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Comparative Study of the proximate composition and antioxidant capacity of processed *Corchorus olitorius*

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Abstract

Corchorus olitorius is globally used both as a vegetable and as herb for medical and therapeutic purposes. The aim of this study was to evaluate the effect of different processing techniques (air drying- AD, oven drying- OD and sun drying-SD) on the antioxidant activity and proximate composition of *Corchorus olitorius.*

The moisture content of *C. olitorius* was significantly higher in SD and OD drying methods and was also significantly lower in AD when compared to other drying method. There is a significant increase in the carbohydrate level and ash content in the air-dried processed *C. olitorius*. All the other nutrients including crude protein and fats show that temperature conditions in oven drying, sun drying and air drying had no substantial effect on its retention.

Highest 2, 2-diphenyl-2-picryl-hydrazyl free radical scavenging activity (DPPH %) and Ferric reducing antioxidant power (FRAP) value retention were observed in air drying and lowest in oven drying.

The proximate composition and antioxidant activity of C. *olitorius* were found to be significantly higher ($p < 0.05$) in AD compared to OD and SD. The study concluded that AD should be considered an appropriate drying procedure for retaining excellent nutritive qualities and antioxidant capacity of *Corchorus olitorius.*

Keywords: *Corchorus olitorius*; Proximate composition; Antioxidant; Air drying; DPPH; FRAP

1. Introduction

Antioxidants are compounds that inhibit or delay the oxidation of other molecules by inhibiting the initiation or propagation of oxidizing chain reactions [1]. They neutralize free radical reactive species that are generated endogenously through aerobic metabolism [2]. Antioxidants are substances that prevent and stabilize the damage caused by free radicals by supplying electrons from antioxidants to these damage cells. Antioxidants may be defined as complex determined compounds that function as defensive shields against several diseases [3].

Oxidative stress, an imbalance condition when reactive oxygen species (ROS) formation exceed cellular antioxidant capacity, has become a major issue in Humans and Animals. Animal and Human body has effective antioxidant defence systems, which constitute enzymes, such as superoxide dismutase (SOD), catalase and compounds, such as ascorbic acid, tocopherol, and glutathione [4]. But all these endogenous antioxidants are not sufficient in protecting the body against oxidative stress. Hence, dietary supplementation through natural antioxidants is vital.

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Plants produce phenolic compounds in response to stress as a defence mechanism [5] and phenolics compound belong to the very important group of plant antioxidants which are natural.

Corchorus olitorius is an excellent source of phenolic compounds (flavonoids, phenolic acid and alcohols, tocopherols, tocotrienols, stilbenes), ascorbic acid and carotenoids. Jute leaves are rich sources of Vitamin A (β-carotene), C, E, B1, B2, folic acid and minerals such as iron and calcium, proteins, lipid and carbohydrates [6,7,8,9,10]. It also contains high levels of all essential amino acids [11]. The leaves, roots and seeds of jute mallow are used as herbal medicine by local people in various parts of the world [12]. Consumption of the leaves of *C. olitorius* is observed to be demulcent, deobstruent, diuretic, lactagogue, purgative and tonic [13,14]. It is also a folk remedy for aches and pains, dysentery, enteritis, fever, pectoral pains, ascites, piles, tumors, gonorrhea, and chronic cystitis [12,15].

C. olitorius leaves are cooked into thick viscous soup added to stews and eaten with starchy staples [16]. They can be processed through the means of drying and kept for further domestic uses.

Drying is the most common processing step to increase the shelf life of fresh materials [20,21]. Drying is basically defined as a process of water removal and decreasing of moisture content, aimed at preventing microbial and enzymatic activity.

This study is designed to determine the effect of different processing techniques on the antioxidant activity and proximate composition of *Corchorus olitorius.*

2. Material and methods

2.1. Sample Collection and Preparation

Corchorus olitorius was collected from the Peace House Agricultural Training Institute Research Farm. The obtained herbs materials were cleansed and washed with water and separated into three parts, a part was subjected to air drying, another subjected to oven drying and the last part to sun drying. The air drying was at room temperature (24°C) and oven drying at 40°C.

2.2. Proximate Analysis

2.2.1. Crude Fiber

A small amount of finely ground sample (2 g) was taken into a filter crucible and was inserted into the hot extraction unit (Hot Extractor, Model-1017). Sufficient amount of pre-heated 0.128M H_2SO_4 was added into the reagent heating system and few drops of octanol were added through the valves. The mixture was digested for 30 minutes. Acid was then removed from it by filtering and washing with boiling water. The residue in the flask was boiled with required amount of 0.223M KOH for 30 minutes and then filtered with subsequent washing in boiling water and acetone. The residual content was then dried in an oven at 105°C for a few hours and then ignited in muffle furnace at 550°C for 3 hours. The loss of weight represented the crude fibre.

2.2.2. Crude Protein

Crude protein of the samples was estimated by using Kjeldahl. A sample of 0.5 g and a blank was estimated in the digestion tube. For digestion at high temperature, 10 ml of concentrated sulfuric acid and 1.1 g digestion mixture were added in the tube. Then the digestion tubes were set in digestion chamber fixing at 420^0C for 45 minutes ensuring water supply, easier gas outlets etc. After digestion the tubes were allowed to cool and 5 ml of sodium thiol-sulphate ($Na_2S_2O_3$, 33%) and 30 ml sodium hydroxide (NaOH) solution was added in each tube. Then the distilled extraction was collected with 25 ml of Boric acid (4%) and titrated with standard hydrochloric acid (0.2N).

2.2.3. Ash

Clean crucibles were ignited at 350^0C for about 15mins, cooled in a desiccator and weighed. 1g of each sample was transferred into each of the appropriately labelled crucibles and then reweighed. Then, the crucibles with their contents were transferred into the muffle furnace at 550^0C the for about 5hrs. After complete aching, the crucibles were allowed to cool in a desiccator and then reweighed.

2.2.4. Crude Fat

Crude fat was determined by extracting a weighed quantity (3 g) of samples with analytical grade acetone in ground joint Soxhlet apparatus. Extraction was allowed to continue by heating in the electric heater at the temperature of 70^0C until clear acetone (without oil) was seen in siphon, which took about 3 hours. Then the round bottom flask of the apparatus was separated and the extract was transferred to a pre-weighed beaker and left for evaporation of acetone. After the evaporation of acetone, only the lipid was left in the beaker which was later calculate.

2.2.5. Carbohydrate

Carbohydrate (Cho), a soluble carbohydrate was calculated by subtracting the sum of the percentage contents of moisture, crude protein, lipid, ash and crude fiber from 100.

Cho % = {100- (moisture + crude protein + crude lipid + ash + crude fiber)}

2.2.6. Moisture Content

The moisture content of the sample was determined using air oven [24]. The petri dishes were washed and dried in air oven. The dishes were then transferred into the desiccator and allow to cool. The weights of the petri dishes were determined. 3g of sample was weighed in to a dry petri dish and the contents were transferred into an oven maintaining a temperature of 105^0C. The content was allowed to dry at this temperature for 6hrs. The petri dished with their content was removed from the oven and placed in the desiccator. After cooling, the weight was recorded, after drying to constant weight.

2.3. *In vitro* antioxidant activity

2.3.1. Determination of free radical scavenging ability

The free radical scavenging ability of the extract against DPPH (1, 1- diphenyl-2-picryhydrazyl) using [26] method. 1ml of the extract was mixed with 1ml of the 0.4mM methanolic solution of the DPPH the mixture was left in the dark for 30min before measuring the absorbance at 516nm.

2.3.2. Determination of ferric reducing property

The reducing property of the extract will be determined by [27], 0.25ml of the extract was mixed with 0.25ml of 200mM of Sodium phosphate buffer pH 6.6 and 0.25ml of 1% KFC. The mixture was incubated at 50oC for 20min, thereafter 0.25ml of 10% TCA was also added and centrifuge at 2000rpm for 10min, 1ml of the supernatant was mixed with 1ml of distilled water and 0.1% of FeCl3 and the absorbance was measure at 700nm.

2.4. Data Analysis

The means and standard error of mean (SEM) of the data were calculated. The results were analysed by two-way analysis of variance (ANOVA) with Bonferroni Test using GraphPad prism to determine significant differences between means and where applicable, least significant difference (LSD) was used to determine significant results. The differences between groups were considered significant at $P < 0.05$.

3. Results and discussion

Table 1 Proximate analysis of processed *C. olitorius*

Group	CF	MC	Protein	Fat	Ash	CHO
AD	4.11 ± 0.02^a	61.15 ± 0.03^a	8.46 ± 0.02^a	0.53 ± 0.02^{ab}	0.78 ± 0.07^a	24.98 ± 0.10^a
SD	4.37 ± 0.03^b	71.47 ± 0.02^b	9.03 ± 0.02^b	0.49 ± 0.02^a	0.67 ± 0.02^{ab}	13.98 ± 0.10^b
OD	4.15 ± 0.03^a	73.37 ± 0.02^b	8.34 ± 0.02^c	0.56 ± 0.01^b	0.64 ± 0.02^b	12.95 ± 0.09^c

Foot Note: CF- Crude fibre, MC- Moisture content, CHO- Carbohydrate. AD- Air dried, SD- Sun dried and OD- Oven dry. Values are expressed in Mean±SEM. Mean with same superscript across the same column are not significant (P>0.05). Mean with different superscript across the same column are significant at P<0.05.

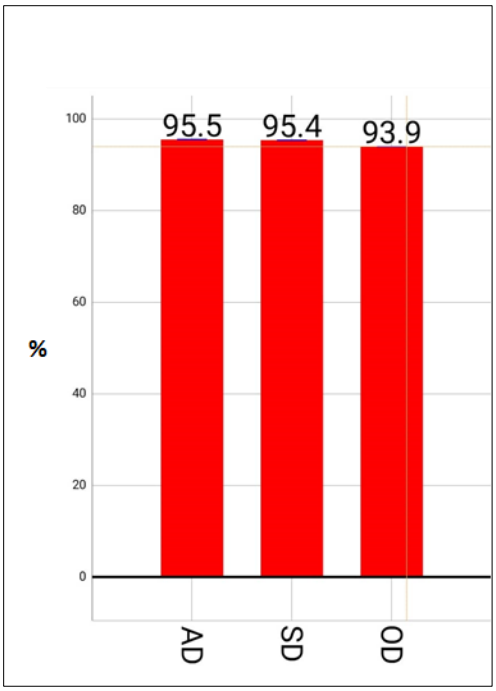

Figure 1 DPPH Scavenging Properties (%)

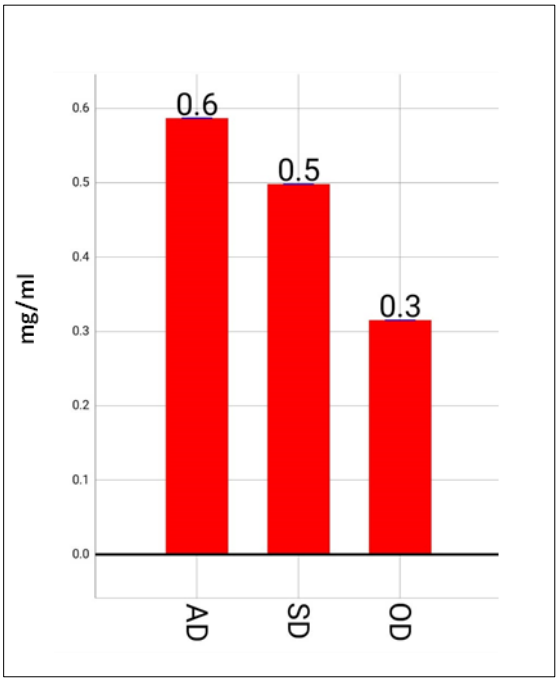

Figure 2 FRAP (mg/ml)

4. Discussion

The moisture content of *C. olitorius* was significantly higher in SD and OD drying methods and was also significantly lower in AD when compared to other drying method. This result is also similar to the study conducted by [19]. The moisture content of any food product is an index of its water holding activity and is used as a measure of stability and susceptibility to microbial contamination [17]. The high amount of moisture is also disadvantageous and leads to spoilage [18]. There is a significant increase in the carbohydrate level and ash content in the air-dried processed *C. olitorius*, this shows that there is a high dietary fibre in the air-dried processed *C. olitorius* when compared to the other

processing methods. Vegetables are rich in fibre and fibre is an essential nutrient for maintaining a healthy digestive system and reduces the risk of developing type 2 diabetes.

All the other nutrients including crude protein and fats show that temperature conditions in oven drying, sun drying and air drying had no substantial effect on its retention.

According to the results given in Figure 1, DPPH radical scavenging activity percentage was significantly affected ($p<0.05$) during different types of drying methods for *C*. *olitorius* leaves. The highest DPPH radical scavenging % was recorded in the AD method (95.5%) and the lowest DPPH radical scavenging % (93.9%) was seen in OD method. FRAP values of *C. olitorius* showed a significant difference against different methods of drying ($p<0.05$) and results pertaining to the FRAP values are illustrated in Figure 2. In the case of FRAP value, this also showed the same pattern as DPPH radical scavenging % for AD, OD and SD. The highest FRAP value was recorded in AD method (0.6mg/ml) and the lowest FRAP value was seen in OD method (0.3mg/ml).

This finding is similar to the study of [22] who reported that sun drying has higher radical scavenging activity when compared to oven drying. Another study also shows that lower temperatures can retain more antioxidant content than higher temperatures [23] because high temperatures can contribute to irreversible oxidative processes for natural antioxidants. It shows that air drying has the potential of retaining phenolic compounds and antioxidant activities of *C*. *olitorius* as compared to other drying methods. It also implies that oven drying may not be an efficient method for drying *C*. *olitorius* leaves or the drying time, method of handling and temperature, may be the reasons for the variation.

In a study by [25] he reported that all methods of thermal drying (microwave, OD, SD) resulted in drastic declines in antioxidant activity, whereas non-thermal drying methods resulted in increase in antioxidant activity.

5. Conclusion

The present study investigated the effects of three different drying methods (AD, OD, and SD) on the proximate composition and antioxidant activity of *C*. *olitorius*. In comparing the nutritional quality and antioxidant activity of the different drying methods of *C*. *olitorius*, air drying was the preferred drying method to preserve *C*. *olitorius* as a potential antioxidant source and to also retain its nutrients. The results of this study could be helpful for future research as well as for the production and commercialization of the product.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare no conflict of interest.

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