GSC Biological and Pharmaceutical Sciences

eISSN: 2581-3250 CODEN (USA): GBPSC2

Cross Ref DOI: 10.30574/gscbps

Journal homepage: https://gsconlinepress.com/journals/gscbps/

(RESEARCH ARTICLE)

Check for updates

Kenikir (*Cosmos caudatus* Kunth) as an ingredient in *Pecel* (Traditional Javanese Ethnic Salad): Potential and Bioactivity

Marina Silalahi * and Riska Septia Wahyuningtyas

Biology Education Study Program, Faculty of Teacher Training and Education, Christian University of Indonesia.

GSC Biological and Pharmaceutical Sciences, 2025, 30(02), 102-108

Publication history: Received on 11 December 2024; revised on 04 February 2025; accepted on 07 February 2025

Article DOI: https://doi.org/10.30574/gscbps.2025.30.2.0404

Abstract

Kenikir (*Cosmos caudatus*) is a vegetable that has long been used by local communities in Indonesia, especially those living on the island of Java. The aim of the research is to explain the benefits and bioactivity of *C. caudatus*, so that its potential can be increased. The research method was carried out using surveys, interviews and literature studies. The respondent is a *pecel* trader who uses *kenikir* as an its ingredient. Secondary data was obtained online using the keywords *C. caudatus* and bioactivity of *C. caudatus*. *Kenikir* is a perennial herb with lobed leaves with capitulum flowers. Local people in Jatisampurna use *C. caudatus* as an ingredient for *lalapan* (vegetables consumed fresh) and for *pecel* (a traditional Javanese ethnic salad). The distinctive aroma of *C. caudatus* leaves makes it suitable for consumption in fresh form or as simple preparations. In traditional medicine, *C. caudatus* is used to treat various diseases such as osteoporosis and for beauty (preventing aging). The *C. caudatus* is rich in nutrients such as protein, fiber, Vit C, Vit B1, Vit B2, Beta Carotene, Potassium, Calcium, Iron and Phosphorus. The bioactivity of *C. caudatus* 's is anti-microbial, tea herbal, anti-osteoporosis, anti-diabetes mellitus, anti-oxidant, neuroprotection, beauty, anti-hypertension and anti-cancer. The use of *C. caudatus* as a traditional salad and beauty ingredient needs to be researched further so that it becomes an alternative as a natural anti-aging agent.

Keywords: Cosmos caudatus; Traditional salad; Anti-aging; Tea herbal

1. Introduction

Kenikir (*Cosmos caudatus* Kunth) is a vegetable that has been long used by local communities in Indonesia, especially those living on the island of Java. In Southeast Asia, *C. caudatus* is also used in traditional medicine [1,2,3], culinary and therapy [4]. In Malaysia, *C. caudatus* known as ulam raja can be eaten raw with rice [5], an appetizer [6] in the form of salad [7].

Research researchers reported bioactivities of *C. caudatus* such as anti-diabetic, antioxidant, anti-inflammatory, anti-hypertensive [1,8,9], anti-microbial [1,9], anti- -bacterial, anti-fungal, anti-osteoporosis, anti-hyperlipidemia, anti-cancer, anti-hepatoprotective, and to overcome fertility problems [8] (, healthy bone formation [9]. In traditional medicine, *C. caudatus* is used in healing bone fractures in conditions of osteoporosis [1,10]. The utilization and bioactivity of *C. caudatus* is related to the content of secondary metabolites [4] such as flavonoids and essential oils.

The *C. caudatus* also has the potential to be developed as a herbal tea because it contains high levels of antioxidant compounds [5,11]. The addition of *C. caudatus* leaves to other food ingredients can improve quality, provide a healthier effect [5] and can be developed into future anti-aging products [12]. The addition of *C. caudatus* extract at a dose of 500 mg/kg to beef patties showed a strong lipid oxidation inhibitory effect [5].

* Corresponding author: Marina Silalahi

Silalahi et al [13] stated that *C. caudatus* has long been bought and sold in traditional markets in West Java, where it is used as an ingredient for *lalapan* (vegetables consumed raw) and as an ingredient for other vegetables, including the ingredients for making *pecel*. The *pecel* is a traditional Indonesian salad made from various boiled vegetables added with peanut sauce (Figure 1). Initially *pecel* was associated with Javanese ethnicity, but now it is consumed by the majority of Indonesian people. Empirically, it can be seen that the types of vegetables used as *pecel* ingredients vary from one region to another, depending on the biodiversity found in the surrounding environment. Based on a field survey we conducted, several *pecel* traders in the Jatisampurna area use *C. caudatus* as one of their main ingredients. This study aims to explain the use and bioactivity of *C. caudatus* so that its development and use as an alternative ingredient for traditional salads can be improved.

Figure 1 Processed *kenikir* (*C. caudatus*). A. Boiled *kenikir* leaves together with other vegetables are served as an ingredient for *pecel*. B. The *kenikir* as ingredient pecel is equipped with a topping of peanut brittle

2. Research Methods

The research method was carried out using surveys and interviews with *pecel* traders in Jatisampurna, Bekasi, West Java. Respondents are traders who use *kenikir* as a of the ingredients for making *pecel*. To complete the *kenikir* bioactivity, secondary data was used sourced from articles published online using the keywords *C. caudatus* and bioactivity of *C. caudatus*. The data and information obtained were synthesized to explain the botany, benefits, bioactivity and potential of *C. caudatus* as a traditional salad.

3. Results and Discussion

3.1. Botany of *Cosmos caudatus* Kunth

The Asteraceae family is one of the largest families of flowering plants, with more than 1600 genera and 25,000 species worldwide [14]. Asteraceae flowers have the characteristic that the flowers are bisexual, female and male, surrounded by small leaves, and form a capitulum [15]. *Cosmos caudatus* is a species that is widely used as food and traditional medicine.

Description *C. caudatus*: A showy flowered, tall and annual herb, lateral, herbaceous, round, glabrous with some hairy. Leaves opposite, compound bipinnate, exstipulate, petiole 3.5cm. long lobed or 2-3 pinnatisect, area covered (7.8cm. L x 7.6cm. B), attenuate, acuminate, entire, hairy, membranous, dorsiventral, reticulate and green colour. Inflorescence solitary or loosely corymbose. Hermaphrodite florets with slender arms thickened upwards, hirsute, with short, acute appendages, receptacle concev, ovary inferior, 1-ovule, basal placentation [16,17].

Figure 2 *Kenikir* (*C. caudatus*). A. A bunch of *C. caudatus* is sold in the market showing the morphological structure of the leaves; B. *Kenikir* with other types of vegetables sold in the market

3.2. Uses and bioactivity

The local people in Indonesia have long used *C. caudatus* as an ingredient for fresh vegetables, vegetables and *pecel*. To meet consumers, various traders at the Kranggan market (Jatisampurna) have been selling *C. caudatus* (Figure 2). The distinctive aroma of the leaves makes this plant delicious to consume both in fresh and processed form. In processed *pece*l (Figure 1), *C. caudatus* is boiled briefly (5 minutes). The use of *C. caudatus* as a salad ingredient is related to its nutritional content and has great potential to be developed as an alternative food ingredient. Hui et al [18] reported that every 100 g of *C. caudatus* contains protein (2.9 g), fiber (1.6 g) and is rich in Vit C, Vit B1, Vit B2, Beta Carotene, Potassium, Calcium, Iron and Phosphorus.

In traditional medicine, *C. caudatus* is used to strengthen bones, treat cardiovascular disorders [2,7], slow aging [2,3], reduce fever, treat infections, improve skin texture [7], and prevent degenerative diseases [3]. Based on the literature review that we obtained, *kenikir* has various benefits and bioactivity such as antidiabetic, antioxidant, anti-inflammatory, antihypertensive [1,8,9], anti-microbial [1,9], antibacterial, antifungal, anti-osteoporotic, antihyperlipidemic, anticancer, anti-hepatoprotective, and to overcome fertility problems [8], healthy bone formation, and blood glucose levels [9]. Below we will explain *C. caudatus* bioactivities as anti-microbial, herbal, anti-osteoporosis, anti-diabetes mellitus, anti-oxidant, neuroprotection, anti-hypertension and anti-cancer.

3.2.1. Anti-microbial

The bioactivity of *C. caudatus* as an anti-microbial has been reported by Yusoff et al [19], Sia et al [20], Yusoff et al [21], Yusof et al [22]. The *C. caudatus* inhibits the growth of *Staphylococcus aureus*, *Escherichia coli* [20,22], *Pseudomonas aeruginosa* {19,20], *Bacillus cereus*, *B. subtilis*, *Proteus mirabilis*, and *Candida albicans* [19], and *Salmonella* sp. [20]. Bioactive compounds thought to be related to antimicrobials are palmitic acid, stigmasterol, phytol and neophytadiene [22].

The antimicrobial bioactivity of *C. caudatus* is influenced by pH, temperature and type of microbe. The *C. caudatus* leaf ethanol extract inhibits the growth of both Gram positive (*S. aureus*) and Gram negative (*E. coli*) bacteria with an inhibition zone (22-24 mm) the same as commercial antiseptics [22]. The *C. caudatus* leaf extract increases its antimicrobial activity at lower acidity (pH 3) and higher temperature (50°C) against most pathogens [21]. The killing time curve of *C. caudatus* extract for *B. cereus, B. subtilis, P. mirabilis, P. aeruginosa* and *C. albicans* at concentration was directly proportional to concentration [19]. The *C. caudatus*'s ability to inhibit microbial growth has great potential for development in food cleaners [21], natural antimicrobial agents [19] and commercial antiseptics [22].

3.2.2. Herbal Tea

Consumption of herbal tea is increasing because it tastes refreshing and has a positive impact on health, is easy to obtain, has abundant resources and cheaper prices [23]. Herbal tea made from young *C. caudatus* leaves has very strong antioxidant activity compared to that made from mature and old leaves [11], but the mineral content of tea from old leaves is higher than that from mature and young leaves [23,24]. Different stages of maturity of plants used as raw materials can influence antioxidant activity, color and mineral content in herbal tea [24].

3.2.3. Anti Osteoporosis

Cosmos caudatus is traditionally a bone strengthening agent [1,4,7,25,26], a bone-protecting and bone proliferation agent [7]. The use of *C. caudatus* in strengthening bones is thought to be related to the Calcium content [10] of around 270 mg [18]. The *C. caudatus* improves bone histomorphometry in ovariectomized mice by increasing the rate of mineral apposition, osteoid volume and osteoblast surface [10].

3.2.4. Anti-diabetes mellitus

The leaves of *C. caudatus* are rich in bioactive compounds so they are prospective for development as an anti-diabetic agent [9,27], especially in type 2 diabetes patients [8,28]. Optimizing glycemic control is critical to preventing complications associated with type 2 diabetes [10]. The supplementation of *C. caudatus* improves insulin resistance and sensitivity in type 2 diabetes patients [8]. In experimental animals after 8 weeks of supplementation, *C. caudatus* significantly reduced serum insulin and HbA1C levels [27,28]. Leaf ethanol extract and *C. caudatus* solvent fraction inhibit the α-glucosidase enzyme [27].

3.2.5. Antioxidant

The use of different types of extraction solvents has a significant influence on the antioxidant properties of *C. caudatus* extracts [29]. The butanol fraction of *C. caudatus* shoots has the highest antioxidant activity compared to other fractions [2]. 100% methanol and 50% ethanol extracts of *C. caudatus* leaves showed the highest antioxidant activity [29,30]. Ethanol 50% is further recommended as the most efficient solvent for extracting antioxidant compounds from *C. caudatus* leaves [29]. The ethanol extract of *C. caudatus* contains several compounds, such as isoquercitrin, quercetin-3-O-rutinoside, avicularin, routine, quercitrin, and vitexin, which likely contribute to the antioxidant capacity of *C. caudatus* [30].

3.2.6. Neuroprotection

The *C. caudatus* contains high levels of flavonoids and may be beneficial in neuroprotection and thus has the potential to prevent neurodegenerative diseases [31]. The *C. caudatus* supplementation (250 mg/capsule) or placebo (500 mg maltodextrin/capsule) twice daily for 12 weeks has the potential to improve global cognition, tension, total mood disturbance, and oxidative stress among older adults with mild cognitive impairment [31].

3.2.7. Cosmetics

Cosmos caudatus is traditionally claimed as an anti-aging agent in Malaysia [12], Southeast Asia and Latin America [25]. The *C. caudatus* has great potential to be developed in the cosmetics industry because it has antioxidant, anti-collagenase, anti-elastase, anti-tyrosinase activity [32]. Skin aging is associated with collagen degradation by matrix metalloproteinases (MMPs), leading to loss of skin elasticity and the formation of wrinkles [12]. The leaves and shoots of *C. caudatus* can make skin younger, if consumed regularly [32]. Administration of 1000 μg/mL *C. caudatus* water extract inhibited the activities of collagenase, elastase and tyrosinase 51.3; 63.7 and 72.7% respectively compared to control [32]. Flavonol glycosides derived from quercetin and kaempferol, and flavon C-glycosides derived from apigenin were the main compounds identified in *C. caudatus* water extract [32].

The E2 and E3 fractions of *C. caudatus* inhibited collagenase activity, MMP-1 and MMP-3 mRNA and protein expression, as well as NF-κB activation induced by TNF-α in *C. caudatus* D-966SK cells. Most *C. caudatus* consists of flavonoids and their glycosides such as Quercitrin (14.79% w/w) and quercetin (11.20% w/w) inhibit collagenase activity [12]. The *C. caudatus* fraction rich in flavonoid glycosides showed skin anti-aging effects through inhibiting collagenase, MMP-1 and MMP-3 activities, possibly via the NF-κB pathway. *C. caudatus* which reveals its potential to be developed as an anti-aging product in the future [12].

3.2.8. Anti Hypertension

The *C. caudatus* is a medicinal herb used traditionally in Latin America and Southeast Asia for cardiovascular uses [25]. The butanol fraction of *C. caudatus* had the highest inhibitory effect at IC25 on the migration and invasion of vascular smooth muscle cells which accounted for 53.93% and 59.94%, respectively. Butanol extract and ethanol extract fractions at IC10 displayed the highest invasion inhibition index (around 68%) [25].

3.2.9. Anticancer

The ethanol extract and ethyl acetate extract of *C. caudatus* leaves increase anticancer activity. The Microtetrazolium test shows that the ethanol extract and ethyl acetate extract of *C. caudatus* leaves have strong cytotoxic activity with IC50 of 17.46 ppm and 6.31 ppm respectively [33]. Fractions F2, F7 and F8 *C. caudatus* showed strong dose-dependent cytotoxicity on Human Colorectal Carcinoma Cells with IC50 values of 15.53 ± 0.4, 32.72 ± 0.3 and 34.16 ± 1.4 µg/mL respectively [20].

4. Conclusion

- *Kenikir* (*C. caudatus*) is a perennial herb with lobed leaves with capitulum flowers.
- Local people in the Jatisampurna, West Java use *C. caudatus* as an ingredient for fresh vegetables, vegetables and *pecel*. The distinctive aroma of the leaves makes this plant delicious to consume both in fresh and processed form.
- The *C. caudatus* has bioactivity as anti-microbial, herbal, anti-osteoporosis, anti-diabetes mellitus, anti-oxidant, nerve protection, cosmetic, anti-hypertension and anti-cancer.

Compliance with ethical standards

Acknowledgments

Acknowledgments to the Universitas Kristen Indonesia for research funding. This article is part of our research with title: an ethnobotany study of traditional salads in the Jatisampurna, Bekasi City, West Java Province.

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] Cheng SH, Barakatun-Nisak MY, Anthony J, & Ismail A. Potential medicinal benefits of *Cosmos caudatus* (Ulam Raja): A scoping review. Journal of research in medical sciences: the official journal of Isfahan University of Medical Sciences, 2015; 20(10): 1000.

[2] Moshawih S, Cheema MS, Ibraheem ZO, Tailan ND, & Hakim MN. *Cosmos caudatus* extract/fractions reduce smooth muscle cells migration and invasion in vitro: A potential benefit of suppressing atherosclerosis. Porto Biomedical Journal, 2017; 2(6): 293-300.

[3] Chan EWC, Wong SK, & Chan HT. Ulam herbs of Oenanthe javanica and *Cosmos caudatus*: An overview on their medicinal properties. Journal of Natural Remedies, 2016; 137-147.

[4] Moshawih S, Cheema MS, Ahmad Z, Zakaria ZA, & Hakim MN. A comprehensive review on *Cosmos caudatus* (Ulam raja): pharmacology, ethnopharmacology, and phytochemistry. International Research Journal of Education and Sciences, 2017; 1(1): 14-31.

[5] Reihani SFS, Tan TC, Huda N, & Easa AM. Frozen storage stability of beef patties incorporated with extracts from ulam raja leaves (*Cosmos caudatus*). Food Chemistry, 2014; 155: 17-23.

[6] Abdullah A, Dhaliwal KK, Roslan NNF, Lee CH, Kalaiselvam M, Radman HM, ... & Jaarin K. The effects of *Cosmos caudatus* (ulam raja) on detoxifying enzymes in extrahepatic organs in mice. Journal of Applied Pharmaceutical Science, 2015; 5(1): 082-088.

[7] Uzbek UH & Shahidan WN. Tasty herb that heals: A review of *Cosmos caudatus* (Ulam raja) and its potential uses in dentistry. World, 2019; 10(4): 322.

[8] Ahda M, Jaswir I, Khatib A, Ahmed QU, & Syed Mohamad SNA. A review on *Cosmos caudatus* as A potential medicinal plant based on pharmacognosy, phytochemistry, and pharmacological activities. International Journal of Food Properties, 2023; 26(1): 344-358.

[9] Murugesu S, Perumal V, Balan T, Fatinathan S, Selvarajoo PD, Rozali MAB, & Aziz NIA. A Review of *Cosmos caudatus* as a promising antidiabetic plant. Malaysian Journal of Medicine & Health Sciences, 2020; 16(4).

[10] Godspower PR, Mohamed N, & Shuid AN. *Cosmos caudatus* enhances fracture healing in ovariectomised rats: A preliminary biomechanical evaluation. Int J Appl Res Nat Prod, 2015; 8(1): 12-19.

[11] Dian-Nashiela F, Noriham A, Nooraain H & Azizah AH. Antioxidant activity of herbal tea prepared from *Cosmos caudatus* leaves at different maturity stages. International Food Research Journal, 2015; 22(3).

[12] Loo YC, Hu HC, Yu SY, Tsai YH, Korinek M, Wu YC, ... & Chen YJ. Development on potential skin anti-aging agents of *Cosmos caudatus* Kunth via inhibition of collagenase, MMP-1 and MMP-3 activities. Phytomedicine, 2023; 110, 154643.

[13] Silalahi M, Sunarto, Munthe TM & Pardosi D. Keanekaragaman Tumbuhan yang Diperjual-belikan di Pasar Kranggan, Jawa Barat. Laporan Penelitian, Universitas Kristen Indonesia, Jakarta, 2021.

[14] Rolnik, A., & Olas, B. (2021). The plants of the Asteraceae family as agents in the protection of human health. *International Journal of Molecular Sciences*, 22(6), 3009.

[15] Xu Z, Chang L, Xu Z & Chang L. Asteraceae (pp. 441-721). Springer Singapore, 2017.

[16] Purnobasuki H, Rakhashiwi GA, Junairiah J, Wahyuni DK, Putra RE, Raffiudin, R & Soessilohadi RH. Morpho-anatomical characterization and DNA barcode of *Cosmos caudatus* Kunth. Biodiversitas Journal of Biological Diversity, 2022; 23(8): 4097-4108.

[17] Rahman AHMM, Alam MS, Khan SK, Ahmed F, Islam AKMR & Rahman MM. Taxonomic studies on the family Asteraceae (Compositae) of the Rajshahi division. Research Journal of Agriculture and Biological Sciences, 2008; 4(2), 134-140.

[18] Hui CS, Yusof BNM, Hamid A & Ismail A. The king of salad, ulam raja (*Cosmos caudatus*), in: functional foods wonder of the world evidence based functional foods in health and disease. Serdang University Putra Malaysia Press. 2017: 192-231.

[19] Yusoff NAH, Bustamam MS, Abas F, Khatib A & Rukayadi Y. Antimicrobial activity of *Cosmos caudatus* extract against foodborne pathogens. J. Pure Appl. Microbiol, 2014; 8(5): 3681-3688.

[20] Sia YS, Chern ZW, Hii SP, Tiu ZB & Arifin MA. Antimicrobial, antioxidant and cytotoxic activities of *Cosmos caudatus* extracts. International Journal of Engineering Technology and Sciences, 2020; 7(1): 32-43.

[21] Yusoff NAH, Rukayadi Y, Abas F, Khatib A & Hassan M. Antimicrobial stability of Cosmos caudatus extract at varies pH and temperature, and compounds identification for application as food sanitiser. Food Res, 2021; 5(3): 83-91.

[22] Yusof MN, Buyong F, & Azmi WNAW. Antimicrobial activity of Cosmos caudatus against *Staphylococcus aureus* and *Escherichia coli*. *Journal of Advanced Research in Applied Sciences and Engineering Technology*, 2023; 30(2): 272-281.

[23] Fatanah DN, Abdullah N, Hashim N, & Abd Hamid A. Antioxidant activity, colour and mineral content of herbal tea prepared from *Cosmos caudatus* leaves at different maturity stages. Malaysian Journal of Analytical Sciences, 2016; 20(3), 607-617.

[24] Fatanah DN, Abdullah N, Hashim N, & Hamid AA. Antioxidant and mutagenic activity of herbal tea prepared from *Cosmos caudatus* leaves at different maturity stages. Sains Malaysiana, 2018; 47(4): 725-730.

[25] Moshawih S, Cheema MS, Ibraheem ZO, Tailan ND & Hakim MN. *Cosmos caudatus* extract/fractions reduce smooth muscle cells migration and invasion in vitro: A potential benefit of suppressing atherosclerosis. Porto Biomedical Journal, 2017; 2(6), 293-300.

[26] Sharifuldin MMA, Ismail Z, Aisha AFA, Seow EK, & Beh HK. Quantification of rutin, quercitrin and quercetin in *Cosmos caudatus* Kunth by reverse phase high performance liquid chromatography. Quality Assurance and Safety of Crops & Foods, 2016; 8(4): 617-622.

[27] Ahmad WNW, Shaari K, Khatib A, Hamid AA, & Hamid M. Chemical profile, total phenolic content, DPPH free radical scavenging and á-glucosidase inhibitory activities of *Cosmos caudatus* Kunth leaves. Pertanika Journal of Tropical Agricultural Science, 2018; 41(3).

[28] Cheng SH, Ismail A, Anthony J, Ng OC, Hamid AA & Barakatun-Nisak MY. Eight weeks of *Cosmos caudatus* (ulam raja) supplementation improves glycemic status in patients with type 2 diabetes: a randomized controlled trial. Evidence-Based Complementary and Alternative Medicine, 2015.

[29] Cheng SH, Khoo HE, Ismail A, Abdul-Hamid A & Barakatun-Nisak MY. Influence of extraction solvents on *Cosmos caudatus* leaf antioxidant properties. Iranian Journal of Science and Technology, Transactions A: Science, 2016; 40: 51-58.

[30] Rafi M, Hayati F, Umar AH, Septaningsih DA & Rachmatiah T. LC-HRMS-based metabolomics to evaluate the phytochemical profile and antioxidant capacity of *Cosmos caudatus* with different extraction methods and solvents. Arabian Journal of Chemistry, 2023; 16(9), 105065.

[31] You YX, Shahar S, Rajab NF, Haron H, Yahya HM, Mohamad M, ... & Maskat, MY. Effects of 12 weeks *Cosmos caudatus* supplement among older adults with mild cognitive impairment: a randomized, double-blind and placebo-controlled trial. Nutrients, 2021; 13(2): 434.

[32] Zakaria NNA Okello EJ & Howes MJ. Antioxidant, anti-collagenase, anti-elastase and anti-tyrosinase activities of an aqueous *Cosmos caudatus* Kunth (Asteraceae) leaf extract. Tropical Journal of Natural Product Research, 2020; 4(12): 1124-1130.

[33] Dwira S, Fadhillah MR, Fadilah F Azizah NN, Putrianingsih R & Kusmardi K. Cytotoxic activity of ethanol and ethyl acetate extract of kenikir (*Cosmos caudatus*) against cervical cancer cell line (HeLa). Research Journal of Pharmacy and Technology, 2019; 12(3): 1225-1229.