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Research Article

A COMPARATIVE STUDY OF VARIATION IN THE NUTRIENTS & PHYTOCHEMICAL COMPOSITION OF DIFFERENT COLOURS OF CABBAGE (*Brassica oleracea*)

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ABSTRACT

Brassica oleracea, a member of the Brassicaceae family. The members of the family which also includes Broccoli and cauliflower are green leafy vegetables and significant food crops because they give people plenty of the vitamins and minerals, they need in their diets. It is highly suggested to regularly consume vegetables, especially dark green leafy vegetables, since they have the potential to lower the risk of chronic illnesses. In the current study focused the authors focused on studying the variation in the nutrient composition of purple and green cabbage. A series of physico-chemical and biological investigations were done to study the comparative effects. Phytochemical analysis of the plant showed the presence of good number of primary and secondary metabolites such as alkaloids, glycosides, flavonoids and tannins. Anti-microbial and antioxidant studies also yielded positive results. The positive results of antioxidant activity and antimicrobial activity is an indication of its potential to prevent chronic diseases. All these parameters were determined by using standard analytical procedures, with a view to evaluate the difference in nutrient composition of the two varieties of Brassica oleracea. Metal composition studies also showed high percentages of potassium, sodium, magnesium, and other nutrients. Hence the authors conclude that a regular intake of cabbage is very beneficial.

Keywords: Nutrients, Metals, phytochemicals, antioxidants.

INTRODUCTION

Cabbage, *Brassica oleracea* is a plant belonging to the family *Brassicaceae*. It is a cool seasoned plant with a high tolerance for cold [1]. Cabbage has a thick stem, gray-green leaves and four petals in flowers. Cabbage leaves are red or green or purple, smooth or wrinkled. They are low in carbohydrate, calories and fats; however, they are good sources of protein which contains all the essential amino acids

most especially the Sulphur containing amino acids [2]. In Oman the cabbage is mostly cultivated among the rural and peri-urban dwellers.

Over the past years, there has been growing issues on the safety of consuming fresh vegetables such as cabbage as a result of their questionable safety due to their possible health risk associated with pesticide and fertilizer applications [3]. Cabbage can be eaten either in a raw or prepared form throughout the world. In a couple of research articles scientists have used multivariate analysis to assess the mineral composition of cabbage. Nitric acid and hydrogen peroxide are used to digest the samples, and inductively coupled plasma optical emission spectrometry was used for analysis [4].

All parts of the plant *Brassicas* provide leaf, flower, and root vegetables that are consumed raw, cooked, and processed. In some countries and the Plants are also used as fodder and forage, particularly during the winter months when domesticated animals that produce meat and milk need food supplies; Cabbage is also a rich source of protein and oil for low-fat edibles, industrial lubricants, illumination, and condiments like mustard, herbs, and other flavorings; and they are used as soil conditioners like green manure and composting crops [5].

Vegetables belonging to the family *Brassica* are highly valued for their nutritional content; they are a good source of soluble fiber and vitamin C, and they also include a variety of other nutrients and phytochemicals. Phytochemicals are plant-based molecules that are thought to be largely responsible for our body's defense against disease. They are found in a diet high in fruits, vegetables, grains, and plant-based drinks [6] .

Cabbage was found to be highly beneficial for the treatment of headaches, gout, diarrhea, and peptic ulcers, even before it was treated as a major food source. Many studies have tried to understand the phytochemicals found in cabbage, including its sulforaphane, indoles, and indole-3-carbinole (I3 C). These molecules aid in the body's antioxidant and detoxification processes, which break down and get rid of chemicals that cause cancer[7].

MATERIALS AND METHODS

Various Techniques were used to analyze the cabbage samples. Colorimeter was used to determine composition of Iron, Flame emission spectrophotometer was used to determine the composition of Sodium & Potassium, Calcium was used determined by using UV-Visible spectrophotometer and finally Cu, Co & Zn were determined by using Atomic Absorption Spectrophotometer. The collected samples were analyzed for major phytochemical components, Biochemical components (protein by Biuret method and Carbohydrates by anthrone method), metal composition, functional properties, antimicrobial activity (well and disc diffusion methods), antioxidant activity, role as natural indicator and in titration were performed.

RESULTS AND DISCUSSION

Qualitative analysis of Phytochemical Components: For qualitative analysis of phytochemical components based on standard procedures were used to test the existence of alkaloids, cardiac glycosides, flavonoids, phenols, saponins, tannins, terpenoids, quinones and proteins **(Table-1)**

Metal composition studies of purple and green cabbage showed the presence of high concentrations of Potassium, calcium, magnesium and sodium and low percentages of iron, zinc, copper and cobalt. Green cabbage was slightly better in metal composition that purple cabbage. **(Table-2)**

Table :1. Phytochemical components of Cabbage

Phytochemical components	**Purple cabbage**	**Green cabbage**
Alkaloids	+	+
Glycosides	+	+
Steroids	+	+
Flavonoids	+	+
Saponin	+	+
Tannin	+	+
Terpenoids	+	+
Phytosterols	+	_

Table :2. Metal composition of Cabbage

Name of the metal (ppm)	**Purple cabbage**	**Green cabbage**
Potassium (K)	43	52
Calcium (Ca)	15	12
Magnesium (Mg)	23	18
Sodium (Na)	12	14
Iron (Fe)	0.89	0.65
Zinc (Zn)	0.58	0.23
Copper (Cu)	0.16	0.12
Cobalt (Co)	0.18	0.27

Antimicrobial studies: In addition to the above activities, the Anti-bacterial and Anti-fungal activities of cabbages were tested against *Staphylococcus aureus* and *Pseudomonas aeruginosa*. Antifungal activities were tested against *Aspergillus* and *Rhizopus* species. The activities were determined using both the well and disc diffusion methods (**Table-3 &4).**

Table-3 (a). Anti-bacterial activity of Cabbage (well diffusion method)

Bacteria	*Staphylococcus aureus*			*Pseudomonas aeruginosa*		
Con.	Cabbage Sample			Cabbage Sample		
		Purple	Green		Purple	Green
	C	100 µl	100 µl	C	100 µl	100 µl
Methanol extraction	18 mm	26 mm	34 mm	18 mm	24 mm	28 mm
Aqueous extraction	19 mm	34 mm	28 mm	18 mm	28 mm	36 mm

Table-3 (b). Anti-bacterial activity of Cabbage (Disc diffusion method)

Bacteria	*Staphylococcus aureus*			*Pseudomonas aeruginosa*		
Con.	Cabbage Sample			Cabbage Sample		
		Purple	Green		Purple	Green
	C	100 µl	100 µl	C	100 µl	100 µl
Methanol extraction	20 mm	12 mm	12 mm	11 mm	16 mm	102 mm
Aqueous extraction	19 mm	14 mm	15 mm	10 mm	16 mm	14 mm

Table-4. Anti-Fungal activity of Cabbage

Extraction	Zone of Inhibition					
	Rhizopus			*Penicillium*		
	Well diffusion			Well diffusion		
Con.	Cabbage Sample			Cabbage Sample		
		Purple	Green		Purple	Green
	C	100 µl	100 µl	C	10 µl	50 µl
Methanol extraction	21 mm	14 mm	12 mm	21 mm	15 mm	16 mm
Aqueous extraction	24 mm	12 mm	15 mm	24 mm	12 mm	13 mm

Antioxidant activity

Using the 1, 1-diphenyl-2-picrylhydrazyl (DPPH) assay, the fractions' capacity to scavenge free radicals was assessed in vitro. A solution of 0.3 mM DPPH was made with 100 % ethanol, and 1 ml of this mixture was combined with 1 ml of methanol and 1 ml of sample solution, that ranged in concentration from 20 to 100 µg/ml. Sample solution was not used in the control reaction. After shaking the mixture and letting it stand for 30 minutes at room temperature, a spectrophotometer was used to measure the absorbance at 517 nm. The percentage of scavenging inhibition was calculated and contrasted with the standard, gallic acid **(Table-5)**.

Table-5: % Antioxidant activity by DPPH radical scavenging method

Cabbage Sample	Concentration of extract (µg/ml)	Inhibition (%)	Gallic acid concentration (µg/ml)	Inhibition (%)
Purple	100	96.04	100	97.11
Green	100	90.15	100	87.58

Biochemical analysis was performed to determine the percentages of proteins and carbohydrates in both varieties of cabbage. The amount of carbohydrates was very high in the purple variety and less in the green variety. The amount of protein was high in the purple category and less in the green variety (Table-6 & 7)

Table: 6. % of Carbohydrates of Cabbage

Cabbage Sample	Amount of Carbohydrate (g/100 g)
Purple	6.7
Green	5.6

7

Table: 7. % of proteins of Cabbage

Cabbage Sample	Amount of protein (g/100 g)
Purple	2.3
Green	1.8

The extracts were cut into small pieces, and then was treated with strong acids and bases and salt solutions and different sample solutions like vinegar, mouth wash and others as shown in **Table 8 and Table-9**, to check whether the cabbage samples are acidic or alkaline in nature in order to understand their role as natural indicator.

Table: 8. Purple Cabbage extract as natural indicator in acids and bases

Cabbage Sample	Chemical solution	Observation of colour	pH range
Purple cabbage extract	Strong acid	Red	1-3
	Weak acid	Pink	4-6
	Strong base	Green	11-14
	Weak acid	Yellow	8-10
	Salt solution	Purple	7

Table: 9. Testing of samples and observation of colour with purple Cabbage extract.

Cabbage Sample	Sample name	Observation of colour	pH
Purple cabbage extract	Drain cleaner	Red	Acidic
	Vinegar	Green	Acidic
	Mouth wash	Purple	Alkaline
	Apple juice	Pick	Acidic
	Orange juice	Bright red	Acidic
	Antacid	Light purple	Alkaline
	Lemon juice	Red	Acidic
	Baking soda	Light purple	Alkaline
	Tomato ketchup	Red	Acidic
	Hand soap	Purple	Alkaline

Cabbage samples were cut into small pieces, and then treated with hot water. Filtered and collected the extract to check whether the extract can be used as a natural indicator during titrations **Table-10.**

Table: 10. Purple Cabbage extract as natural indicator used in the titration

Cabbage Sample	Chemical solution	Observation of colour at the end point	Required volume of titrant (mL)
Purple cabbage extract	Strong acid /strong base	Red To Green	12.4
	Weak acid/Strong base	Pink To green	16.8
	Strong Acid/Weak base	Red to yellow	21.3

Moisture and ash content of the samples were determined using standard procedures and the results were tabulated. The moisture content was very high in purple and green cabbage and the ash content was negligible in both the extracts **(Table-11)**

Table-11: Compositional profile of Cabbage

Functional property	**Purple**	Green
Moisture (%)	89	82
Ash (%)	0.89	0.82

CONCLUSION

Many different diseases have been treated with plants since ancient times. Thus, several advantageous impacts of red cabbage, including phytochemicals that are good for health, were discovered in this study. Purple cabbage has more medicinal potential and can be used to cure a variety of disorders since it contains phytochemicals such alkaloids, glycosides, steroids, flavonoids, saponin, tannin, terpenoids, and phytosterols. Modern medicine is therefore not entirely safer for human consumption and has a lot of adverse effects. Adopting natural food is therefore preferable since it is safer for human consumption and has no negative consequences.

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