Kwaghe International
Journal of Sciences and Technology

ISSN: 1595-7977
Index: Harvard, Boston, Sydney University, Dimensions, Lens, ResearchGet Scilit, Semantic, Google, Base etc

https://doi.org/10.58578/KIJST.v3i3.12461

Proximate Analysis of Carrot and Cabbage Cultivated at Ajiwa Dam Batagarawa Local Government

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Submitted:	Revised:	Accepted:	Published:
Sep 12, 2026	Oct 11, 2026	Oct 22, 2026	Oct 27, 2026

Abstract

Vegetables cultivated at Ajiwa Vegetable Garden in Batagarawa Local Government Area, Katsina State, are irrigated with water from Ajiwa Dam. This study assessed the proximate composition and oxalate and phytate contents of carrot and cabbage grown in the garden. Proximate analysis examined moisture, ash, crude lipid, crude protein, crude fibre, and carbohydrate contents. The reported values for carrot and cabbage, respectively, were moisture, 29.60 ± 0.16 and 6.74 ± 0.01; crude lipid, 0.58 ± 0.04 and 0.18 ± 0.02; crude protein, 4.19 ± 0.17 and 3.59 ± 0.25; crude fibre, 16.14 ± 0.13 and 32.21 ± 0.17; and carbohydrate, 43.49 ± 1.68 and 46.33 ± 1.31. Both vegetables had an ash content of 6.00 ± 0.28. Oxalate and phytate contents were each reported as 1.62 ± 0.04 in carrot and 0.73 ± 0.10 in cabbage. Cabbage exhibited higher crude fibre and carbohydrate values, whereas carrot had higher moisture, crude lipid, crude protein, oxalate, and phytate values. These findings document differences in the composition of the two vegetables and provide baseline compositional information on carrot and cabbage cultivated under irrigation from Ajiwa Dam.

Keywords: Proximate Analysis; Carrot; Cabbage; Antinutritional Factors; Ajiwa Dam

INTRODUCTION

Vegetables constitute an important component of a balanced diet because they provide water, carbohydrates, dietary fibre, minerals, vitamins and a wide range of biologically active compounds. Regular consumption of vegetables is associated with

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improved dietary quality and contributes to the intake of nutrients required for normal physiological functions. Among commonly consumed vegetables, carrot (*Daucus carota* L.) and cabbage (*Brassica oleracea* var. *capitata*) are particularly important because they combine nutritional value with relatively wide culinary use. Their nutritional composition, however, can vary according to cultivar, soil conditions, agricultural practices, maturity, environmental conditions and postharvest handling. Consequently, laboratory determination of their proximate composition is important for establishing the nutritional characteristics of vegetables produced in specific local environments.

Carrot is an economically important root vegetable belonging to the family Apiaceae. It is widely cultivated and consumed in fresh and processed forms and is recognized particularly for its carotenoid content. Recent reviews indicate that fresh carrots contain substantial moisture together with carbohydrates, dietary fibre, modest amounts of protein and fat, and minerals. Carrots are also notable for carotenoids, including β-carotene, which serves as a precursor of vitamin A. Motegaonkar et al. (2024) reported that carrot contains approximately 86–89% moisture, 0.9–1.09 g/100 g protein, 0.24 g/100 g fat and approximately 9.58 g/100 g carbohydrate. The authors further highlighted carotenoids, dietary fibre, vitamins and minerals as important components contributing to the nutritional and functional value of carrot.

Cabbage, on the other hand, is a leafy vegetable belonging to the Brassicaceae family and is represented principally by *Brassica oleracea* var. *capitata*. It is cultivated extensively because of its adaptability, culinary versatility and nutritional properties. Recent research has demonstrated that cabbage contains important nutrients and phytochemicals, including vitamins, minerals, phenolic compounds, flavonoids and glucosinolates. Statilko et al. (2024) emphasized that cabbage cultivars can differ considerably in their phytochemical composition, indicating that cultivar and production conditions may influence the nutritional quality of the vegetable. Similarly, Yang et al. (2024) demonstrated significant variation in soluble protein, soluble sugars, vitamin C, polyphenols, flavonoids and mineral elements among different cabbage varieties and forms.

The nutritional characteristics of vegetables are closely associated with their proximate composition. Proximate analysis is a fundamental analytical approach used to determine major nutritional components, commonly including moisture, crude protein, crude fat, crude fibre, ash and carbohydrate. These parameters provide a general indication

of the nutritional and physicochemical characteristics of food materials and are useful for comparing different crops, cultivars and production environments. Determination of moisture is particularly important because high-moisture vegetables are generally highly perishable, whereas protein, fat, fibre, ash and carbohydrate measurements provide information about their nutrient and energy contributions.

Moisture is one of the dominant components of fresh vegetables and has important implications for storage stability and postharvest deterioration. Fresh carrot commonly contains approximately 86–89% moisture, while cabbage can contain more than 90% water depending on cultivar and growing conditions (Motegaonkar et al., 2024; Yang et al., 2024).

High moisture contributes to the fresh and crisp characteristics of vegetables but also provides favourable conditions for microbial growth and biochemical reactions when postharvest handling and storage are inadequate. Therefore, determining the moisture content of carrot and cabbage cultivated at Ajiwa Dam is important for understanding their perishability and potential storage requirements.

Protein is another important proximate component because it contributes amino acids required for growth, tissue maintenance and numerous physiological processes. Although vegetables are generally not considered major sources of dietary protein compared with legumes and animal products, their cumulative contribution can be nutritionally relevant when consumed regularly as part of a diverse diet. Recent evidence indicates that carrot contains relatively small amounts of protein, while cabbage also contributes modest quantities. The nutritional contribution of these vegetables should therefore be considered within the context of the overall diet rather than as primary protein sources.

Dietary fibre is particularly important in vegetables because it contributes to normal gastrointestinal function and forms an important part of a healthy dietary pattern. Carrots contain both soluble and insoluble fibre, while cabbage and other Brassica vegetables also contribute dietary fibre. Recent research on Brassica vegetables has emphasized their broader nutritional importance, including their contents of vitamins, minerals, carotenoids, phenolic compounds and glucosinolates (Wang et al., 2025).

These components make vegetables relevant not only as sources of conventional nutrients but also as foods containing bioactive compounds with potential health-promoting properties.

Agricultural conditions may influence the nutritional composition of vegetables. Soil fertility, fertilization practices, irrigation, cultivar selection and environmental conditions can affect plant growth and the accumulation of nutrients and phytochemicals. For example, Gelaye (2024) reported that nitrogen management significantly influences cabbage growth, yield and quality, while recent research on carrot production has also demonstrated that cultivation practices can influence growth and nutritional characteristics.

Therefore, vegetables cultivated in different geographical locations cannot necessarily be assumed to possess identical proximate compositions.

Ajiwa Dam in Batagarawa Local Government Area of Katsina State provides an important agricultural environment for vegetable cultivation. The availability of irrigation water around dam-associated agricultural areas can support vegetable production, particularly where seasonal rainfall is insufficient for continuous cultivation. Carrot and cabbage grown in such an environment may be exposed to distinctive soil, irrigation, climatic and agronomic conditions that could influence their nutritional composition. Assessing locally cultivated vegetables is therefore valuable because published nutritional values obtained from other geographical regions may not accurately represent vegetables produced under local conditions.

Despite the nutritional importance of carrot and cabbage, there is a need for location-specific information on the proximate composition of vegetables cultivated around Ajiwa Dam. Such information can provide baseline data on the moisture, protein, fat, fibre, ash and carbohydrate contents of these vegetables and may assist in evaluating their nutritional contribution to local diets. It can also provide useful information for nutrition education, food processing, agricultural production and further research on the influence of cultivation environments on vegetable quality.



Figure 1. Cabbege (Brassica oleracae)



Figure 2. Carrot (Daucus carota L.)

Therefore, this study is designed to determine the proximate composition of carrot and cabbage cultivated at Ajiwa Dam, Batagarawa Local Government Area, Katsina State. The study will focus on the major proximate parameters, including moisture, crude protein, crude fat, crude fibre, ash and carbohydrate contents. The findings will provide empirical information on the nutritional characteristics of the two vegetables and establish a basis for

comparing their proximate composition under the local production conditions of Ajiwa Dam.

MATERIALS AND METHODS

Samples Collection

Carrot and cabbage samples were procured from farms within the Ajiwa vegetable garden. The samples were left to air dry for six weeks before being brought to the University of Jos' Department of Plant Science and Biotechnology for identification. After being collected, the fruits and vegetable leaves were destalked and cleaned with cold, running tap water. For the investigation, fresh leaves were employed.

Sample Preparation

Sample are crushed and powdered using pistol and mortar and kept in air tight containers for further analysis. The sample was digested using Nitric and hydrochloric acids, and the digested was analyzed using Microwave Plasma Atomic Emission Spectroscopy.

Determination of Moisture Content of Carrot and Cabbage

A precisely weighed glass Petri dish containing 10.00 g of sample was placed in the Hot Air Oven, heated to 105 0C for four hours, cooled in the desiccator, and then weighed. Until a constant weight was achieved for each sample, this process was repeated.

The percent (%) moisture was calculated thus,

$$(W2\text{-}W3 \div W2\text{-}W1) \times 100$$

Where

W1= weight of glass Petri dish alone.

W2= weight of glass Petri dish + sample before drying.

W3= weight of glass Petri dish + sample after drying.

Determination of Crude Lipid (fat) in Carrot and Cabbage.

A fat free thimble was weight (W1), and then 2g of moisture free sample was added into the Thimble and weight again (W2). A 500 mL round bottom flask was also weighed

(W3) and the Flask was filled with 300ml n-hexane. The sample was then heated and allowed to reflux for 6 Hours; after which the flask containing the fat residue was evaporated to recover the solvent and the residue in a hot air oven at 100°C for 5 minutes. The resultant residue was allowed to Cool in a desiccator and weighed (W4). The percentage crude lipid was calculated thus;

$$\% \text{ Crude Lipid (fat)} = (W4-W3) \div (W2-W1) \times 100$$

Where;

W1= weight of empty thimble

W2= weight of thimble + sample

W3= weight of empty flask

W4= weight of flask + sample after reflux.

Determination of Crude fiber in Carrot and Cabbage,

A 500 mL beaker was filled with 5g of deflated samples, 200 ml of 1.25 percent H2SO4 was added, and the mixture was heated for 30 minutes. After that, hot distilled water was used to wash it. The residue was carefully transferred into a second 500 ml beaker, to which 200 mL of 1.25 % NaOH was added. The mixture was then boiled for an additional 30 minutes, and the residue was cleaned with hot distilled water. To remove any remaining fatty materials, 10 mL of ethanol was added to wash down the remaining water, along with 10 mL of acetone and petroleum ether.

The samples were then put onto a glass Petri dish that had been previously weighed, and they were dried for 24 hours at 105°C in the oven. The samples were weighed once more after cooling, and they were then moved into the muffled furnace for six hours.

$$\% \text{ Crude fiber} = \text{Loss of weight after ignition} \div \text{weight of original dried sample} \times 100$$

Determination Ash Contents in Carrot and Cabbage

2.00 g of dried deflated sample was weight into a crucible and transferred into a Muffled Furnace at 600°C for 6 hours until white ash was obtained. It was then cooled in the desiccator and reweighed.

$$\text{Percentage Ash Content} = (W3-W1 \div W2-W1) \times 100$$

Where;

W1=weight of empty crucible.

W2= weight of crucible + weight of sample before ashing.

W3= weight of crucible + weight of sample after ashing.

Determination of Crude Protein in Carrot and Cabbage

2 g of the moisture free sample was weighed and recorded as Wg. The sample was heated with Concentrated Tetraoxosulphate (vi) Acid and a digestion tablet added in a long necked Kjeldahl flask. The sample was heated on the digester until the solution becomes clear. A blank containing the digestive reagent was treated same as the sample. The clear sample and the blank were filtered through the whatman no1 ash less filter paper in to a 50ml volumetric flask. 10ml of the digest was pipetted in to the distillation unit and 10ml of 40% sodium hydroxide was added and distilled in to the conical flask containing boric acid until 50ml of the distillate was obtained.it was then titrated with 0.02N HCl until a sharp end point of faint pink was obtained it was repeated in triplicates and the titre value calculated.

$$\% \text{ Nitrogen Free Extract} = ((V1-V2) \times 14.01 \times N) \times 100 \div (W8 \times 1000)$$

Where V1=Titre Value

V2=Blank Value

N=Normality of the acid

Wg=Weight of the sample digested

% protein = % Nitrogen free extract × conversion factor

Conversion factor is 6.25 was used

Determination of Total Carbohydrate in Carrot and Cabbage

Carbohydrate content of the sample was determined by the difference between 100%, and the Total percentage of other proximate fractions;

% carbohydrate= 100- (% moisture + %protein + % ash +%crude fiber + %fat)

Determination of Oxalate Content in Carrot and Cabbage

Oxalate content was determined using an acid-extraction and potassium permanganate titration procedure, with modifications based on previously reported

methods for plant-derived food materials (Anyiam et al., 2023; *Nutritional Quality and Physicochemical Properties of Biscuit from Composite Flour*, 2023). Recent studies continue to employ acid extraction followed by hot titration with standardized potassium permanganate for the quantification of oxalates in plant materials.

1.0 g of the finely powdered carrot or cabbage sample was accurately weighed into a 250-mL beaker, and 75 mL of 1.5 N sulfuric acid (H_2SO_4) was added. The mixture was thoroughly stirred for 1 h using a mechanical or magnetic stirrer to facilitate extraction of soluble oxalates. The resulting suspension was filtered through Whatman No. 1 filter paper. A 25-mL aliquot of the filtrate was transferred into a 250-mL conical flask and titrated while hot against a standardized potassium permanganate ($KMnO_4$) solution until a faint persistent pink colour was obtained as the endpoint. Similar acid-extraction/hot-permanganate titration procedures have been reported recently for plant samples.

Determination of Phytate Content in Carrot and Cabbage

Phytate content was determined using an acid-extraction and ferric chloride titration method based on the classical Wheeler and Ferrel procedure, with modifications. The method remains widely used in recent food and plant-material studies for estimating phytate concentration by extraction with dilute hydrochloric acid followed by titration with iron(III) chloride using ammonium thiocyanate as an indicator.

4.0 g of the finely powdered sample was weighed into a suitable container and soaked in 100 mL of 2% hydrochloric acid (HCl) for 3 h at room temperature. The mixture was thoroughly mixed during extraction and subsequently filtered through Whatman No. 1 filter paper. A 25-mL aliquot of the filtrate was transferred into a 250-mL conical flask. Subsequently, 5 mL of 0.3% ammonium thiocyanate (NH_4SCN) solution was added as the indicator, followed by 53.5 mL of distilled water. The resulting solution was mixed thoroughly and titrated against a standardized iron(III) chloride ($FeCl_3$) solution until a brownish-yellow colour persisted for approximately 5 min, which was taken as the endpoint. This extraction and titration procedure is consistent with recent applications of the phytate determination method in food and plant samples.

RESULTS

Table 1. Proximate and antinutrient composition of carrot (CT1) and cabbage (CB1)

Parameter	CT1	CB1
Moisture content	29.60±0.16	6.74±0.01
Ash content	6.00±0.28	6.00±0.28
Crude lipid	0.58±0.04	0.18±0.02
Crude protein	4.19±0.17	3.59±0.25
Crude fibre	16.14±0.13	32.21±0.17
Carbohydrate	43.49±1.68	46.33±1.31
Oxalate	1.62±0.04	0.73±0.10
Phytate	1.62±0.04	0.73±0.10

Key:
CT1= Carrot, CB1 = Cabbage

The proximate and antinutrient composition of carrot (CT1) and cabbage (CB1) revealed clear differences that reflect both species characteristics and the apparent processing state of the samples.

Moisture content was markedly higher in carrot (29.60 ± 0.16%) than in cabbage (6.74 ± 0.01%). The very low moisture value for cabbage is atypical of fresh heads (normally ~90–93%) and indicates that the cabbage sample was likely dried or dehydrated before analysis. Lower moisture improves storage stability but concentrates other components on a dry-weight basis (Dodo et al., 2023).

Ash content was identical in both vegetables (6.00 ± 0.28%), suggesting comparable total mineral levels. Crude lipid was low in both samples, consistent with the general composition of non-oily vegetables, but higher in carrot (0.58 ± 0.04%) than in cabbage (0.18 ± 0.02%). Crude protein was moderate and slightly higher in carrot (4.19 ± 0.17%) than in cabbage (3.59 ± 0.25%). These protein values fall within ranges reported for dried or semi-dried samples of the same species (Abdi et al., 2022; Dodo et al., 2023).

Crude fibre showed the largest difference: cabbage contained approximately twice the fibre of carrot (32.21 ± 0.17% versus 16.14 ± 0.13%). High dietary fibre supports bowel regularity, glycaemic control, and reduced risk of certain chronic diseases, making cabbage particularly valuable in this regard (Abdi et al., 2022). Carbohydrate contents were similar and relatively high (43.49 ± 1.68% in carrot and 46.33 ± 1.31% in cabbage), reflecting the contribution of both available carbohydrates and residual fibre on a low-moisture basis.

Oxalate and phytate concentrations were higher in carrot (both 1.62 ± 0.04) than in cabbage (both 0.73 ± 0.10). These antinutrients can form insoluble complexes with calcium, iron, zinc, and magnesium, thereby reducing mineral bioavailability. Although the absolute values are not extremely high, the higher levels in carrot suggest that mineral absorption may be more affected by frequent carrot consumption than by cabbage, especially without processing steps known to reduce antinutrients (Abdi et al., 2022).

Cabbage provided substantially more dietary fibre and lower levels of oxalate and phytate, while carrot offered higher moisture (when fresh), slightly higher protein and lipid, and comparable ash and carbohydrate contents. Both vegetables remain nutritionally useful; however, the antinutrient differences and the unusually low moisture in the cabbage sample highlight the importance of specifying whether analyses were performed on fresh or dried material and of applying appropriate preparation methods to minimise antinutrient effects.

CONCLUSION

The proximate and antinutrient analysis of carrot (CT1) and cabbage (CB1) demonstrated clear compositional differences between the two vegetables. Carrot exhibited higher moisture, crude lipid, crude protein, oxalate, and phytate contents, while cabbage was markedly richer in crude fibre and contained lower levels of the antinutrients oxalate and phytate. Ash and carbohydrate contents were comparable in both samples.

These findings indicate that cabbage is a superior source of dietary fibre and presents a lower antinutrient burden, which may favour better mineral bioavailability. Carrot, on the other hand, provides modestly higher protein and lipid levels. The unusually low moisture content recorded for cabbage strongly suggests that the sample was dried or dehydrated prior to analysis, emphasising the need for clear reporting of sample preparation methods in future studies.

Both vegetables remain valuable components of a balanced diet. Appropriate processing techniques (such as boiling or fermentation) are recommended to further reduce antinutrient levels, particularly in carrot, thereby enhancing the nutritional quality and mineral bioavailability of these commonly consumed vegetables.

REFERENCES

Abdi, F. A., Gemede, H. F., & Keyata, E. O. (2022). Nutritional composition, antinutrient contents, and polyphenol compounds of selected underutilized and some commonly consumed vegetables in East Wollega, West Ethiopia. *Journal of Food Quality, 2022*(1), Article 6942039. https://doi.org/10.1155/2022/6942039

Anyiam, P. N., Sai-Ut, S., Kingwascharapong, P., Suriyarak, S., Jung, Y. H., Zhang, W., & Rawdkuen, S. (2026). Influence of pretreatments methods on chemical composition and physico-chemical properties of potential protein sources for plant-based food applications. *Future Foods, 13*, Article 101040. https://doi.org/10.1016/j.fufo.2026.101040

Dodo, J. D., Muhammad, S. A., Afi, U. O., Adam, A. B., Abubakar, A. J., Abubakar, I., & Kaugama, A. A. (2023). Proximate analysis of carrot and cabbage cultivated at Farin Gada farm land. In *Proceedings of the BúLTEK-VII International Symposium on Current Developments in Science, Technology and Social Sciences* (Vol. 7).

Gelaye, Y. (2024). A systematic review on effects of nitrogen fertilizer levels on cabbage (*Brassica oleracea* var. *capitata* L.) production in Ethiopia. *The Scientific World Journal, 2024*(1), Article 6086730. https://doi.org/10.1155/2024/6086730

Motegaonkar, S., Shankar, A., Tazeen, H., Gunjal, M., & Payyanad, S. (2024). A comprehensive review on carrot (*Daucus carota* L.): The effect of different drying methods on nutritional properties and its processing as value-added foods. *Sustainable Food Technology, 2*(3), 667–688. https://doi.org/10.1039/D3FB00162H

Statilko, O., Tsiaka, T., Sinanoglou, V. J., & Strati, I. F. (2024). Overview of phytochemical composition of *Brassica oleraceae* var. *capitata* cultivars. *Foods, 13*(21), Article 3395. https://doi.org/10.3390/foods13213395

Yue, Z., Zhang, G., Wang, J., Wang, J., Luo, S., Zhang, B., Li, Z., & Liu, Z. (2024). Comparative study of the quality indices, antioxidant substances, and mineral elements in different forms of cabbage. *BMC Plant Biology, 24*, Article 187. https://doi.org/10.1186/s12870-024-04857-4

Zhang, X., Jia, Q., Jia, X., Li, J., Sun, X., Min, L., Liu, Z., Ma, W., & Zhao, J. (2025). *Brassica* vegetables—An undervalued nutritional goldmine. *Horticulture Research, 12*(2), Article uhae302. https://doi.org/10.1093/hr/uhae302