International Journal of Ecotoxicology and Ecobiology
2023; 8(3): 37-40
http://www.sciencepublishinggroup.com/j/ijee
doi: 10.11648/j.ijee.20230803.12
ISSN: 2575-1727 (Print); ISSN: 2575-1735 (Online)

Proximate Composition Study in Leafy Ethiopian Mustard (*Brassica Carinata* A. Braun) Accessions

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To cite this article:
Ousman Yimer. Proximate Composition Study in Leafy Ethiopian Mustard (*Brassica Carinata* A. Braun) Accessions. *Journal of Food and Nutrition Sciences*. Vol. 8, No. 3, 2023, pp. 37-40. doi: 10.11648/j.ijee.20230803.12

Received: August 14, 2023; **Accepted**: August 30, 2023; **Published**: September 13, 2023

Abstract: Ethiopian mustard is one of the major traditional and common leafy vegetables in Ethiopia. It is a well-known and much-liked component of the local food system and diet. Farmers in Ethiopia grow *Brassica carinata* as a leafy vegetable in their gardens. This study was conducted to assess the proximate composition in leafy Ethiopian mustard genotypes. A total of 36 Ethiopian mustard genotypes were evaluated for proximate composition analysis (moisture, dry matter and protein content analysis). The research result revealed the presence of highly significant differences among Ethiopian mustard genotypes for all proximate composition analysis. The genotypes had mean values that ranged from 80.60 to 85.61% for moisture content and 14.39 to 19.40% for dry matter content. Acc. 21377 and 208404 had significantly the highest and lowest mean values, for moisture content and the reverse is true for dry matter content, respectively. The lowest moisture content in 208404 is a desirable characteristic for leafy vegetables to be kept for a long time before use. The genotypes had overall mean values of 11.36%, ranging from 6.55 to 14.76% for protein content. Acc. 21336 was characterized by the highest protein content without significant difference with mean values of Acc. 21374, 208598, and Acc. 212665. The variety S67 yellow seed has the lowest protein content. Generally, the Ethiopian mustard genotypes had higher proximate composition than most of leafy vegetable crops.

Keywords: Composition, Leafy Ethiopian Mustard, Nutritional, Proximate

1. Introduction

Ethiopian mustard (*Brassica carinata* A. Braun) is one of four *Brassica* species that are widely used as a vegetable, condiment, and source of vegetable oil. Several Brassica species are originated in the Mediterranean region. *Brassica carinata* evolved as a natural cross between *Brassica nigra* (BB) (n = 8) and *Brassica oleracea* (CC) (n = 9) and underwent further chromosomal doubling (2n = 34), in the highlands of the Ethiopian plateau and the adjoining portion of East Africa [16]. Ethiopian mustard, is one of the major traditional leafy vegetables in east Africa, particularly in Ethiopia, and is a well-established integral part of the local food system and diet [14]. Farmers in Ethiopia grow *Brassica carinata* as a leafy vegetable in their gardens and also harvest seed for oil [8, 11]. The leaves are largely consumed during summer season, when shortages of most crops encounter usually after the planting season (July, September) and also tender leaves and sprouts are boiled and eaten especially during periods of fasting, commonly among the Coptic [1]. Mainly women and children collect or harvest the plant. *Brassica carinata* produces the greatest number of leaves with high in mass and height clearly exceeds both parental species [12]. The nutritional composition of *Brassica carinata* is an essential feature; its leaf content has been reported to be comparable to *Brassica juncea*. One reason to eat Ethiopian mustard instead of rapa is that it has less glucosinolate [7].

In the absence of sufficient information for the nutritional quality assessment of leafy Ethiopian mustard genotypes, the proximate composition study has critical importance in generating information that could help in assessing the nutritional content and designing breeding methods to develop varieties of high nutritional traits. Therefore; this research was initiated with the general objective of assessing the proximate composition in leafy Ethiopian mustard genotypes.

2. Materials and Methods

2.1. Description of Experimental Site and Experimental Materials

The nutritional content for the proximate composition of genotypes was conducted in both the soil chemistry and food science laboratory of Holetta Agricultural Research Center. For this study, 36 genotypes of Ethiopian mustard were used. Among the tested genotype five check varieties were used.

2.2. Experimental Procedures

The leaves along with the succulent stems from the field of all the replications for each genotype were used for the determination of laboratory analysis. The composite samples of plant leaves and succulent stems were washed with distilled water and prepared for moisture content assessment, while the remaining samples were drained and powdered for protein analysis in the laboratory.

2.3. Data Collection

2.3.1. Proximate Composition

The data for proximate composition (moisture content, dry matter content, and protein) were collected from laboratory analyses performed in accordance with the internationally established procedures stipulated by official methods of analysis of Associations of Official Analytical Chemists [4] for each trait. The descriptions and measurements for this data are provided below.

2.3.2. Moisture and Dry Matter Content of Edible Parts

5 g samples were carefully weighed into pre-labeled, pre-weighed dishes and dried at 105°C for 3 hours to constant weight before being transferred to a desiccator for cooling. Dried samples/dishes were weighed. Moisture content (%) was calculated using the following relation.

$$\text{Moisture (\%)} = \frac{w1-w2}{w1} \times 100$$

Where w1=weight (g) of sample before drying, w2= weight (g) of sample after drying, then from this we can calculate dry matter content as follows:-

Dry Matter Content =100 - Moisture Content

2.3.3. Protein Content

The protein content was determined by first digesting around 2 g of sample in a Kjeldahl flask, and then adding 10 g of kjeldhal tablet to the sample inside the flask. Twenty milliliter of 98% concentrated sulphuric acid was mixed with the sample. The digestion of the sample began by attaching the Kjeldhal flasks to the digestion rock. When the brown color of the sample had totally disappeared, the digestion was complete.

After digestion, 250 mL of water and 45% sodium hydroxide were added, then followed by distillation into 25 mL of excess boric acid containing 0.5 mL of screened indicator. Finally, the distillate was titrated with 0.1N hydrochloric acid to the red end point to get % of nitrogen and the required protein content calculated with the following relation.

$$\text{Nitrogen (\%)} = \frac{(B-S)*N*0.01401*100}{wt.of\ sample}$$

Where B = back titration of blank, S= back titration of sample, N = normality % Crude protein = %N*6.25

2.3.4. Data Analysis

All proximate composition analysis was performed in duplicate. The data were subjected to analysis of variance (ANOVA) [13]. The comparison of mean performance of genotypes was done following the significance of mean squares using Duncan's Multiple Range Test (DMRT).

3. Results and Discussion

The proximate composition of 36 leafy Ethiopian mustard genotypes is shown in Table 1. There were significant differences between Ethiopian mustard genotypes in moisture, dry matter, and protein contents.

3.1. Moisture and Dry Matter Content

The genotypes had mean values ranged from 80.60 to 85.61 for moisture content and 14.39 to 19.40 for dry matter content. Acc. 208404 and 21377 had significantly the lowest and highest mean values, for moisture content and the reverse is true for dry matter content, respectively. However, other 20 and 14 genotypes had also mean values as minimum and maximum mean values without significant differences among the genotypes for moisture content, respectively (Table 1). From five varieties used as a check, Holetta-1 Brown seed had identified the highest moisture without significant difference with Holetta-1 Yellow seed, Holetta-1 Brown seed and S 67 Yellow seed and vice versa (lowest mean value) for dry matter content. The variety Yellow dodolla had the lowest moisture content but the highest dry matter content without significant difference with S 67 Yellow seed and Brown seed.

More than half of the genotypes (58.33%) had mean value lower than overall mean value for moisture content, this lowest moisture content is a desirable characteristic for leafy vegetables to be kept for a long time before use; the moisture content has to be reduced to inhibit the autocatalytic enzymes. In contrast, high moisture content in vegetables indicates both freshness and perishability [15]. Moisture content is a widely used parameter in the processing and testing of food. It is an index of water activity of many foods. The observed general value suggested that it may have a short shelf life since microorganisms that cause spoilage thrive in foods having high moisture content and also is indicative of low total solids [2]. Both Emebu and Anyika [5] and Ogebede *et al* [9] in Nigeria observed for moisture content of *Brassica oleracea* with a range of 81.38 to 87.93%.

3.2. Protein Contents

The genotypes had mean values ranging from 6.55 and

14.76% for protein content. Acc. 21336 was characterized by the highest protein content without significant difference with mean values of Acc. 21374, 208598 and Acc. 212665. However the variety S67 yellow seed has the lowest protein content (Table 1). Among the five varieties used as a check variety, S67 Brown seed was identified as highest protein content followed by Yellow dodolla.

A total of 19 (52.7%) of genotypes had mean value lower than overall mean value of all genotypes for protein contents. Green leafy vegetables are the richest and cheapest sources of proteins. This is because of their ability to synthesize and accumulative amino acids with the help of abundant source of sunlight, water, oxygen, and nitrogen which is readily available in the atmosphere [3]. The Kjeldahl method cannot distinguish between protein nitrogen and non-protein nitrogen, the protein percentages in vegetables that contain significant nitrate levels may be overestimated [6]. Higher protein content is not a characteristic of leafy vegetables but recently higher protein content had been observed for leafy vegetables research study. For instance, research study on kale reported that *Brassica oleracea* is a good source of vegetable having a protein content of 11.67%. Its protein content makes it suitable for consumption, as necessity for body development. The protein value of kale as observed in this study confers on it the advantage as rich source of vegetable protein over some vegetables [5, 10].

Table 1. *Mean values for proximate composition of leafy Ethiopian mustard genotypes.*

Accession	Moisture content (%)	Dry matter content (%)	Protein content in (%)
Acc.21315	83.70^{a-j}	16.30^{c-l}	12.38^{b-f}
Acc.21336	82.22^{e-l}	17.78^{a-h}	14.76^{a}
Acc.21338	84.30^{a-h}	15.70^{e-l}	10.18^{g-k}
Acc.21349	81.92^{g-l}	18.08^{a-f}	11.19^{d-j}
Acc.21364	80.99^{kl}	19.01^{ab}	10.97^{d-j}
Acc.21371	83.48^{a-k}	16.52^{b-l}	12.70^{bcd}
Acc.21374	84.42^{a-g}	15.58^{f-l}	13.49^{abc}
Acc.21377	85.61^{a}	14.39^{l}	12.01^{b-g}
Acc.207915	82.20^{e-l}	17.80^{a-h}	11.85^{c-i}
Acc.208355	83.01^{a-l}	16.99^{a-l}	12.53^{b-e}
Acc.208404	80.60^{l}	19.40^{a}	11.13^{d-j}
Acc.208406	82.87^{b-l}	17.13^{a-k}	12.30^{b-f}
Acc.208407	81.69^{h-l}	18.31^{a-e}	10.81^{d-j}
Acc.208409	82.70^{b-l}	17.3^{a-k}	8.41^{k}
Acc.208412	82.34^{d-l}	17.66^{a-i}	9.70^{jk}
Acc.208421	82.52^{c-l}	17.48^{a-j}	9.89^{ijk}
Acc.208593	81.84^{g-l}	18.16^{a-f}	11.87^{c-h}
Acc.208598	84.93^{a-d}	15.07^{i-l}	13.62^{abc}
Acc.208601	83.70^{a-j}	16.30^{c-l}	10.04^{h-k}
Acc.208602	81.33^{i-l}	18.67^{a-d}	11.51^{d-j}
Acc.208608	81.30^{jkl}	18.70^{abc}	12.19^{b-f}
Acc.208807	82.44^{c-l}	17.56^{a-j}	11.30^{d-j}
Acc.208969	82.63^{b-l}	17.37^{a-k}	11.35^{d-j}
Acc.212665	84.00^{a-h}	16.00^{d-l}	9.58^{jk}
Acc.212666	81.30^{jkl}	18.70^{abc}	13.85^{ab}
Acc.212668	85.04^{abc}	14.96^{jkl}	11.36^{d-j}
Acc.212674	82.03^{e-l}	17.97^{a-h}	11.98^{b-h}
Acc.212901	82.00^{f-l}	18.00^{a-g}	11.23^{d-j}
Acc.216845	83.15^{a-l}	16.85^{a-l}	11.91^{c-h}
Acc.219786	82.22^{e-l}	17.78^{a-h}	11.50^{d-j}
Acc.237529	85.23^{ab}	14.77^{kl}	10.64^{e-j}
S-67 Brown seed	82.45^{c-l}	17.55^{a-j}	11.87^{c-h}
S-67 Yellow seed	83.10^{a-l}	16.9^{a-l}	6.55^{l}
Holetta -1 Brown seed	84.70^{a-e}	15.3^{h-l}	10.44^{f-j}
Holetta-1 Yellow seed	84.62^{a-f}	15.38^{g-l}	10.85^{d-j}
Yellow Dodolla	82.20^{e-l}	17.80^{a-h}	11.06^{d-j}
Mean	82.91	17.09	11.36

Mean values with similar letter(s) did not have significant differences in each row, MC (%) = Moisture content in percent, DM (%) = Dry matter content in percent, ASH (%) = Ash content in percent, respectively, PC (%) = Protein content in percent.

4. Conclusion

Generally, the Ethiopian mustard genotypes showed the lowest moisture content which is a desirable characteristic for leafy vegetables to be kept for a long time before use. The protein contents in Ethiopian mustard could serve as a potential source of nutrients for alleviation of problems associated with nutritional problems in the country. The results showed that higher chance of developing Ethiopian mustard varieties for high nutritional values through breeding of Ethiopian mustard genotypes collected from different regions of Ethiopia. It is recommended to analyze other nutritional and anti-nutritional factors related to quality characteristics.

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