aml FM. Morsy *et al.* (2010) [1] have concluded in their study that red cabbage has a protective action against hepatocellular carcinoma in rats, thus this study suggest that increased dietary intake of red cabbage may be beneficial for patients with liver cancer as a preventive measure. Several studies have stated anti-inflammatory (Lin JY. *et al.* 2008) [16], analgesic (Choudhary A. *et al.* 2010) [3], anti-bacterial effects (Lee YL *et al.* 2003) [13] and antidiabetic (Kataya HA *et al.* 2008) [12] effects of red cabbage.

2. Materials and Methods

Plant material

Red cabbage leaves were shade dried followed by hot air oven drying at 50° centigrade and then ground to a fine powder and stored in air tight container for the analysis. Fresh red cabbage leaves were grinded in the mixer for the collection of juice.

Qualitative phytochemical evaluation- (Handa, 1995) [7] Extraction

The coarse powder and juice of red cabbage was extracted with petroleum ether, chloroform, methanol and water at the ratio of 30:70. The extracts of red cabbage powder and juice were collected separately and filtered using Whatman filter paper. All the extracts were concentrated and the excessive solvents were evaporated under vacuum.

Preliminary phytochemical analysis

All plant extracts were further used for chemical tests for the presence of following phytochemicals such as phenolics compounds, alkaloids, saponin, glycosides, phytosterols, tannin, flavonoids, steroids, terpenoids using the methods mentioned below:-

A). Alkaloids

a. Mayer’s test

To a few ml of filtrate, a drop or two of Mayer’s reagent were added by the side of test tube. A white or creamy precipitate indicate indicated the test as positive.

b. Wagner’s test

To a few ml of filtrate, few drops of wagner’s reagent were added by the side of the test tube. A reddish –brown precipitate confirmed the test as positive.

B). Glycosides

a). To ml of aqueous extract of the samples, 5ml of Benedict’s solution and few drop of dilute HCl were added and heated for minutes. The solution became red with precipitate which indicated the presence of glycosides.

b). Brontrager’s Test

To 2 ml of filtered hydrolysate, 3 ml of chloroform was added and shaken, chloroform layer was separated and 10% ammonia solution was added to it pink colour indicated the presence of glycosides.

C). Terpenoids

Liebermann – Burchard’s test: 2ml of acetic anhydride solution was added to 1ml of petroleum ether extract of the drug in chloroform, followed by 1 ml of concentrated sulphuric acid. A violet color ring was formed indicating the presence of terpenoids.

D). Steroids

Liebermann –Burchard’s test: 2 ml of acetic anhydride solution was added to 1 ml of petroleum ether extract of the drug in chloroform followed by 1 ml of concentrated sulphuric acid. A greenish color was developed which turned to blue.

E). Saponins

In a test containing about 5 ml of an aqueous extract of the drug, a drop of sodium bicarbonate solution was added. The mixture was shaken vigorously and left for 3 minutes. Honeycomb like froth was formed.

F). Tannins

To 1-2 ml of plant extract, a few drops of 5% FeCl₃ solution were added. A green color indicated the presence of gallotannins which brown color indicated tannins.

G). Phytosterol

a. Liebermann–buchard’s test: The extract (50 mg) was dissolved in 2ml acetic acid anhydride. To this, one or two drops of concentrated sulphuric acid were added slowly along the side of the test tube. An array of color changes showed the presence of phytosterols.

b. The extract was treated with Salkowski’s reagent

The yellowish colour with green fluorescence appearance indicated the presence of phytosterol in it.

H). Flavonoids

SHONODA TEST: In a test tube containing 0.5 ml of alcoholic extract of the drug, 5-10 drops of dilute HCL was added followed by small pieces of magnesium. In the presence of flavonoids, a reddish pink or brown colour produced.

3. Result and Discussion

In the present study the comparison between the phytochemical property of red cabbage powder and juice were estimated. The preliminary phytochemical investigation on red cabbage powder and juice extracts revealed the presence of various secondary metabolites such as alkaloids, glycosides, steroids, flavonoids, saponin, tannin, terpenoids and phytosterols in the different extracts (Table 1 &2).

Table 1: Preliminary Phytochemical Screening of Red Cabbage Powder Extract.

Name of the chemical test	Petroleum ether extract	Chloroform extract	Methanol extract	Distill water extract
Alkaloids	-	-	+	+
Glycosides	-	+	-	+
Steroids	+	+	+	+
Flavonoids	+	-	+	+
Saponin	+	+	-	+
Tannin	-	-	+	+
Terpenoids	+	-	-	+
Phytosterols	-	-	+	+

The phytochemical analysis of Red cabbage powder showed the presence of various phytochemical compounds in powder extract. The phytochemicals such as alkaloid, glycosides, steroids, flavonoids, saponin, tannin, terpenoids and

phytosterols are present in distilled water extract where as in petroleum ether, chloroform and methanol extract some phytochemicals were absent.

Table 2: Preliminary Phytochemical Screening of Red cabbage Juice Extract

Name of the chemical test	Petroleum ether extract	Chloroform extract	Methanol extract	Distill water extract
Alkaloids	+	+	+	+
Glycosides	+	-	+	+
Steroids	+	+	-	+
Flavonoids	+	-	+	+
Saponin	-	-	-	+
Tannin	+	+	-	+
Terpenoids	+	+	-	+
Phytosterols	-	-	+	+

In the water extract of Red cabbage juice showed the presences of all the phytochemicals, where as some phytochemical compounds were absent in other extract Red cabbage juice. The estimation of phytochemical compounds in powder and juice extract showed that the water extract of powder and juice of Red cabbage were rich in phytochemical compound which may help in treating many disease. In other prepared extract some phytochemicals were absent which may due to presence of chemical in the extract which react with the compound and makes it invisible. And, thus the powder had lost their phytochemical compound which makes them weak to enhance the quality of powder and juice. Thus, the study revealed that the Red cabbage powder and juice have the potential to cure many diseases.

4. Conclusion

From the ancient times, plants have been used for treatment of variety of disease. Thus, the present study revealed that a number of positive effects of Red cabbage such as phytochemicals were found which is beneficial for the health. The phytochemical such as alkaloids, glycosides, steroids, flavonoids, saponin, tannin, terpenoids and phytosterols were present which increases the medicinal potential of Red cabbage and thus can be used for the treatment of various diseases. Therefore, modern medicine has many side effects and it is not quite safer for human consumption. So it is better to adopt natural food which has no side effects and quite safer too for human consumption.

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