# ROXIMATE COMPOSITION AND PHYTOCHEMICAL CONSTITUENTS OF CACTUS PEAR PLANT EXTRACTS USING DIFFERENT SOLVENT

Ojo, Mofoluwaso Olufunmiola, *Obi, Fortune Arinze, Femi, Fortune Abidemi. Maxwell, Yemmy Mitchel Omeiza, Abdulwahab Muhammed[1] and Ibrahim, Olaitan Raji

Department of Food Science and Technology
Federal University of Technology Minna

***Correspondence author:** obi.arinze@st.futminna.edu.ng

**ABSTRACT**
This study investigates the proximate composition and phytochemical constituents of cactus pear (*Opuntia ficus-indica*) extracts obtained using 100 % water (WE), 50: 50% methanol: water (MWE), 100 % methanol (ME) extraction solvents and fresh cladodes (FC). The proximate and phytochemical analysis revealed significant ($p<0.05$) difference in the samples. The water methanol (WME) extraction solvents samples had higher amount of crude fibre, ash at 3.76 % and 6.26 % while FC samples had the lowest at 2.17 and 4.01 % respectively. There was no significant ($p>0.05$) difference between the water methanol (WME) extraction solvents and, methanol (ME) extraction solvents in crude protein and crude fat. High moisture content of observed in the fresh cladodes at 82.42 %. The phytochemicals constituents indicated that methanol-extracted samples exhibited the highest concentration of total phenolic and flavonoid content, suggesting superior antioxidant activity in the extract compared to other samples. These results highlight the potential of cactus pear plant extract which could be of use as a valuable ingredient in the development of functional foods and nutraceuticals

**Keywords:** Cactus pearl (*Opuntia ficus-indica*), solvent, extract, phytochemicals,

## INTRODUCTION

The cactus pear (*Opuntia ficus-indica* L.) is the most economically significant plant in the Cactaceae family worldwide (Christiana *et al.*, 2018). Both the fruit and cladodes are eaten fresh, but they can also be cooked, dried, canned, or processed into concentrated juices, jams, or syrups. Furthermore, prickly pear has been utilized for phytoremediation, animal feed, biofuel production, and medicinal purposes (Mendoza *et al.*, 2018). In recent years, the utilization of *Opuntia* in functional food development has gained significant attention (Dick *et al.*, 2020). The rising demand for healthy and convenient foods has contributed to the expansion of this relatively new area within the food industry (Oniszczuk *et al.*, 2020). This growing interest in functional foods has prompted the exploration of *Opuntia* cladodes as potential ingredients in novel functional food products.

Phytochemicals in plants contains bioactive substances possessing positive or negative effect depending on the dose, nature of the compound and its bioavailability (Walia *et al.*, 2019). The pear cactus (*Opuntia ficus-indica*), is a rich source of antioxidants such as flavonoids, phenolic acids, and betalains. These compounds have demonstrated the ability to neutralize free radicals, thus protecting cells and DNA from oxidative stress and damage. The consumption of these antioxidants has been associated with a reduced risk of type 2 diabetes and other chronic diseases, including cancer, cardiovascular disorders, and neurodegenerative conditions (Azer *et al.*, 2019). Incorporating *Opuntia* mucilage and cladode flour into cookies, bread, cake, and gluten-free crackers has shown increased total phenolic acid content, antioxidant activity, and sensory acceptance compared to control products (Dick *et al.*, 2020).

Cacti are remarkable plants that have developed unique adaptations to thrive in arid environments, enabling them to survive in conditions characterized by limited water availability. This study aims

to investigate the health benefits of cacti found in Minna with a particular focus on the proximate composition and the phytochemical constituents of cactus pear plant extracts utilizing different extraction. By analyzing these phytochemical constituents and their potential applications, this research aspires to unlock the full benefits of these extraordinary plants and promote their sustainable use.

## MATERIALS AND METHODS

### Source of raw material

Fresh cladodes of *Opuntia Ficus indica* were obtained from Murtala Park Garden Minna, Niger state. All samples were washed with clean water, separated into portions, and stored at 4°C prior to processing.

### Preparation of cladode powder extract

Fresh cladodes were selected and the leaf spines carefully removed. The cladodes were then washed in a running water to eliminate any contaminants or other foreign matters. The washed cladodes were then subjected to size reduction using a cutter to enhance their surface area. Thereafter 500g of cladodes was weighed and 100 mL of solvent was added in a blender (Kenwood BLP31.A0 WH) and this was allowed to blend for 15 min at operating speed of 6 to achieve a uniform mixture and followed by filtering (100 µm sieve), this was followed by centrifuging at 1800-3500 rpm and drying in an air draft oven (50 °C, 3 h) to obtain the extract. The solvents used for the extraction were 100 % water (WE), 50: 50% methanol: water (MWE), and 100 % methanol (ME). Fresh cladodes were also analyzed (FC).

### Proximate and Phytochemical Analyses

The proximate properties of cactus cladodes extracts which include the moisture, crude fat, crude fiber, ash, and crude protein were determined using AOAC (2012) method and carbohydrate was calculated by difference using equation 1;

$$\%\text{Carbohydrate} = 100 - (\text{Moisture} + \text{Crude fibre} + \text{Crude protein} + \text{Ash} + \text{Crude fat}) \quad (1)$$

The phytochemical constituents of the cactus cladodes extracts, which include the flavonoids, alkaloids and glycoside were evaluated according to the method described by Mahadeva *et al.* (2016) while the saponin content was determined using the method described by Lawal *et al.* (2015).

### Statistical Analysis

All data were analyzed in triplicate and One Way Analysis of Variance (ANOVA) and Duncan Multiple Range Test at 5 % significance level were performed using SPSS software version 20 to separate the means.

## RESULTS AND DISCUSSION

### Proximate properties of cactus cladode (*Opuntia ficus-indica)* extract

The proximate composition of cactus pear *(Opuntia ficus-indica)* extracts (Table 1) reveals significant variations in moisture, crude fat, crude fiber, ash, crude protein, and carbohydrate contents, which can be attributed to the different extraction methods employed. The high moisture content in the FC indicates its potential as a hydrating agent, while the lower moisture in ME suggests that methanol effectively extracts with less water retention, making it more suitable for concentrated extract applications (Rao *et al.*, 2020). Fat content varied significantly, with the lowest in ME (0.87%). This implies that polar solvents like methanol are less effective in extracting lipophilic compounds compared to aqueous methods, which may solubilize fats more (Zhang *et al.*, 2019). Fiber content was highest in the water-methanolic extract (WME) at 3.76%, followed closely by WE (3.63%). Concentration factor could probably have played a role as the fresh cladode had

the lower fiber content than the powder extract. The significant fiber content in the extracts indicates their potential for promoting digestive health and may also enhance the functional properties of food products (Kumar *et al.*, 2022). Ash content, which reflects the mineral content, was highest in WME (6.26%). The elevated ash content in WME suggests that it effectively extracts essential minerals, making it beneficial for supplementation and health applications (Ali *et al.*, 2023). The protein content varied, with the highest concentration in WE (4.89%) and the lowest in ME (3.40%). This variation may indicate high solubility of proteins in water solvents than methanol. The higher protein content in WE may contribute to its nutritional value, as proteins play a crucial role in various physiological functions (Sahu *et al.*, 2021). The carbohydrate content was significantly high in ME (80.85%), suggesting that methanol extraction is effective in solubilizing carbohydrates, which can serve as a valuable energy source (Odeyemi *et al.*, 2022). The lower carbohydrate content in FC (5.64%) indicates the potential for utilizing the extracts in functional food formulations that require low carbohydrate profiles.

**Table 1. Proximate composition of cactus cladode *(Opuntia ficus-indica)* plants extracts using different solvent**

| Samples | Parameters (%) | | | | | |
|---|---|---|---|---|---|---|
| | Moisture content | Crude Fat | Crude fiber | Ash | Crude Protein | Carbohydrate |
| WE | $6.52^{bc}$±0.08 | $1.25^{a}$±0.02 | $3.63^{b}$±0.02 | $5.73^{b}$±0.02 | $4.89^{a}$±0.04 | 77.98b±0.07 |
| WME | $6.66^{b}$±0.06 | $1.25^{a}$±0.00 | $3.76^{a}$±0.00 | $6.26^{a}$±0.33 | $4.89^{a}$±0.00 | 77.17c±0.39 |
| ME | $5.90^{d}$±0.03 | $0.87^{c}$±0.02 | $2.87^{c}$±0.04 | $6.12^{ab}$±0.06 | 3.40c±0.06 | 80.85a±0.06 |
| FC | $82.42^{a}$±0.10 | $1.01^{b}$±0.00 | $2.17^{d}$±0.05 | $4.01^{c}$±0.01 | 4.75b±0.02 | 5.64d±0.03 |

Values are means±standard deviation of triplicate determination; means with different superscript in the same column are significantly ($p \geq 0.05$) different
WE= Cladodes extract produced using 100% water
WME= Cladodes extract produced using 50% Water and 50% methanol
ME= Cladodes extract produced using 100% methanol
FC= Fresh cladode

**Phytochemical constituents of Cactus cladode *(Opuntia ficus-indica)***

The results of the phytochemical constituents are presented in Table 2. Flavonoids were found in varying concentrations across the different extraction methods, with the methanol extract (ME) showing the highest concentration at 122.19 mg/100g. This increase may be attributed to the efficient extraction properties of methanol in solubilizing flavonoids, aligning with findings by Zbinden *et al.* (2020), who reported enhanced flavonoid extraction with polar solvents such as methanol. Flavonoids are well-documented for their anti-inflammatory and, antioxidant effects (Gani *et al.*, 2012,) indicating the potential health benefits of cactus cladode extracts. Alkaloids were also present, with the highest concentration observed in the methanolic extract (12.4 mg/100g). The presence of alkaloids in *Opuntia* species suggests a possible role in plant defense mechanisms (Ali *et al.*, 2023). Alkaloids have been noted for their therapeutic effects, including anti-inflammatory and antimicrobial properties (Krishnamoorthi *et al.*, 2022). The variation in alkaloid content with different extraction methods emphasizes the significance of extraction parameters in obtaining phytochemicals. The concentration of saponins varied, with the highest level recorded in the fresh cactus pear (7.42 mg/100g) and the lowest in the methanolic extract (2 mg/100g). Saponins are known for their amphipathic nature, which contributes to their surfactant properties and may exhibit cholesterol-lowering effects (Sharma *et al.*, 2023). The presence of saponins in cactus pear highlights its medicinal potential, although caution is advised regarding their gastrointestinal effects at high concentrations (Johnson, 2013). Glycosides were found in low amount compared to other phytochemicals examined and it ranged from 1.42 (ME) -

mg/100g (WE). Glycosides play essential roles in various biological processes and possess various health benefits, including antioxidant and anti-inflammatory activities (Kregiel *et al.*, 2017). The higher glycoside content in the methanolic extract underscores the efficiency of methanol as a solvent for extracting these compounds.

**Table 2. Phytochemical composition of cactus cladode *(Opuntia ficus-indica)* plants extracts using different solvent**

| Sample | Phytochemicals (mg/100g) | | | |
|---|---|---|---|---|
| | Flavonoid | Alkaloid | Saponin | Glycoside |
| WE | $85.38^{c}\pm0.04$ | $7.65^{c}\pm0.00$ | $5.79^{b}\pm0.00$ | $1.42^{d}\pm0.01$ |
| WME | $108.55^{b}\pm0.09$ | $12.14^{b}\pm0.00$ | $3.53^{c}\pm0.02$ | $1.76^{b}\pm0.00$ |
| ME | $122.19^{a}\pm1.18$ | $12.46^{a}\pm0.10$ | $2.44^{d}\pm0.01$ | $2.25^{a}\pm0.00$ |
| FC | $57.83^{d}\pm0.03$ | $4.32^{d}\pm0.01$ | $7.42^{a}\pm0.00$ | $1.55^{c}\pm0.00$ |

Values are means±standard deviation of triplicate determination; means with different superscript in the same column are significantly ($p\geq0.05$) different

WE= Cladodes extract produced using 100% water
WME= Cladodes extract produced using 50% Water and 50% methanol
ME= Cladodes extract produced using 100% methanol
FC= Fresh cladode

## CONCLUSION

The type of solvents used significantly influenced the proximate and phytochemical parameters of cactus pear extracts using different solvents. These extracts had varied proximate composition with no significant difference in crude protein composition in the 100 % water and 50:50 (water: methanol) extract. In addition, the pear cactus extract using WME had higher ash content. However, the pear cactus extract produced using 100 % ethanol had higher amount of flavonoids, alkaloids, and glycosides. This reveals substantial potential for health benefits, driven by their diverse bioactive compounds. The result confirms the effectiveness of methanol or combined with water in this extraction and this can be utilized in the food and pharmaceutical industries.

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