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Research Article

Nutritional Composition, Antinutrient Contents, and Polyphenol Compounds of Selected Underutilized and Some Commonly Consumed Vegetables in East Wollega, West Ethiopia

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In Ethiopia, some plants (Ethiopia kale, Swiss chard, and celery) remain underutilized for human consumption, as information on their nutritional potential remains limited. As a result, the purpose of this study was to determine the proximate, mineral, antinutrient, and phytochemical content of Ethiopia kale (*Brassica carinata*), Swiss chard (*Beta vulgaris*), carrot (*Daucus carota*), tomato (*Lycopersicon esculentum*), and cabbage (*Brassica oleracea*) using standard analytical methods. The moisture, crude protein, crude fiber, crude fat, total ash, total carbohydrate, and energy contents were found to be 6.44–16.62%, 6.76–33.64%, 9.19–54.86%, 0.50–4.00%, 1.00–2.75%, 7.28–68.73%, and 141.06–333.28 kcal/100 g, respectively. Ethiopia's kale had a high protein content, while celery had a high fat and fiber content. The calcium, magnesium, iron, phosphorous, potassium, zinc, and sodium content (mg/100 gdb) ranged between 8.00 and 306.00, 8.10–11.83, 0.64–4.85, 11.34–63.00, 2.83–810.00, 0.15–41.65, and 1.50–443.80 mg/100 g, respectively. Swiss chard contained magnesium, potassium, and sodium, whereas celery was high in calcium and iron. The total oxalate, condensed tannin, and phytate (mg/100 gdb) ranged as follows: 0.88–4.92, 138.27–892.19, and 69.14–265.99, respectively. Ethiopia's kale recorded a comparatively low amount of tannin and phytate. High mineral bioavailability, such as calcium, iron, and zinc, was obtained in Ethiopia kale. The results also showed that Ethiopia's kale contained a good amount of total phenolic and flavonoid content. The findings indicated that Ethiopia kale was a significant source of protein, had low antinutrient content with high mineral bioavailability, and had the potential to formulate nutrient-rich infant and young child foods using staple cereals and pulse grains.

1. Introduction

In developing countries, the demand for food is very high due to some of the fundamental driving forces of food and nutrition insecurity, such as ever-increasing population, traditional agricultural practices associated with low yield, climate change, land degradation, reduced productivity, and high postharvest losses [1]. Apart from developing countries, Ethiopia is one of the most affected by food insecurity, where hunger is occurring sporadically in some communities, some of them to the extent of famine [2]. However, the country is endowed with different types of edible plant species, which could contribute to supporting food and nutrition security efforts.

Among plants, vegetables are rich in dietary fiber, beta-carotene, total phenolic, total flavonoid content, and antioxidant capacity, which play a vital role in human health [3]. Keyata et al. [4] also indicated that vegetables rich in protein and minerals such as calcium, sodium, potassium, phosphorous, iron, and zinc are essential to mitigate protein malnutrition and micronutrient deficiencies.

In developing countries, plant products are used as a source of nutrients, as they are cheaper than animal products. However, some plants may remain underexploited because very little information is available on their nutritional potential or possible toxicity. The low consumption of vegetables is directly linked to various health problems such as cardiovascular disease, cancer, diabetes, and kidney disease [5].

Ethiopia, particularly the Eastern Wollega zone, has a well-intentioned potential to produce vegetables. Some underutilized vegetables [Ethiopia kale (*Brassica carinata*), Swiss chard (*Beta vulgaris*), and celery (*Apium graveolens*)] and selected commonly consumed vegetables [tomato (*Lycopersicon esculentum*), cabbage (*Brassica oleracea),* and carrot (*Daucus carota*] are consumed in the vicinity of Nekemte town, Eastern Wollega, Ethiopia]. Ethiopia kale, Swiss chard, and celery are considered underutilized vegetables because they are not widely exploited for human consumption and are cultivated in western Oromia, the study area in particular. Besides this, some commonly consumed vegetables such as tomato, cabbage, and carrot are widely consumed in the study area but not used for value addition to developing new products. This might be due to limited scientific data on the nutritional composition, antinutrients, and health-enhancing polyphenol compounds. Therefore, to increase consumption of the indicated underutilized and some commonly consumed vegetables, proximate composition, mineral content, antinutrients, mineral bioavailabilities, and polyphenol compounds were reported.

2. Materials and Methods

2.1. Sample Collection and Preparation. The samples of vegetables such as cabbage, carrot, celery, Ethiopia kale, Swiss chard, tomato, and carrot were purchased from the farmers around Nekemte town (Guto Gida, Leka Dulacha, Diga, and Wayu Tuka woreda) in Eastern Wollega, Oromia, Ethiopia, where most of the farmers sell their products. The samples were wrapped in airtight bags, preserved in iceboxes, and shipped to Wollega University's FTPE laboratory. Then, samples of vegetables were cleaned with a dry cloth, and moisture content was determined on a wet weight basis. The sliced leaves, carrot roots, and tomato fruit were dried in an oven at 45°C (24 h for the roots and fruits and 18 h for the leaves). The dried beans were ground into a fine powder that passed through a 0.5 mm screen mesh size. After being sealed into airtight polyethylene plastic bags, the powdered samples were kept in the refrigerator until the analyses were completed.

2.2. Proximate Compositions and Gross Energy Contents. The moisture content of the samples was determined by the convective oven drying method (130°C for 1 hour) by taking about 3 g of sample (dried sample powder) as described in the AOAC [6] method 925.10. Crude protein content was determined by the micro-Kjeldahl method by taking about 1.0 g of the sample as described in the AOAC [6] method, 920.87. The crude fat content was determined by taking about 1.5 g of the sample by the Soxhlet extraction method using petroleum ether as a solvent [6], method 920.39. The crude fiber content was determined following the AOAC [6] method 962.09 after sequential digestion with 1.25% H_2SO_4 and 28% KOH, screening through 75 microns, drying, and ignition in a muffle furnace (Sx2-4-10, Zhejiang, China) to subtract ash from the crude fiber. The total ash content was determined gravimetrically after the carbonization of about 2.0 g of sample on a blue flame of a Bunsen burner, followed by ignition of the sample at 550°C until ashing was completed [6], method 923.03. The difference determined the total carbohydrate content (TCC) [7]. The results of all proximate compositions were expressed in percentages (%). Gross energy content was calculated using Atwater's conversion ratios: 4 kcal/g for protein, 9 kcal/g for fat, and 4 kcal/g for carbohydrates [8]. All the above-indicated parameters were reported on a dry weight basis.

2.3. Determination of Mineral Contents. The mineral content was evaluated using an atomic absorption spectrophotometer (AAS) following the AOAC [9] method 985.35. About 3.0 g of samples were weighed into the predried, ignited, and ashed at 550°C until ashing was completed. A 5 mL solution of 6N HCl was used to dissolve the white ash, which was then dried on a hot plate. The solution flask was then combined with distilled water after seven mL of 3N HCl was added and heated on the crucible on the hot plate. Finally, utilizing air-acetylene as a source of flame energy for atomization, the solution was diluted to the mark (50 mL) with freshly deionized water for minerals (Mg, Ca, Fe, and Zn). By detecting the emission at 589 nm and 767 nm, the Na and K concentrations were estimated using a flame photometer. The ammonium molybdovanadate colorimetric AOAC [10] official method 965.17 was used to determine the phosphorus concentration.

2.4. Antinutritional Factors. Maxson and Rooney [11] and Vaintraub and Lapteva [12] used UV-visible spectrophotometers to determine the condensed tannin and phytate concentration, respectively. However, total oxalate content was investigated by the AOAC [6] method 974.24 using titration methods.

2.5. Molar Ratios: Antinutrients to Minerals. The molar ratio of phytate to minerals (Ca, Zn, and Fe) was calculated by dividing the mole of phytate (the molar mass of phytate = 660 g/mol) by the mole of minerals (the molar mass of Ca = 40 g/mol; the molar mass of Zn = 65 g/mol; the molar mass of Fe = 56 g/mol) [13]. The oxalate to calcium molar ratio was calculated by dividing the mole of oxalate (88 g/mol) by that of calcium. The molar ratios were also compared with the critical toxicity values described in WHO/FAO [14].

2.6. Polyphenol Compounds

2.6.1. Determination of Total Phenolic Content. The total phenolic content was determined using Singleton and Rossi's [15] techniques (TPC). A test tube was filled with 100 mg of ground samples, and the suspension was slightly agitated after adding 5 mL of 80% aqueous methanol. Tubes

Table 1: Proximate compositions (dwb) of composite vegetable samples.

Name of Sample	Moisture	Crude Protein	Crude Fiber	Crude Fat	Total Ash	Total Carbohydrate	Gross Energy
Cabbage/*B. oleracea*/	6.44 ± 0.01^{c}	17.5 ± 0.18^{d}	46.18 ± 0.10^{b}	0.75 ± 0.25^{c}	1.00 ± 0.32^{a}	28.12 ± 0.34^{c}	189.25 ± 2.91^{e}
Ethiopia kale/*B. carinata*/	16.62 ± 5.33^{a}	33.64 ± 0.41^{a}	20.47 ± 1.00^{d}	0.50 ± 0.00^{d}	2.75 ± 0.35^{a}	27.93 ± 0.18^{c}	260.76 ± 1.06^{c}
Swiss chard/*B.vulgaris*/	8.96 ± 0.03^{c}	30.19 ± 0.9^{b}	11.49 ± 0.20^{e}	1.75 ± 0.25^{b}	2.66 ± 0.99^{a}	44.95 ± 0.60^{b}	316.41 ± 4.39^{b}
Celery/*A. graveolens*/	12.57 ± 0.00^{b}	18.99 ± 0.9^{c}	54.86 ± 0.02^{a}	4.00 ± 0.00^{a}	2.3 ± 0.39^{a}	7.28 ± 0.31^{d}	141.06 ± 1.58^{f}
Tomato/*L. esculentum*/	7.60 ± 0.05^{c}	12.34 ± 0.9^{e}	9.19 ± 1.00^{f}	1.00 ± 0.00^{c}	1.14 ± 0.16^{a}	68.73 ± 0.88^{a}	333.28 ± 3.16^{a}
Carrot/*D. carota*/	13.39 ± 0.82^{b}	6.76 ± 0.9^{f}	33.10 ± 0.10^{c}	1.00 ± 0.00^{c}	1.99 ± 0.32^{a}	43.78 ± 0.70^{b}	211.11 ± 2.43^{d}

were sonicated for 40 minutes at 40°C in a sonicator bath and then centrifuged (14000 rpm for 10 min). For each sample, 100 μl of the extract was added to the two test tubes, with 2.5 mL of Folin-reagent Ciocalteu's and 1.5 mL of (20%) sodium carbonate. The tubes were filled with the solution and incubated for 30 minutes at 40°C. Absorption at 765 nm was measured using a UV-visible spectrophotometer (Model: JASCO V-630, Shimadzu Corporation, Tokyo, Japan). Pure gallic acid was used to make a series of standard solutions (0, 50, 100, 150, 250, and 500 mg/kg of gallic acid equivalent). The absorbance of all the standards and the blank was measured at the same wavelength as the sample extract stated above. The total phenolic content was calculated using a Gallic acid equivalent (GAE) standard curve and reported as mg of GAE/g of dry weight.

2.6.2. Determination of the Total Flavonoids Content. Total flavonoid content was determined using colorimetric methods described by Xu and Chang [16]. A 0.25 mL extract was combined with 1.25 mL of deionized water and 75 μl of a 5% $NaNO_2$ solution. After 6 minutes, 150 μl of a 10% AlCl3.6H2O solution was added to the mixture. After a 5-minute incubation period at room temperature, 0.5 mL of 1 M NaOH and 2.5 mL of deionized water were added. The pink color's absorbance was measured at 510 nm against a blank using a UV-visible spectrophotometer (Model: JASCO V-630, Shimadzu Corporation, Tokyo, Japan) after the liquid was entirely vortexed for 5 minutes. The concentration of (+)-catechin used in the calibration curve ranged from 10 to 1000 μg/mL. The catechin equivalent (CE) of total flavonoids was calculated and represented as mg of CE/g of dry weight.

2.7. Statistical Analysis. SAS version 9.3 was used to conduct all statistical analyses. The separation means were determined using Duncan's multiple range tests. The significance test level was set at 5% ($p < 0.05$). Mean ± standard error (SE) was reported.

3. Results and Discussion

3.1. Proximate Composition and Gross Energy Contents. The proximate composition and gross energy contents of the six vegetables in this study are presented in Table 1.

The result showed no significant ($p < 0.05$) difference in the moisture content among carrots, Swiss chard, and celery. However, there was a significant ($p < 0.05$) difference in cabbage and tomatoes compared to Ethiopia kale. The moisture content of leafy cabbage (5.9%) and root carrot (13.39%) obtained in this study was similar to the results reported for gerger leaves (5.9%) and figl roots (2.9%) reported by Keyata et al. [17]. The findings highlighted that relatively low moisture content recorded in the cabbage/*Brassica oleracea* powders could stay in storage without deterioration for value addition.

Consuming high-quality protein in sufficient amounts is essential for growth and development. The result showed that crude protein content on a dry matter basis ranged from 6.76 to 33.64%. The protein contents were high for Ethiopian kale, followed by Swiss chard, but were low for carrots. The protein content of Ethiopia kale/*Brassica carinata* (33.64%) was comparable with the result reported by Yemane [18] (30.03%) for the same vegetable. The values of crude protein content obtained for cabbage (17.5%), celery (18.99%), and carrot (6.76%) in this study were higher than the results reported by Abd El-Fattah [19]. This might be due to genetic variation, climate conditions, and soil fertility. The results demonstrated that Ethiopian kale and Swiss chard could be utilized to fortify and formulate protein-rich diets to reduce protein-energy malnutrition in vulnerable groups such as children, the elderly, pregnant, and nursing mothers.

The crude fiber content of celery was significantly ($p < 0.05$) higher (54.86%) and was followed by cabbage (44.18%), carrot (33.10%), and Ethiopia kale (20.47%). However, the tomato had the lowest crude fiber content (11.49%) on a dry weight basis. The crude fiber content of Ethiopia kale (20.47%) was lower than the leaves of cassava (26.9 g/100 gdb) [20]. The fiber content in celery (54.86%) was more than two times higher than the result stated by Ashoush et al. [21] (19.8%). The high fiber content obtained in celery can significantly contribute to lowering plasma cholesterol levels, decreasing the incidence of colon cancer, lowering insulin requirements of diabetics, and softening the stool. It also has a physiological purpose in maintaining internal distension for appropriate peristaltic movement of the intestinal tract, ensuring that food passes through the digestive tract smoothly [22].

The crude fat content of celery (4.00%) obtained in this study was significantly ($p < 0.05$) higher than in other vegetables such as Swiss chard (1.75%), tomato (1.00%), carrot (1.00%), cabbage (0.75%), and Ethiopian kale (0.5%). The crude fat content of cabbage was more significant than the result indicated by Ogbede [23] (0.31%). According to the findings, excess fat consumption has been linked to cardiovascular diseases like atherosclerosis, cancer, and

Table 2: Mineral contents (mg/100 g, dwb) of composite vegetable samples.

Sample	Calcium	Magnesium	Iron	Phosphorous	Potassium	Zink	Sodium
Cabbage	32.06 ± 10.96^{d}	8.10 ± 3.90^{c}	0.64 ± 0.56^{c}	35.60 ± 0.40^{bc}	167.50 ± 2.50^{c}	41.65 ± 1.55^{a}	17.00 ± 1.00^{d}
Ethiopia kale	145.00 ± 2.00^{b}	8.50 ± 1.50^{c}	3.80 ± 0.30^{ab}	63.00 ± 1.00^{a}	804.40 ± 2.10^{a}	0.37 ± 0.24^{c}	245.00 ± 5.00^{b}
Swiss chard	50.50 ± 0.50^{c}	21.50 ± 1.50^{a}	2.40 ± 1.20^{bc}	39.50 ± 1.50^{bc}	810.00 ± 2.00^{a}	0.45 ± 0.09^{c}	443.80 ± 2.00^{a}
Celery	306.00 ± 4.00^{a}	11.50 ± 0.50^{b}	4.85 ± 0.35^{a}	51.00 ± 1.00^{ab}	142.50 ± 1.50^{d}	0.17 ± 0.04^{c}	77.50 ± 2.50^{c}
Tomato	8.00 ± 1.00^{e}	10.50 ± 0.50^{b}	1.05 ± 0.15^{c}	26.00 ± 3.00^{d}	236.50 ± 0.50^{b}	0.15 ± 0.05^{c}	5.56 ± 1.44^{e}
Carrot	29.50 ± 1.50^{d}	11.83 ± 1.02^{b}	0.67 ± 0.62^{c}	11.34 ± 1.46^{d}	2.83 ± 0.03^{e}	3.07 ± 0.01^{b}	1.50 ± 0.80^{e}

Means within the same column with different superscripts were significantly ($p < 0.05$) different. Values are presented as Mean ± SE, $n = 2$.

aging. Therefore, the consumption of vegetables should be encouraged, particularly for people affected by obesity.

In this study, six vegetables' total carbohydrate content (TCC) ranged from 7.28 to 68.73%. The study's findings showed that tomatoes contain significantly ($p < 0.05$) high TCC compared to the studied vegetables. However, celery had a significantly ($p < 0.05$) low TCC (7.28%). The TCC of tomato and a Swiss card is similar to the results reported for red calyces of karkade (*Hibiscus sabdariffa*) (68.7%) and gerger (*Eruca sativa*) leaves (43.7%), respectively [4]. However, the TCC of carrot roots was lower than that of fig root (*Raphanus sativus*) (52.3%) reported by the same authors.

The gross energy contents of this study's four different leafy vegetables ranged from 141.06 to 316.41 kcal/100 g. In addition, the gross energy content of tomato and carrot root had 333.28 and 211.11 kcal/100 g, respectively. The gross energy content of cabbage (189.25 kcal/100 g) obtained in this study was similar to that of leaves of *Amaranthus viridis* (195.00 kcal/100 g), *Vitex doniana* (194.03 kcal/100 g), and *Corchorus olitorius* (184.00 kcal/100 g) as reported by Saha et al. [24]. The gross energy content of Swiss chard (316.41 kcal/100 g) recorded in this study is in line with spinach leaves (300.94 kcal/100 g) reported by Umar et al. [25].

3.2. Mineral Compositions. Table 2 shows the mineral content of six vegetables commonly consumed in Ethiopia's Eastern Wollega zone on a dried weight basis.

Calcium requirements are essential for all stages of life, and requirements are most significant during childhood, pregnancy, and breastfeeding [26]. The study showed that among the studied vegetables, celery leaves had high calcium content (306.00 mg/100 g), which was found within the daily allowance recommended for all life cycles (200–1300 mg/day) [27]. However, the tomato had a significantly ($p < 0.05$) lower calcium content (8.00 mg/100 g) than all other samples on a dry weight basis. The value of calcium content in this study was higher than the findings reported by Kasa [28] for Swiss chard, Ethiopia kale, cabbage, and Simaro. This might be due to genetic variation, climate conditions, and soils. The findings highlight that the high amount of calcium recorded in this study plays a vital role in building strong bones and teeth in early and later life [29].

The magnesium content (8.10–21.50 mg/100 g) obtained in this study was more significant than the results stated for wild edible vegetables such as *Ipomoea aquatic* (4.4 mg/100 g), *Achyranthes aspera* (4.9 mg/100 g), *Asystasia gangetica* (4.2 mg/100 g), *Enydra fluctuans* (3.8 mg/100 g), *Oldenlandia corymbosa* (5.3 mg/100 g), and *Amaranthus viridis* (3.9 mg/100 g) [30]. The higher magnesium contents found in this study are essential for maintaining electrical potential in nerves and membranes and for the normal metabolism of calcium and phosphorus [31].

Inadequate iron intake during pregnancy can impact the fetus's growth and development [32]. The iron content in the celery was significantly ($p < 0.05$) high when compared to other studied vegetables. However, it is lower than the iron contents of figl and gerger leaves reported by Keyata et al. [4]. The iron content of both celery (4.85 mg/100 g) and Ethiopia kale (3.80 mg/100 g) was within the recommended daily allowance (RDA) for children (3.0 to 4.1 mg/d) for the formation of new red blood cells and brain development [33].

Phosphorus is an essential nutrient found in practically all diets and is required for various physiological activities and structures in the human body [34]. The phosphorus content of the six vegetables in this study ranged from 11.34 to 63.00 mg/100 g. The phosphorous content obtained in this study was lower than edible vegetables collected from the southern coastal region of Bangladesh, such as *T. portulacastrum* (178 mg/100 g), *D. esculentum* (158 mg/100 g), *H. sabdariffa* (153 mg/100 g), *H. auriculata* (104 mg/100 g), *H. indicum* (180 mg/100 g) [35], and spinach leaves (313.3 mg/100 g) [36]. However, similar to the phosphorus content of cabbage (41.7 mg/100 g), Ethiopia kale (52.2 mg/100 g), lettuce (75.9 mg/100 g), and Swiss chard (68.4 mg/100 g) reported by Jiru and Urga [37], the findings suggest that insufficient consumption of foods with low phosphorus may cause bone diseases such as rickets in children and osteomalacia in adults.

Potassium is necessary to regulate blood pressure, prevent stroke, prevent renal vascular, glomerular, and tubular damage, lower urinary calcium excretion, and limit kidney stones' production [38]. The phosphorus content in the Swiss chard (810.00 mg/100 g) and Ethiopia kale (804.40 mg/100 g) was significantly ($p < 0.05$) high as compared to the other studied vegetables. The result was higher than *Moringa oleifera* (75.33 mg/100 g), *Chenopodium album* (70.70 mg/100 g) [24], and cabbage (678.00) [23]. The study indicated that potassium in the leaves of Swiss chard and Ethiopian kale can achieve the recommended daily intake for all age groups (400–5100 mg/day) [39]. The high potassium content obtained in this work is essential for people taking diuretics to control hypertension [40].

Table 3: Antinutrient content (mg/100 g, dwb) of composite vegetable samples.

Sample	Oxalate	Tannin	Phytate
Cabbage/*Brassica oleracea*/	0.88 ± 0.06^{e}	261.76 ± 0.23^{e}	130.88 ± 0.11^{e}
Ethiopia kale/*Brassica carinata*/,	2.77 ± 0.00^{d}	138.27 ± 0.12^{f}	69.14 ± 0.01^{f}
Swiss chard/*Beta vulgaris*/	3.56 ± 0.09^{b}	531.97 ± 0.01^{b}	163.31 ± 0.50^{d}
Celery/*Apium graveolens*/	3.18 ± 0.03^{c}	327.62 ± 0.11^{d}	265.99 ± 0.00^{b}
Tomato/*Lycopersicon esculentum*/	4.92 ± 0.13^{a}	422.45 ± 0.01^{c}	211.23 ± 0.10^{c}
Carrot/*Daucus carota*/	5.05 ± 0.00^{a}	892.19 ± 0.00^{a}	446.11 ± 0.00^{a}

Means within the same column with different superscripts were significantly ($p < 0.05$) different. Values are presented as Mean ± SE, $n = 2$.

Zinc is a high requirement for women of fertile age, infants, and adolescents for normal collagen synthesis and mineralization of bones [41]. The zinc content of cabbage (41.65 mg/100 g) was significantly ($p < 0.05$) higher than all samples of vegetables considered in this study (0.15–3.07 mg/100 g). The result also showed no significant ($p < 0.05$) difference between Ethiopian kale, Swiss chard, celery, and tomatoes. The finding indicated that cabbage leaves contain a high amount of zinc, which achieved the daily requirements of all life cycles, such as infants (2 to 3 mg/d), children (3 to 5 mg/d), adults (8 to 11 mg/d), pregnancy (11 to 12 mg/d), and lactating women (12 to 13 mg/d) [33].

Excess sodium salt in the diet has been linked to an increased risk of cardiovascular disease [42]. The leaves of Swiss chard had significantly ($p < 0.05$) high (443.80 mg/100 g) sodium content, followed by Ethiopia kale (245 mg/100 g), which is within the range of RDA for all age groups (120–1500 mg/day) [39]. However, the sodium content of celery (77.50 mg/100 g), tomato (5.56 mg/100 g), carrot (1.5 mg/100 g), and cabbage (17 mg/100 g) is below the range of RDA for all age groups and should be supplemented with sodium-rich sources. Despite this, low sodium content in the diet is essential for the food industry to produce low sodium foods for better health.

3.3. Antinutrient Contents. The content of antinutrients such as condensed tannin, phytic acid, and total oxalate content in the studied vegetables is indicated in Table 3.

Condensed tannin has been shown to obstruct nutrient digestion and inhibit the body from absorbing beneficial bioavailable chemicals [43]. The condensed tannin content of leaf vegetables in this study ranged from 138.27 to 531.97 mg/100 g. The obtained results in vegetable leaves, carrot root, and tomato were lower than *Amaranthus* graecizans leaves (1537 mg/100 g) reported from Southern Ethiopia [44]. However, it was higher than the leaves of figl (*Raphanus sativus*) (104.7 mg/100 g) and gerger (*Eruca sativa*) (124 mg/100 g) grown in Benshangul–Gumuz [4]. The findings showed that, except for carrots, the tannin contents of all vegetables in this study were below the maximum tolerable level (560 mg/100 g) reported by Anonymous [45].

Foods high in phytic acid are getting a bad reputation due to their ability to bind to essential minerals such as iron, zinc, calcium, and magnesium in the digestive tract and inhibit their absorption by the body [46]. The phytate content observed in this study was between 69.14 and 446.11 mg/100 g. The lowest phytate was recorded in the Ethiopia kale, while the highest was observed in the carrot. The phytate content obtained in this study was lower than the leaf vegetables reported by Ehilé et al. [_Ehilé_et_al_2018] (720–1300 mg/100 g). The phytate contents of cabbage, Ethiopia kale, and Swiss chard are below the tolerable value reported by Hurrell [47] (less than 200 mg). However, the recommended amounts of celery, tomato, and carrots may inhibit the bioavailability of zinc, calcium, iron, and proteins.

The oxalate content (0.88–5.05 mg/100 g) found in this study was lower than the content reported from green cabbage varieties (222–255 mg/100 g) [48]. The results also showed that the total oxalate content (mg/100 g) of tomatoes (4.92) and carrots (5.05) were significantly more significant than the four green leaf (0.88–3.56 mg/100 g) vegetables considered in this study. However, all are below the maximum recommended daily intake (50 mg/100 g) for human consumption, which is essential for people susceptible to kidney stone problems.

3.4. Bioavailability of Minerals. The bioavailability of minerals such as iron, zinc, and calcium is mainly affected by phytate (Phy) and causes micronutrient deficiency [49]. The molar ratios of antinutrients to minerals of the six vegetables considered in this study are indicated in Table 4.

Calcium bioavailability is considered good when the Phy : Ca molar ratio is 0.17. Based on this information, cabbage, Swiss chard, and tomatoes are most likely to be harmed by phytate, whereas the others are not. Therefore, processing techniques are highly suggested to reduce the phytate content in the above-indicated vegetables.

Phytate: iron molar ratios greater than one indicate poor iron bioavailability [47]. The Phy: Fe molar ratios in the studied vegetables ranged from 1.43 to 68.05. The results imply that the iron absorption from all samples would be inhibited by phytate and then reduce the bioavailability of iron, which causes iron deficiency anemia.

The phytate to Zn ratio of greater than 15 affects the bioavailability of zinc [50]. According to this context, the bioavailability of zinc in cabbage, Ethiopia kale, and carrot may be unaffected by phytate, whereas celery, Swiss chard, and tomato have lower zinc bioavailability.

A molar ratio of Phy•Ca : Zn higher than 200 might negatively influence zinc bioavailability [51]. The results obtained in this study showed that all vegetables were within the recommended values and suitable for zinc bioavailability.

Table 4: Molar ratios of commonly consumed vegetables.

Name of sample	ph/Ca	ph/Fe	ph/Zn	Ca*ph/Zn
Cabbage/*Brassica oleracea*/	0.24 ± 0.01^{b}	18.9 ± 0.10^{b}	0.29 ± 0.00^{f}	0.00 ± 0.00^{d}
Ethiopia kale/*Brassica carinata*/	0.03 ± 0.01^{e}	1.43 ± 0.01^{f}	10.05 ± 0.05^{e}	0.37 ± 0.01^{b}
Swiss chard/*Beta vulgaris*/	0.19 ± 0.00^{c}	6.25 ± 0.00^{d}	25.05 ± 0.05^{c}	0.31 ± 0.01^{b}
Celery/*Apium graveolens*/	0.05 ± 0.01^{d}	4.44 ± 0.01^{e}	133.32 ± 0.02^{b}	10.15 ± 0.05^{a}
Tomato/*Lycopersicon esculentum*/	0.60 ± 0.00^{a}	16.0 ± 0.05^{c}	160.05 ± 0.05^{a}	0.32 ± 0.01^{b}
Carrot/*Daucus carota*/	0.05 ± 0.05^{d}	68.05 ± 0.05^{a}	13.61 ± 0.00^{d}	0.11 ± 0.10^{c}
Standard value	<0.17	<1	<15	<200

Means within the same column with different superscripts were significantly ($P \leq 0.05$) different. Values are presented as Mean ± SE, n = 2.

Table 5: Total polyphenol compounds content (dwb) of composite vegetable samples.

	TPC (mg GAE/g)	TFC (mg CE/g)
Cabbage/*Brassica oleracea*/	0.45 ± 0.60^{cd}	1.54 ± 0.06^{d}
Ethiopia kale/*Brassica carinata*/,	1.01 ± 0.10^{a}	3.35 ± 0.09^{b}
Swiss chard/*Beta vulgaris*/	0.89 ± 0.12^{ab}	3.37 ± 0.99^{b}
Celery/*Apium graveolens*/	0.70 ± 0.07^{bc}	3.59 ± 0.01^{a}
Tomato/*Lycopersicon esculentum*/	0.79 ± 0.01^{ab}	1.09 ± 0.06^{e}
Carrot/*Daucus carota*/	0.36 ± 0.08^{d}	3.19 ± 0.05^{c}

3.5. Polyphenol Compounds

3.5.1. Total Phenolic Content. The total phenolic content (TPC) in the six vegetables commonly consumed in the Eastern Wollega zone of Ethiopia has ranged from 0.36 to 1.01 mg GAE/g (Table 5). There was no statistically significant ($p > 0.05$) difference between Ethiopia kale (1.01 mg GAE/g), Swiss chard (0.89 mg GAE/g), and tomato (0.79 mg GAE/g). The TPC in this study was higher than that in leafy vegetables (0.08–0.32 mg GAE/g) reported by Khanam et al. [52]. This might be due to genetic differences in the plants, methods of extraction, and equipment used to determine TPC. Vegetable-rich phenolic compounds play a substantial role in anti-inflammatory and anticarcinogenic diseases and combat oxidative stress-related diseases [53].

3.5.2. Total Flavonoid Content. The total flavonoid content (TFC) in the vegetable samples ranged from 1.09 mg CE/g to 3.59 mg CE/g (Table 5). The sample's celery had the highest TFC, while the tomato had the lowest on a dry weight basis. The found results were lower than *Amaranthus caudatus* (69.67 mg QE/g) reported by Nyonje [54] while higher than exotic vegetables (0.05–1.00 mg QE/g) such as cabbage, onion, mugwort, and broccoli [55]. High TFC showed excellent potential for antibacterial, anti-inflammatory, antiallergic, antineoplastic, antiviral, antithrombotic, and vasodilator activities [56].

Means within the same column with different superscripts were significantly ($P \leq 0.05$) different. Values are presented as Mean ± SE, $n = 2$ TPC : total phenolic content, TFC : total flavonoid content.

4. Conclusion

This study investigated the nutritional composition, antinutrient contents, and polyphenolic compounds of the six vegetables commonly consumed and grown in East Wollega Zone, Oromia, Ethiopia. The study's results highlighted that the vegetable crops were found to be a good source of all proximate composition, mineral content, and polyphenol compounds. The findings also highlighted that Ethiopia kale had high protein, low antinutrient content, high mineral bioavailability, and good potential for polyphenol compounds among indicated vegetables. Therefore, it can help formulate nutrient-rich complementary foods with the supplementation of staple cereals and pulse grains available in the study area. However, celery is rich in fiber and has the potential for the development of elderly foods [57].

Data Availability

All data generated in the current study are included within the article. Further datasets can be obtained from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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