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Phytochemical screening and antioxidant activity of Brasicca oleracea vegetables from Cikajang, Garut

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ABSTRACT

Antioxidants from dietary plants have been thought to be good for human health. *Brassica oleracea* vegetables are potential antioxidant vegetables. Cikajang is one of the vegetable-producing centers in West Java, located in Garut district. Vegetables cultivated in the Cikajang area include cabbage, cauliflower, and keciwis, which are species of *Brassica oleracea*. There is no research regarding the phytochemistry and antioxidant activity of *Brassica oleracea* vegetables collected in Cikajang. Behalf of that, this research aims to determine the phytochemical screening and antioxidant activity of cabbage, cauliflower, and keciwis from Cikajang. The phytochemical screening was carried out using several identification reagents, while the antioxidant activity test was carried out using the DPPH (2,2 diphenyl-1-picrylhidrazyl) method. The results of phytochemical screening show that in the dry powder and extract of cabbage, flavonoids, phenols, and steroids/triterpenoids were identified. In the dry powder and extract of cauliflower, flavonoids, saponins, phenols, and steroid/triterpenoids were identified. In the dry powder and extract of keciwis, flavonoids, saponins, gallic tannins, and phenols were identified. The results of the antioxidant activity test using DPPH show that vitamin C as a standard had an IC50 value of 5.223 µg/ml, while the IC50 values of cabbage, cauliflower, and keciwis extracts were 39.948, 35.199, and 15.032 µg/ml, respectively.

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INTRODUCTION

Many chronic and degenerative diseases, including cancer, respiratory, neurological, and digestive disorders, have been connected to an excess of reactive oxygen species (ROS), or free radicals. Antioxidants can be produced externally or internally and work to scavenge reactive oxygen species (ROS) and reduce cellular molecule oxidation, which alleviates oxidative stress (Dontha, 2016)(Zewen Liu et al, 2018). Antioxidants from dietary plants have been thought to be good for human health. Free radicals and other reactive oxygen and nitrogen species, which are linked to the majority of chronic diseases, can be eliminated by antioxidants. Different compounds antioxidants can be found in dietary plants. The body gets an additional supply of antioxidants from vegetables to combat free radicals (Azmir et al., 2013) (A. Shetty, 2013). Strong antioxidant, free radical scavenging, and anti-inflammatory properties are frequently found in vegetables. Additional bioactivities and health benefits, such as anticancer, anti-aging, and preventive qualities against obesity, diabetes mellitus, cardiovascular disease, and neurodegenerative illnesses, are based on these features (Zhang et al., 2015).

It has been suggested that consuming more fruits and vegetables high in phytochemicals can help prevent chronic illnesses linked to oxidative stress in the human body (Zhang et al., 2015) (Yi-Fang Chu, 2002). The most prevalent antioxidants in human diets are natural polyphenols, which have the ability to scavenge radicals by substituting hydroxyl groups in the aromatic rings of phenolic compounds (Rokayya et al., 2013).

Previously known as cruciferous plants, the Brassicaceae family of plants includes many species that are consumed widely worldwide. Because of its pharmacological properties and high nutritional content, the popularity of Brassica is increasing (Favela-González et al., 2020). In addition to having many phenolic compounds, *Brassica oleracea* is distinguished from other vegetables by a special class of compounds called glucosinolates. These substances also give rise to a variety of biological properties in the Brassica genus, such as antioxidant properties (Velasco et al., 2011)(Salehi et al., 2021).

Cikajang is one of the vegetable-producing centers in West Java, located in Garut district. Vegetables cultivated in the Cikajang area include cabbage, cauliflower, and keciwis, which are species of *Brassica oleracea*. Red, white, and savoy cabbages are the three primary cultivar types of cabbage (Moreb et al., 2020). Cauliflower comes in a variety of colours, including white, green, purple, orange, and Romanesco (Kalisz et al., 2018). In Indonesia, including Cikajang, the cabbage that is generally cultivated is white cabbage, while the cauliflower that is generally cultivated is white cauliflower.

There is no research regarding the phytochemistry and antioxidant activity *of Brassica oleracea* vegetables collected in Cikajang. Behalf of that, the purpose of this study is to evaluate the antioxidant capacity and phytochemical screening of Cikajang's cauliflower, keciwis, and cabbage. In general, the scholarly investigations conducted on Brassica oleracea have significantly advanced our comprehension of the possible health advantages associated with this particular vegetable, as well as its phytochemical composition and antioxidant characteristics.

RESEARCH METHOD

Materials

The materials used in this research were DPPH (2,2-diphenyl-1-picrylhidrazyl), vitamin C obtained from Sigma, Dragendorff reagent, Meyer reagent, Steasny reagent, $AlCl_3$ solution, $FeCl_3$ solution, gelatin solution, Liebermann-Burchard reagent for phytochemical screening, and solvents.

Plant materials

Cauliflower, cabbage and keciwis were collected from Cikajang, Garut, West Java. The plants were identified in the Bandung Institute of Technology's Herbarium Bandungense School of Life Science and Technology. After being cleaned, dried, and ground into powder, those plants.

Extraction

700 g of cauliflower, 700 g of cabbage, and 400 g of kiciwis dry powder were each macerated with 96% ethanol and the solvent was changed every 24 hours for 3 days. Then the filtrates were evaporated using a rotary evaporator until thick extracts were obtained.

Phytochemical screening

Phytochemical screening was conducted to identify the secondary metabolites or phytochemical compounds present in the dry powder and extract. The test was screened for alkaloids, flavonoids, saponins, tannins, phenols, and steroids and triterpenes. The detection reagents used on the samples were Dragendorf for alkaloids, $AlCl_3$ solution for flavonoids, gelatin solution and Steasny reagent for tannins, $FeCl_3$ solution for phenol, and Lieberman-Bourchard reagent for steroids/triterpenes. To check for saponins, concentrated acid was applied after a shaken test (Farnsworth, 1966)(Harborne, 1998). The Indonesian Herbs Pharmacopoeia was followed in the preparation of each reagent solution ("Farmakope Herbal Indonesia," 2017)

Antioxidant activity test

DPPH was used to measure antioxidant activity, with some modifications made to the Rohman et al. technique. Different concentrations of every extract and vitamin C were created. A vial was filled with 1 ml of each concentration of the sample, followed by the addition of 2 ml of DPPH solution (50 µg/ml). After homogenising the mixture, it was placed in a dark room for thirty minutes. Using blank ethanol, absorbance was measured at the maximum wavelength of 516 nm using a UV-vis spectrophotometer. Additionally, 4 ml of DPPH 50 µg were used for the control absorbance measurements, which were conducted in a dark environment for 30 minutes. The examinations were performed three times. After the absorbance is measured, the percent inhibition is calculated based on the equation:

$$\text{Inhibition \%} = [(CA-SA)/(CA)] \times 100\%$$

CA: Control Absorbance
SA: Sample Absorbance

The concentration that can inhibit 50% of DPPH, or the IC50 value, was calculated based on the inhibition percentage. The linear regression curve between the percentage of inhibition and different sample concentrations was used to compute the IC50 value (Rohman et al., 2015).

RESULTS AND DISCUSSIONS

Plant samples were determined to ensure the correct identity of the plant. The determination results showed that samples were cabbage or kubis (*Brassica oleracea* var. *capitata* L.), cauliflower or kembang kol (*Brassica oleracea* L. cv. Group Cauliflower & Broccoli), and keciwis or kubis tunas or baby kailan (*Brassica oleracea* L.).

In the extraction process, samples are used in powder form to increase the surface area so that the extraction process can be maximized, and large extract yields can be obtained. The extraction method used was maceration, which was a cold method, so that damage to the active compounds due to heating could be avoided (Hanani, 2015)

The yields of cabbage, cauliflower, and keciwis extr.acts obtained from the weight of the extract compared to dry powder were 16.64%, 14.09%, and 27.95%, respectively.

The results of phytochemical screening are presented in Table 1. In the dry powder and extract of cabbage, flavonoids, phenols, and steroids/triterpenoids were identified. In the dry powder and extract of cauliflower, flavonoids, saponins, phenols, and steroid/triterpenoids were identified. In the dry powder and extract of keciwis, flavonoids, saponins, gallic tannins, and phenols were identified, and this is in line with research that has been done before (Ahmed & Ali, 2013). The chemicals present within this plant are the ones accountable for its pharmacological effect.

Table 1. The results of phytochemical screening of dry powders and extracts

Phytochemical Compound	Dry powder			Extract		
	Cabbage	Cauliflower	Keciwis	Cabbage	Cauliflower	Keciwis
Alkaloid	-	-	-	-	-	-
Flavonoid	+	+	+	+	+	+
Saponin	-	+	+	-	+	+
Quinon	-	-	-	-	-	-
Tannin						
Gallic tannin	-	-	+	-	-	+
Cathechin tannin	-	-	-	-	-	-
Phenol	+	+	+	+	+	+
Steroid/triterpenoid	+	+	-	+	+	-

Note: + detected
-not detected

Based on color changes in DPPH free radicals, an antioxidant activity test was conducted using the visual spectrophotometer and the DPPH method(Abdullah et al., 2022). At 516 nm in wavelength, a DPPH solution in ethanol will exhibit a strong and purple absorption. The chemicals in the sample release molecules that react with one hydrogen atom to generate a yellow non-radical DPPH compound, which is why the color can change. The absorbance of the residual DPPH solution, which was unaffected by the antioxidant compound sample, was the absorbance that was measured (Kedare & Singh, 2011). Following a 30-minute incubation period to allow the DPPH to react with the sample antioxidant compounds, the absorbance was measured (Zou et al., 2004).

The results of the antioxidant test are presented in Table 2. The results showed that vitamin C as a standard had an IC50 value of 5.223 μg/ml, while the IC50 values of cabbage, cauliflower, and keciwis extracts were 39.948, 35.199, and 15.032 μg/ml, respectively.

Table 2. Regretion equation and IC 50 sample

	Vitamin C	Cabbage extract	Cauliflower extract	Keciwis extract
Regretion equation	y = 4.527x + 26.355	y = 1.341x – 3.578	Y = 1.499x -1.017	Y = 1.771x – 3.999
IC50 (μg/mL)	5.223	39.948	35.199	15.032

Based on the literature, vitamin C, beta-carotene, phenols, flavonoids, and products of glucosinolate hydrolysis are some of the components that give Brassica vegetables their antioxidant potential(Dwikartika et al., 2021)(Handayani et al., 2022). Glucosinolates are sulfur-containing compounds found in certain plants, particularly in the family Brassicaceae (cruciferous vegetables). When tissue is damaged, whether from processing or cooking, the enzyme myrosinase hydrolyzes glucosinolates into active compounds (Stoewsand, 1995)(Šamec et al., 2017). Figure 1 shows the structures of the commonly identified glucosinolates in the white cabbage and the products of their hydrolysis. Based on the results of phytochemical screening of dry powder and cabbage, cauliflower and keciwis extracts contain flavonoids and phenols. The results are the same as in the literature, which states that flavonoids (including kaempferol, quercetin, and routine) and phenols (including caffeic acid and ferulic acid) have been identified in cabbage (Šamec et al., 2017). Flavonoids (including kaempferol, naringenin, and quercetin) and phenols (including syringic acid and cinnamic acid) were identified in cauliflower (Ahmed & Ali, 2013). These results indicated that cabbage, cauliflower, and keciwis from Cikajang were good antioxidant-potential foods.

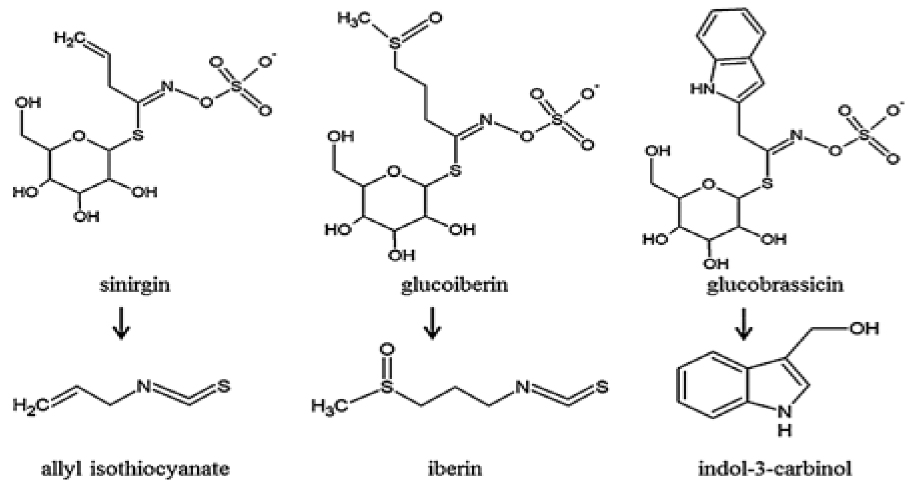

Figure 1. Glucosinolates in white cabbage and its hydrolyzed products (Šamec et al., 2017)

CONCLUSION

The results of phytochemical screening show that in the dry powder and extract of cabbage, flavonoids, phenols, and steroids/triterpenoids were identified. In the dry powder and extract of cauliflower, flavonoids, saponins, phenols, and steroid/triterpenoids were identified. In the dry powder and extract of keciwis, flavonoids, saponins, gallic tannins, and phenols were identified. The results of the antioxidant activity test using DPPH show that vitamin C as a standard had an IC50 value of 5.223 µg/ml, while the IC50 values of cabbage, cauliflower, and keciwis extracts were 39.948, 35.199, and 15.032 µg/ml, respectively.

The current study suggests that the vegetable has a lot of potential as a good source of natural antioxidants that may help prevent and treat diseases linked to oxidative stress. Furthermore, this investigation contributes to the advancement of our comprehension of the plausible health advantages conferred by this vegetable, as well as its phytochemical composition and antioxidant attributes.

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