

## Exploring the nutraceutical and medicinal potential of common weeds *Chenopodium album* L. and *Avena* as alternative food supplement and medicine

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### SUMMARY

Weeds are always considered as notorious plants and sometimes potential threat to agronomic crops. This unfavorable viewpoint ignores the overwhelming evidence that weed species have been useful to numerous societies as edibles and in treating various kinds of the diseases. The present study was conducted with the aim to access the dietary potential and nutraceutical properties of wild *Chenopodium album* and *Avena fatua*. Both plant species are common weeds. The roots and shoots of *C. album* and *A. fatua* were analyzed for different biochemical attributes. Results were statistically analyzed and revealed the presence of alkaloid, saponin and phenolic contents were found to be highest in Bathua shoots i.e. 9.71%, 4.52% and 16.09%. Shoot of both plants showed higher concentration of phytochemicals as compared to roots. *Chenopodium album* shoot and root showed more ash, moisture, phytochemicals and nutritional contents as compare to *Avena fatua*. Antimicrobial activities were observed in the mixture of different solvents extract of shoots and roots of *Chenopodium album* and *Avena fatua* against *Bacillus subtilis* and *Pseudomonas aeruginosa* and in fungus species *Aspergillus niger*, *Fusarium oxysporum* and *Penicillium glabrum*.

**Keywords:** Bathua, Wild Oat, Weeds, phytochemicals, Nutraceutical, antimicrobial activity

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### INTRODUCTION

Plants that are self-grown unnecessarily with crops and also found in the gardens, playgrounds, barnlot, pools and on community spaces are known as weeds (Chavaan *et al.*, 2013). People depended on the weeds in the form of food, firewood, medicines and fodder (Razzaq *et al.*, 2013). Many parts of the weedy plants are considered to be the edible vegetables. Weeds are used in the preparation of many dishes and recipes in many countries of the world (Cruz-garcia, 2012). Weeds are also used as cattle

fodder. In all over the world, the weeds are found to be the chief source of medicine for treatment of the several diseases of humans (Hillocks, 1998; Imtiaz *et al.*, 2023).

*Chenopodium album* belongs to the family *Chenopodiaceae* (goose foot family) also known as pig weed, lamb-quarter, (Pandey and Gupta, 2014) bathua, fathen, chakvit, vastukah (Sikarwar *et al.*, 2013) chandan betu, pappukura and tanko. *Chenopodium album* is local plant of Western Asia (Jain and Singhai, 2012). It is found in multiform i.e., from mealy white to greenish or reddish, odorless with height of 3.5m and grows in all seasons and found in fields of wheat, barley and gram (Pandey and Gupta, 2014; Sikarwar *et al.*, 2013). Whole plant is used as both vegetable and in preparation of herbal medicines (Jain and Singhai, 2012). The plant has high nutritive and curative property because of this weedy plant is used in the preparation of many medicines and food. The plant is helpful against diabetes, cardiovascular diseases, neural and optical disorders but also in aging process (Kumar *et al.*, 2018; Wijayanti *et al.*, 2023) and for treating pile it is used with goat milk (Pandey *et al.*, 2016). It is used in preparation of many recipes like parhata, roti, salad and raita or used with curd (Pandey and Gupta, 2014). Plant is effectual against the pathogens microorganisms (Singh *et al.*, 2011). It has been found that remarkable antifungal potential of the plant is against the phytopathogenic fungi (Kumar *et al.*, 2018).

Wild oat is in botanical term called *Avena fatua* and belongs to the family *Poaceae*, common weed found in the annual cereal crops the weedy plant is grown in winter season. The major annual fastest growing grassy weedy plant is found in the field of barley and wheat (Stokłosa and Kiec, 2006). It is found in the meadows, grasslands (Beckie *et al.*, 2012) cultivable, plough able, wasteland, roadsides (Bond *et al.*, 2007) and cereal crops of spring season (Stokłosa and Kiec, 2006). It having the various kinds of names jai and javi (Chatuevedi *et al.*, 2011) oat grass, (Bond *et al.*, 2007) wild oat, spring wild oats, common wild oats and in botanical term known as *Avena fatua* (Beckie *et al.*, 2012). The plant is the rich source of the phytochemicals, fibers (Chatuevedi *et al.*, 2011), proteins, vitamins, minerals and energy (Beckie *et al.*, 2012). It is important for the humans and animals also used as fodder (Chatuevedi *et al.*, 2011).

The plant based medicines are being used in treating various ailments all over the world. Most of these plants are naturally growing as wild (Azhar, 2014; Azhar *et al.*, 2015; Azhar, *et al.*, 2020). Wild medicinal plants and weeds are significant for domestic medicinal uses traditionally for centuries antimicrobial (Kumar *et al.*, 2023), phytochemical, biochemical and clinical studies of traditional medicinal plants are the fields of research that are crucial to support our efforts in hunt of new medicines (Javid *et al.*, 2017; Azhar *et al.*, 2018; Khan *et al.*, 2019). Weeds like other wild plants could be a potential alternate of medicine and diet especially in famine (Azhar *et al.*, 2014). Although various studies on these weeds have been conducted other parts but depending on a variety of factors, including soil type, climate, and altitude, plants can display variations in their chemical composition. Thus, a more thorough understanding of a plant's phytochemical profile can be obtained by analyzing it in various geographic locations. This knowledge can be beneficial to researchers, pharmaceutical companies, and the agricultural industry. Therefore, this study was

carried out for assessing the nutritional profile, biochemical attributes and antimicrobial activity of *C. album* and *A. fatua*, collected from Southern Punjab.

## MATERIALS AND METHODS

### COLLECTION AND PREPARATION OF SAMPLE

Samples of *Chenopodium album* and *Avena fatua* plants were collected from the wheat fields and roadsides along the Suraj Miani Road, District Multan. After being carefully separated by hand, the roots and shoots of *Chenopodium album* and *Avena fatua* were thoroughly cleaned with tap water. After the cleaning, these samples were dried at 40 °C in an oven, coarsely grounded in a mixer grinder, sieved, and kept for later use in an airtight container that could withstand light.

### EXTRACT YIELD (EY)

The dried extract yield depends on the dried weighed of the plants material by using the given equation that was determined.

$$\text{Yield (g/100g of dried plant material)} = (W1 \times 100) / W2$$

In given equation where,

W1 = weight of the extract after evaporation of the solvent

W2 = weight of the dry plant material

### PLANT MATERIAL EXTRACTION

100g sample of each plant material (roots, shoots) measured properly with electrical weighing balance and extracted with the 200ml mixture of different solvents distilled water, dichloromethane, ethyl acetate, methanol and petroleum ether. The plant material mixture was incubated for 24 hours at 150 rpm and 65°C in an incubator shaker. Whatman-filter paper was used to filter the mixtures following the incubation period. The resulting filtrates were then moved to different beakers and sealed with foil that had tiny holes so that the solvent could evaporate in a hot air oven at 65 °C.

### PHYTOCHEMICALS ANALYSIS

After weighing 2.5 grams of the sample, 100 milliliters of 10% acetic acid solution in ethanol in order were added to a 250 milliliter beaker. After covering, it was left to stand for four hours. After filtering, the extract was diluted to a quarter of its original volume on a water bath. Until the precipitation was finished, concentrated ammonium hydroxide was added to the extract drop by drop. After letting the entire mixture settle, the precipitate was removed, cleaned with diluted ammonium hydroxide, and then filtered once more. After that, the alkaloid was weighed and dried (Harborne, 1973). Using catechin as a standard, the aluminum chloride colorimetric method was likewise employed to determine the total amount of flavonoid compounds. After adding 250 µl of the sample extract to 4.5 ml of distilled water, 0.03 ml of 5% NaNO<sub>2</sub> was added. Then AlCl<sub>3</sub> (0.03 ml, 10%) had been added after 5 minutes at 25 °C. 2 milliliters of 1M NaOH were added to the reaction mixture after an additional five minutes. At 510 nm, the absorbance of the reaction mixture was measured after it had been diluted to 10 ml with distilled water. The outcomes were presented as dried extract equivalents (CE) in µg/mg (Obadoni and Ochuko, 2001). Using the Folin-

Ciocalteu mixture, the amount of phenolic compounds was determined in accordance with Javid et al., (2017). In individual test tubes, 1 ml of plant extracts, 7.5 mL of distilled water, and 0.5 mL of Folin-Ciocalteu reagent were added. Ninety minutes were spent incubating the sample. The optical density was measured at 765 nm. By calibrating the gallic acid curve, the concentration of total phenolic compounds was assessed; the results were expressed as milligrams per gallic acid equivalent (mg GAE/g). Saponin was determined by the method of Obadoni and Ochuko. (Obadoni and Ochuko, 2001).

#### NUTRITIONAL ANALYSIS

The crude protein content was estimated using the macro Kjeldahl method. For twenty-four hours, the powdered samples of different parts of both plant were baked at 105 °C. The moisture content is determined by the weight differential. AOAC method Ref. 942.05. was used to analyze the content of ash. Petroleum ether was used as a solvent to ascertain the samples' fat content. Additionally, the total carbohydrate was computed. The AOAC method was used to determine the crude fiber content (AOAC Method, 1995).

#### ANTIMICROBIAL ACTIVITY

The plant (shoots and roots) extract prepared in mixture of different solvents was used to examine against microbial activity. Two main microscopic organism fungus and bacteria were selected to examine the growth against desired sample. Bacterial strains were obtained from Microbiology lab of IP&AB, BZU, Multan. Activity of plant (shoots and roots) extract in mixture of different solvents against following bacterial species was determined by standard protocol of Kirby-Bauer (Hudzicki, J., 2009). *Escherichia coli*, *Staphylococcus aureus*, *Bacillus subtilis*, *Pseudomonas syringe* and *Pseudomonas aeruginosa*, *Xanthomonas sp.* Antifungal analysis was also determined by Disc diffusion method.

#### STATISTICAL ANALYSIS

*Chenopodium album* and *Avena fatua* extracts of all biochemical and nutritional properties were examined in triplicate. At the end of experimental duration, the data of biochemical and nutritional profiles were attained statistically analyzed with the help of Analysis of variance (ANOVA) technique by using statistic 8.1software.

### RESULTS AND DISCUSSION

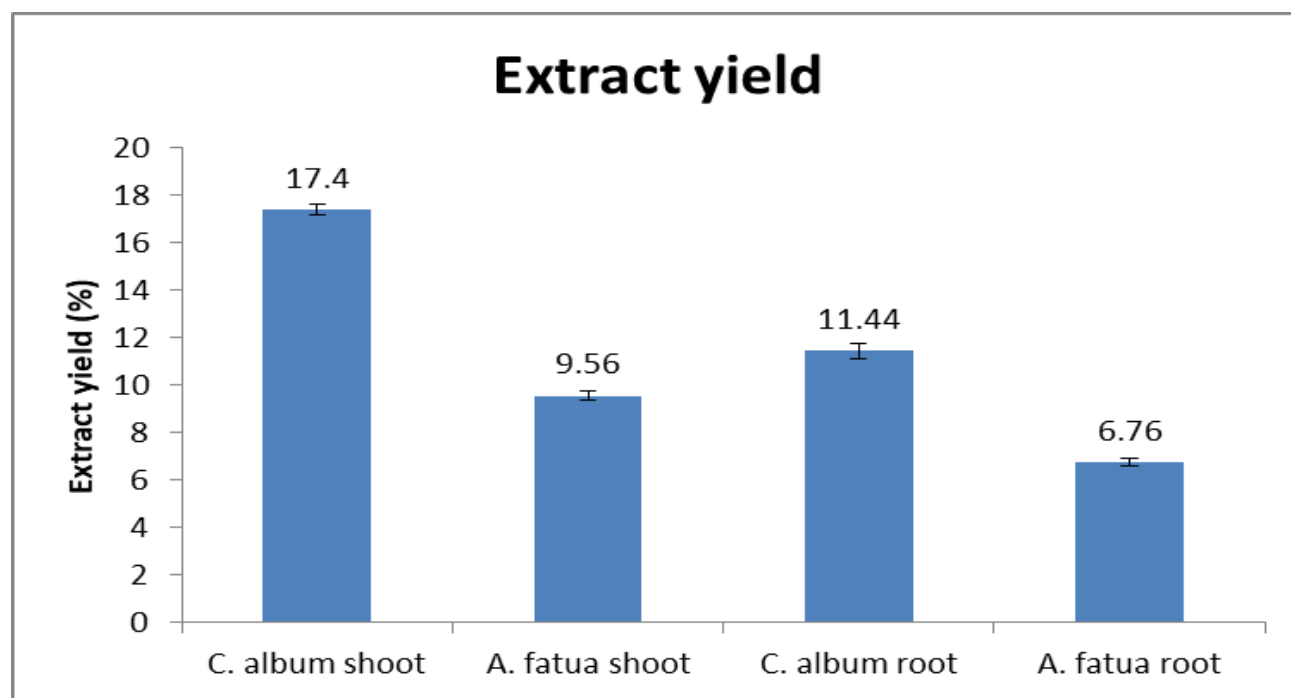
In this research work phytochemicals, nutritional, and antimicrobial activities of two weedy plants i.e. *C. album* and *A. fatua* were studied. Maximum plant extract yield was obtained from *C. album* shoot comparing to others plants parts (Figure 1). *C. album* leaves showed higher moisture, Ash, crude fiber, Fat, carbohydrates and proteins contents as compared to *A. fatua* leaves and roots (Table 1).

The nutritional qualities of *C. album* and *A. fatua* demonstrated potential benefits in the current study (Table 1). Since moisture content and crude fibres determination have a direct impact on plants nutritional content, therefore, they should be reported during nutritional analysis. The root sample extracts of *C. album* had relatively low moisture contents (2.96%) as compare to *A. fatua* (4.53%), which

could be helpful in terms of extending its shelf life. Ash, carbohydrates contents and protein contents have been found higher in shoots of both plants. Although the fat contents are lower, ranging from 0.82% to 0.19% by weight.

**Table 1: Nutritive analysis different parts of *C. album* and *A. fatua*.**

| Parameters            | <i>C. album</i> shoot | <i>A. fatua</i> shoot | <i>C. album</i> root | <i>A. fatua</i> root |
|-----------------------|-----------------------|-----------------------|----------------------|----------------------|
|                       | Mean±SE               | Mean±SE               | Mean±SE              | Mean±SE              |
| Moisture Content      | 8.71±0.64             | 8.63±0.46             | 2.96±0.52            | 4.53±0.348           |
| Ash Content           | 53.33 ±0.785          | 43.7 ±0.785           | 36.71 ±0.375         | 40.03 ±0.101         |
| Crude Fibers Content  | 9.1±1                 | 6.31 ±0.491           | 11.33 ±0.881         | 4.42 ±0.345          |
| Fat Content           | 0.82 ±0.012           | 0.44 ±0.014           | 0.79 ±0.085          | 0.19 ±0.021          |
| Carbohydrates Content | 7.28 ±0.129           | 6.14 ±0.061           | 3.36 ±0.140          | 2.45 ±0.213          |
| Proteins Content      | 4.4 ±0.057            | 3.74 ±0.071           | 2.15 ±0.091          | 1.45 ±0.161          |

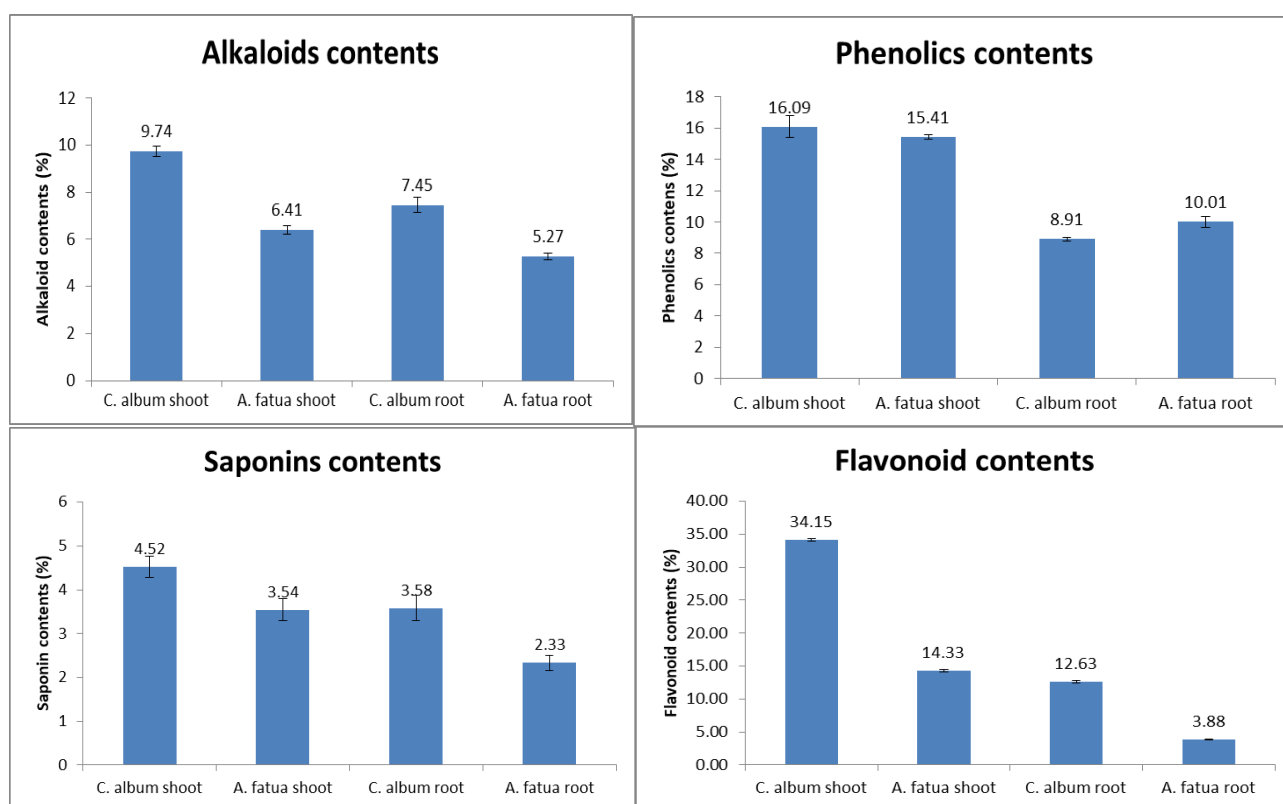


**Figure 1: Extract yield in different parts of *C. album* and *A. fatua*.**

*C. album* and *A. fatua* are common wheat weeds but they have various secondary metabolites and antioxidant compounds which may play a significant role in disease prevention. Phenolic contents (FC), and other secondary metabolites of shoot and roots extracts of both plants were calculated (Figure 2.). Alkaloids contents and saponins were found higher in leaves and root extract of *C. album* (9.74%, 7.45% and 4.52%, 3.58%) as compared with *A. fatua* (6.41%, 5.27% and 3.54%, 2.33%) while crude flavonoids (34.15%, 14.33%), phenolics (16.09%, 15.41%) are higher in the shoot of both plants rather in roots. Roots extracts of both plants showed lower phenolic contents (8.91%, 10.01%) and flavonoids contents (12.63%, 3.88%). The

environmental formation affects the synthesis of these phytochemicals which lead in the improvement of such contents this fact cannot be denied.

In lowering the risk of the abdominal cancer, level of high blood pressure and cholesterol saponin was found to be most beneficial. It has been reported that various researches showed that phenolic play a vital role in providing the important nutritional values for our health. It provides not only healthy nutritional values but also play an important role in aroma, flavor, taste and color of the food. It gives the defense mechanism to the plants that neutralizes the defense mechanism. It also gives the protection against microorganisms, herbivores and insects (Vaya *et al.*, 1997). Flavonoids content were found to be observed in both *Chenopodium album* and *Avena fatua*. Flavonoids played an important in biological activities like prevention in proliferation of cells, enzymes and antioxidant effects (Havsteen, 2002).



**Figure 2: Secondary metabolite contents in different parts of *C. album* and *A. fatua*.**

The extract of shoots and roots from *C. album* and *A. fatua* exhibited antibacterial activity against six distinct bacteria in a mixture of solvents (Table 2). *E. coli* is a gram negative bacterium, while *B. subtilis* is a gram positive bacterium. To test the antibacterial potential, these bacteria along-with four other bacteria were exposed to concentrated and diluted extracts of leaves and roots. Both plants significant antibacterial activity was revealed in both the root and leaf extracts at  $p < 0.05$ . *D. album* shoot extracts (Conc. and Dil.) were found to have the strongest antibacterial activity against *P. aeruginosa* (28.5mm, 14.5mm), *P. syringae* (26.5mm, 13.5mm), *B. subtilis* (24.5mm, 12.0mm), *S. aureus* (21.5mm, 10.0mm) and *Xanthomonas* (24.0mm, 12.0mm). Likewise, *C. album* root extracts (Conc. and Dil.)

exhibited the strongest response against *P. aeruginosa* (24.5mm, 12.5mm), *Xanthomonas* (23.5mm, 11.0mm) and *E. coli* (24.5mm, 13.5mm). Similarly, *A. fatua* root extracts (Conc. & Dil.) were found to have the strongest antibacterial activity against *P. aeruginosa* (27.5mm, 14.5mm), *P. syringae* (27.5mm, 14.5mm), *S. aureus* (21.5mm, 10.0mm) and *Xanthomonas* (26.0mm, 14.0mm). Likewise, *A. fatua* shoot extracts (Conc. & Dil.) exhibited the strongest response against *B. subtilis* (24.0mm, 10.5mm) and *S. aureus* (28.5mm, 15.0mm). Table 2 displays the significant antibacterial activity of the *C. album* root extracts demonstrated against *E. coli*. These outcomes were contrasted with those of amoxicillin, which demonstrated antibacterial activity of 22.0 mm against *E. coli* and 24.5 mm against *B. subtilis* (Table 2).

**Table 2: Antibacterial activity of plant extracts against bacterial strains.**

| Growth inhibition zone (mm) |                       |      |                      |      |                       |      |                      |      |          |          |
|-----------------------------|-----------------------|------|----------------------|------|-----------------------|------|----------------------|------|----------|----------|
| Bacterial Species           | Plant extracts        |      |                      |      |                       |      |                      |      | Controls |          |
|                             | <i>C. album</i> shoot |      | <i>C. album</i> root |      | <i>A. fatua</i> shoot |      | <i>A. fatua</i> root |      | Positive | Negative |
|                             | Conc.                 | Dil. | Conc.                | Dil. | Conc.                 | Dil. | Conc.                | Dil. |          |          |
| <i>P. aeruginosa</i>        | 28.5                  | 14.5 | 24.5                 | 12.5 | ---                   | ---  | 27.5                 | 14.5 | 24.5     | ---      |
| <i>P. syringae</i>          | 26.5                  | 13.5 | ---                  | ---  | ---                   | ---  | 27.5                 | 14.5 | 23.5     | ---      |
| <i>B. subtilis</i>          | 24.5                  | 12.0 | ---                  | ---  | 24.0                  | 10.0 | ---                  | ---  | 24.5     | ---      |
| <i>S. aureus</i>            | 21.5                  | 10.0 | ---                  | ---  | 28.5                  | 15.0 | 21.5                 | 10.0 | 23.0     | ---      |
| <i>Xanthomonas</i>          | 24.0                  | 12.0 | 23.5                 | 11.0 | ---                   | ---  | 26.0                 | 14.0 | 23.0     | ---      |
| <i>E. coli</i>              | ---                   | ---  | 24.5                 | 13.5 | ---                   | ---  | ---                  | ---  | 22.0     | ---      |

Positive control; Amoxicillin, Negative control; sterile water, Conc.; concentrated/pure sample, Dil.; sample diluted to 50%.

Antibacterial compounds (antibiotics), antifungal compounds also inhibit fungal growth mainly in two modes of action i.e., either killing the fungal cells by affecting a substance in the cell walls, causing the contents of the fungal cells to leak out and the cells to die or preventing the fungal cells growing and reproducing (Zhang *et al.*, 2008). Shoot and root extracts of *C. album* showed strongest inhibitory activity against four fungal species i.e., *A. flavus*, *A. niger*, *P. glabrum*, *F. oxysporum* (Table 3). While, leave extracts in concentrated form are more effective against *A. flavus*, *P. glabrum* and *F. oxysporum* and root extract in concentrated against *A. flavus*, *A. niger* and *P. glabrum*.

Both plant extracts contains secondary metabolites, including flavonoids, phenols, and alkaloids, which have been shown to have antimicrobial activity (Javid *et al.*, 2017). Alkaloids are a class of chemical compounds with diverse structural variations that exhibit antimicrobial properties through inhibition of enzyme activity (Patra, 2012). Al Aboody and Mickymaray, 2020 reported that flavonoids have potential to inhibit the fungi growth by damaging their cell wall, cell membrane, malfunctioning of mitochondria and interruption in translation process. Similarly,

phenols considered as strong antimicrobial agents which cause damage to membrane structure and inhibition of specific enzymes of electron transport chain (Bhattacharya *et al.*, 2010). Same species exhibits different phytochemical profile with different geographical areas and depending on plant sample collection season, extraction method and growth stage of plants (Gizaw *et al.*, 2022).

**Table 3: Antifungal activity of plant extracts against fungal species.**

|                |        | Growth inhibition zone |          |            |              |
|----------------|--------|------------------------|----------|------------|--------------|
| Plant extracts |        | Fungal Species         |          |            |              |
|                |        | A. flavus              | A. niger | P. glabrum | F. oxysporum |
| A. fatuda      | Leaves | Conc.                  | +        | -          | +            |
|                |        | Dil.                   | -        | +          | -            |
|                | Roots  | Conc.                  | +        | +          | +            |
|                |        | Dil.                   | +        | +          | +            |
| C. album       | Leaves | Conc.                  | +        | +          | +            |
|                |        | Dil.                   | +        | +          | +            |
|                | Roots  | Conc.                  | +        | +          | +            |
|                |        | Dil.                   | +        | +          | +            |
| Fungicide      |        | +                      | +        | +          | +            |
| Water          |        | +                      | +        | +          | +            |

## CONCLUSION

The phytochemical profile of roots and shoots extracts of *C. album* and *A. fatua* exhibited a prominent variation in biochemical characteristics. Comparative studies indicated that *C. album* shoot and root extracts possess higher moisture, crude fiber, ash, total fat and protein contents. Secondary metabolites like, crude alkaloids, saponin, phenols and flavonoid contents have been found higher in shoot part of both plants. Moreover, various inhibition levels against different fungal species and bacterial strains were observed in both plants extracts in the antifungal and antibacterial assays. These results reveals that unique phytochemical profiles of *C. album* and *A. fatua*, proposing a wide potential utilization in pharmaceuticals, nutraceutical and agriculture.

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