Kikanda, a Congolese Traditional Plant-based Meat: Microscopic Features, Phytochemical Profile, and Antioxidant Activity

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ABSTRACT

Kikanda is a traditional plant-based food consumed in the Katanga Province of the Democratic Republic of Congo (DRC). It is prepared from the powdered tubers of wild-harvested terrestrial orchids (Orchidaceae) with groundnuts (Arachis hypogaea L.), sodium bicarbonate, and aromatic spices. Despite its longstanding cultural and nutritional significance, no prior study has investigated the phytochemical profile and antioxidant capacity of Kikanda or the microscopic features of powders of orchid tubers used in its preparation. This study investigated the phytochemical composition, microscopic characteristics, and in vitro antioxidant activity of Kikanda and its orchid tuber ingredients. Microscopic examinations of orchid tuber powders revealed diagnostic botanical features useful for the identification and authentication of orchid tubers. TLC phytochemical screening identified polyphenols and flavonoids in the various components of Kikanda. All extracts demonstrated significant ABTS and DPPH radical-scavenging activities, with IC_{50} values ranging from 5.57 to 42.17 µg/mL. Orchid tuber extract exhibited the strongest ABTS scavenging activity (IC_{50} = 5.57 ± 0.77 µg/mL), while Kikanda extract also showed substantial antioxidant potential (ABTS IC_{50} = 37.84 ± 1.6 µg/mL). This study is the first to report the antioxidant activity of Kikanda and the microscopic characteristics of powdered orchid tubers used in its preparation. Further in vivo and toxicological studies are necessary to validate Kikanda's potential as a nutritional and functional food.

Keywords: *Kikanda; orchid tubers; antioxidant activity; phytochemical screening; traditional food; functional food; ethnobotany*

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INTRODUCTION

Traditional foods derived from wild plant resources continue to play important nutritional, cultural, and medicinal roles across sub-Saharan Africa. Kuhnlein and Receveur (1996) and Ombeni (2014) demonstrated that indigenous peoples' traditional food systems are intimately linked to biodiversity, cultural identity, and pharmacological heritage. In the Democratic Republic of Congo (DRC), as in many Central and Southern-Eastern African nations, a diverse range of wild plants continues to occupy a central place in local diets, particularly in rural and peri-urban areas (Malaisse and Parent, 1985). Among these botanicals, a remarkable preparation known as *Kikanda* is widely consumed in the southeastern provinces of DRC, such as Katanga.

Kikanda is a traditional plant-based meat prepared from the powdered tubers of wild terrestrial orchids belonging to the family Orchidaceae, combined with ground peanuts (*Arachis hypogaea* L.), sodium bicarbonate, and aromatic spices such as chives and celery (Mbale *et al*., 2013; Malaisse, 1997). It is consumed by the Bemba, Sanga, and Lamba peoples of Katanga during periods of protein scarcity. Similar orchid tuber-based foods are consumed across several African countries, including Zambia (Chikanda), Tanzania (Kinaka), Malawi (Chinaka), and Cameroon (Napssée). The orchid tubers used in the formulation of *Kikanda* belong to the genera *Disa*, *Satyrium*, *Eulophia*, *Brachycorythis*, *Habenaria*, and *Platycorin* (Mbale *et al*., 2013; Malaisse, 1997). These plants grow wild in the damp grasslands and woodland margins of sub-Saharan Africa, and their tubers are exclusively harvested from the wild, as no cultivation protocol has yet been established at scale (Veldman *et al*., 2018; Pérez-Losada *et al*., 2017).

Increasing commercial demand for orchid tubers has raised serious concerns regarding the sustainability and conservation of wild orchid populations in sub-Saharan Africa (Veldman *et al*., 2018; Kwenye *et al*., 2025). Over the past decades, orchids have attracted growing ethnopharmacological interest. Previous phytochemical investigations of several orchid species have identified bioactive compounds such as phenolics, flavonoids, terpenoids, and alkaloids with reported antioxidant and pharmacological activities (Giri and Tamta, 2012; Chand *et al*., 2016; Minh *et al*., 2016). In particular, Giri and Tamta (2012) documented alkaloids and phenolics in *Dactylorhiza hatagirea*; Chand *et al*. (2016) reported DPPH scavenging activity in wild Nepalese orchids; and Minh *et al*. (2016) identified 11 phenolic acids in *Phalaenopsis* spp. Antioxidant evaluation has been linked to polyphenol content in orchid extracts (Giri and Tamta, 2012; Chand *et al*., 2016; Sut *et al*., 2017). The peanut (*A. hypogaea* L.), the principal bulk ingredient of *Kikanda* (approximately 5/6 of the preparation), is a well-recognized source of bioactive compounds, including polyphenols, resveratrol, and tocopherols that contribute antioxidant properties (Isanga and Zhang, 2007; Reed, 1924). Regular consumption of *Kikanda* as part of the traditional diet in Katanga may therefore represent a meaningful source of dietary antioxidants for local communities, relevant to the prevention of oxidative stress-related diseases. Despite this body of evidence on the individual components, no prior study has systematically investigated the phytochemical profile or antioxidant capacity of *Kikanda* as a preparation, nor of the orchid tubers specifically used in the Congolese formulation. Assessing the antioxidant activity of Kikanda is important, particularly in regions affected by protein scarcity, where nutrient-dense foods can contribute to improved dietary quality and health. Its antioxidant properties may further enhance its value as a functional food that helps protect against oxidative stress. TLC phytochemical screening was selected as the analytical approach because it provides rapid, cost-effective, multi-class preliminary characterization, well-suited to the exploratory nature of this first investigation. This study aimed to evaluate the *in vitro* antioxidant activity, phytochemical characteristics of *Kikanda*, and microscopic features of powdered orchid tubers used in its preparation to support their identification and authentication.

MATERIALS AND METHODS

Plant material and samples

The study material consisted of *Kikanda* traditional plant-based food (Figure 1) as well as its individual components, including cut and dried orchid tubers sourced from the province of Katanga, peanut grains, chives, and celery, all purchased at Pascal Market, city of Kinshasa. Sodium chloride and sodium bicarbonate were obtained from local commercial sources. The orchid tuber materials were visually inspected and sorted before use. Orchid tubers were authenticated by Mr. Boniface Nlandu of the Institut National d'Etudes et des Recherches en Agronomie (INERA) in Kinshasa (DR Congo) with the following voucher numbers: No. CK003 and No. CK004, and Dr. Blaise Bikandu from the herbarium of the Faculty of Sciences and Technology, University of Kinshasa, Kinshasa (DR Congo) confirmed the taxonomic identity of orchid tubers with voucher numbers of No. 001/2019 and No. 002/2019. The preparation of *Kikanda* was carried out at Centre d'Etudes des Substances Naturelles d'Origine Végétale (CESNOV) under conditions described in (Table 1).

Preparation of Kikanda

The preparation of *Kikanda* was carried out as follows: ground peanuts were boiled in salted water with continuous stirring until cooked (Step 1: 5 minutes).

Table 1: Composition and cooking quantities used in the preparation of *Kikanda*.

Ingredients	Proportion
Peanuts	900 g
Orchid powder	100 g
Bicarbonate	100 mg
Chives	1 g
Celery	0.5 g
Water	1.5-2 L
Temperatures	100-115 °C (10 minutes) 80-90 °C (5minutes)

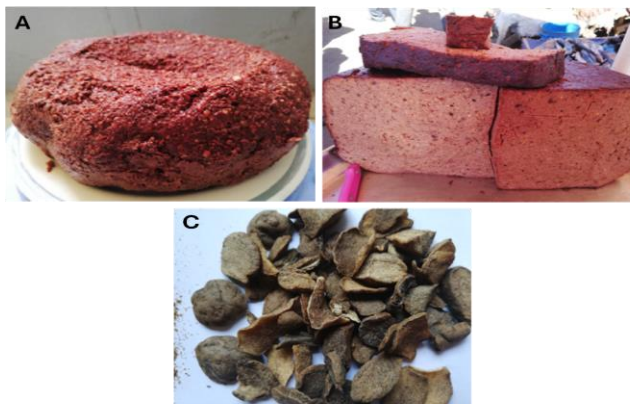

Figure 1: Photo of *Kikanda*, the traditional plant-based meat prepared from orchid tubers, peanut paste, and spices, as traditionally consumed in the Katanga province of the Democratic Republic of Congo. A. Whole meat cooked. **B.** Slices of *Kikanda*, which is generally commercialized. **C.** Sliced and dried mixture of orchids is used in the preparation of *Kikanda*.

Orchid powder was then added progressively while stirring, and the mixture was cooked until a homogeneous paste formed (Step 2: 3 minutes). Spices were incorporated, and cooking was continued (Step 3: 2minutes). Sodium bicarbonate was then added, and the mixture was kneaded until a colored dough with good cohesion was obtained (Step 4: 3 minutes). Heat was then reduced; glowing embers were placed on the lid of the cooking pot to brown the upper surface (Step 5: 2minutes), and the preparation was allowed to simmer before being left to cool and solidify into a firm, sliceable cake (Step 6: 15 minutes) (Figure 2).

Chemicals and reagents

All solvents used were of analytical and HPLC grade and were purchased from Merck VWR (Leuven, Belgium). 1, 1-Diphenyl-2-picrylhydrazyl (DPPH), 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid) (ABTS), 2-aminoethyldiphenylborate, anisaldehyde, and potassium persulfate were purchased from Sigma (Bornem, Belgium). Caffeic acid, chlorogenic acid (purity: 95%), and gallic acid (purity: 97%) were purchased from Sigma

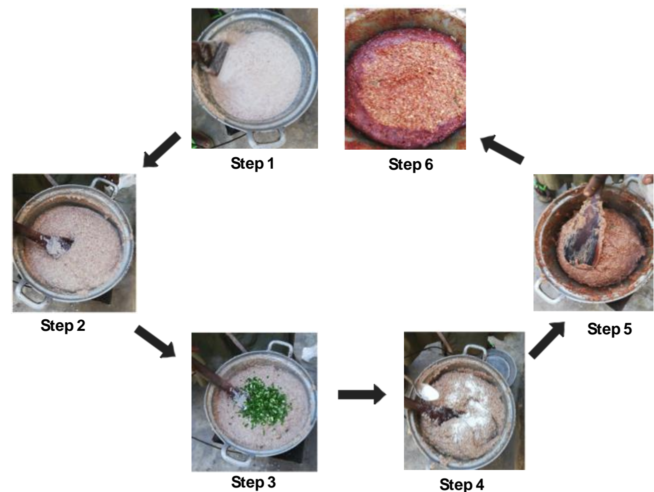

Figure 2. Schematic representation for the preparation of *Kikanda*

(Bornem, Belgium). Deionized water was used throughout all experiments. Rutin (purity: 99%), isoquercitrin (purity: 99%), and quercetin (purity: 98.5%) were HPLC grade and were purchased from Extrasynthese (Genay, France).

Microscopic analysis of orchid tuber powder

Powder observations were carried out using lactic acid (Steimetz reagent), which facilitates the visualization of cellular elements (Bahati *et al*., 2017; Elaka *et al*., 2020). Observations were made using a VisiScope BL124 binocular microscope (VWR International, Leuven, Belgium). Photomicrographs were obtained using a digital imaging system (Samsung Galaxy S9) coupled to the microscope ocular lens at magnifications of 40× and 100×; scale bars are indicated on each micrograph. Representative microscopic elements were identified and documented.

Preparation of extracts

Organic extracts were prepared by cold percolation. Briefly, 10 g of each sample powder was moistened with 15 mL of dichloromethane-methanol (1:1, v/v), packed into a glass percolator, and allowed to macerate for 6 h at room temperature (25 ± 2 °C) before elution at a flow rate of approximately 2–3 mL/min. Solvent was added continuously until a total percolate volume of 200 mL was collected or the percolate ran colorless. The combined percolate was filtered through Whatman No. 1 paper, and the solvent was evaporated under reduced pressure at 40 °C using a rotary evaporator. The dried extracts were weighed on an analytical balance to calculate the extraction yield (% w/w) and stored in dark hermetic flasks at 4 °C until use.

Phytochemical screening by thin-layer chromatography

Analytical TLC was performed on 10 µL of solutions at a concentration of 10 mg/mL of dichloromethane-methanol extracts on normal-phase silica gel 60 F_{254} plates (Merck). Several eluent systems were used for the detection of secondary metabolite classes. The mobile phase ethyl acetate/methanol/water/formic acid (20:5:4:0.5, v/v/v/v) was used for the characterization of polyphenols and flavonoids. The TLC chamber was pre-saturated with the mobile phase for 20 min before each run. After the sample application, plates were developed until the solvent front migrated 8 cm from the origin. Plates were air-dried at room temperature for 5 min before revelation. Reference standards chromatographed alongside samples included caffeic acid, chlorogenic acid, rutin, isoquercitrin, and quercetin. Revelation was performed under UV light (254 nm and 365 nm), followed by derivatization with Natural Products reagent (2-aminoethyldiphenylborate, NP) combined with polyethylene glycol 4000 (PEG) for flavonoid detection, and with anisaldehyde-sulfuric acid reagent for terpene detection, according to Wagner and Bladt (2013) (Wagner and Bladt, 2013).

Cell-free antioxidant assays

Extracts were solubilized in methanol, and their activity was compared against a methanol blank control. Antioxidant activity was assessed by spectrophotometric ABTS and DPPH radical scavenging assays, performed according to the method described by Kapepula *et al.* (2018) (Kapepula *et al.*, 2018). The IC^{50} values were determined by nonlinear regression analysis of percentage inhibition against concentration, expressed in µg/mL. Gallic acid was used as a positive control for both assays. Each measurement was performed in triplicate (*n* = 3), and results are expressed as mean ± standard deviation.

Statistical analysis

All measurements were performed in technical triplicate (n = 3 independent extractions). Results are expressed as mean ± standard deviation (SD). IC_{50} values were determined by nonlinear regression analysis (log[inhibitor] vs. response, variable slope) using GraphPad Prism version 9.0 (GraphPad Software, San Diego, CA, USA). No further inferential statistical tests were applied, as the study was designed as a preliminary phytochemical and antioxidant characterization.

RESULTS

Microscopic characterization of orchid tuber powder

The microscopic examination of orchid tuber powder using Steimetz reagent revealed a range of diagnostic cellular elements. The following histological features were identified: polyhedral starch grains (Figures 3A, 3B, 3C), raphides (Figure 3D), sclereid fibers (Figure 4A), multicellular non-glandular trichomes (Figure 4B), fragments of spiral vessels (Figure 4C, 4D), isolated sclereids (Figure 4A), and fragments of parenchyma (Figure 4B).

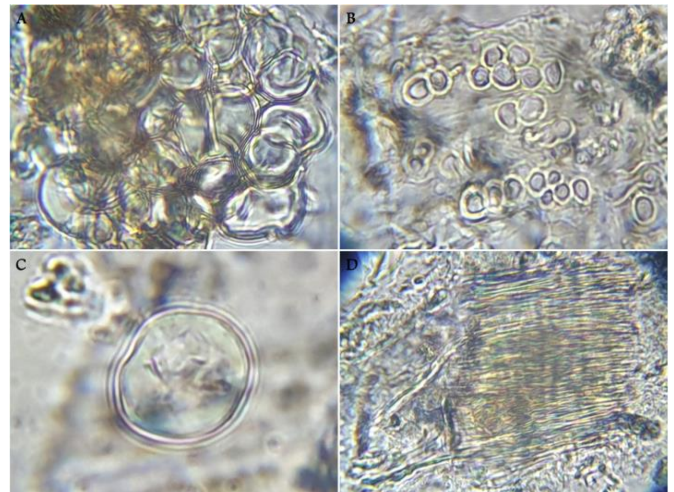

Figure 3: Microscopic elements of orchid tuber powder observed with Steimetz reagent. Polyhedral starch grains (A, B, C); Raphides (D).

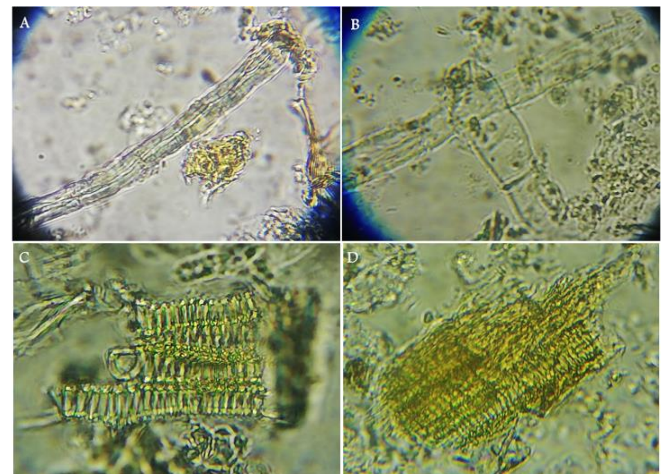

Figure 4: Microscopic elements of orchid tuber powder observed with Steimetz reagent. Sclereid fiber (**A**), multicellular non-glandular trichomes (**B**), and fragments of spiral vessels (**C, D**).

TLC phytochemical screening

The TLC analysis of the dichloromethane-methanol extracts of *Kikanda* and its individual ingredients revealed the presence of multiple classes of secondary metabolites. Polyphenols, including phenolic acids, were detected in chives and orchid tuber extracts. Flavonoids were identified in celery and chives. These results are summarized in (Figure 5).

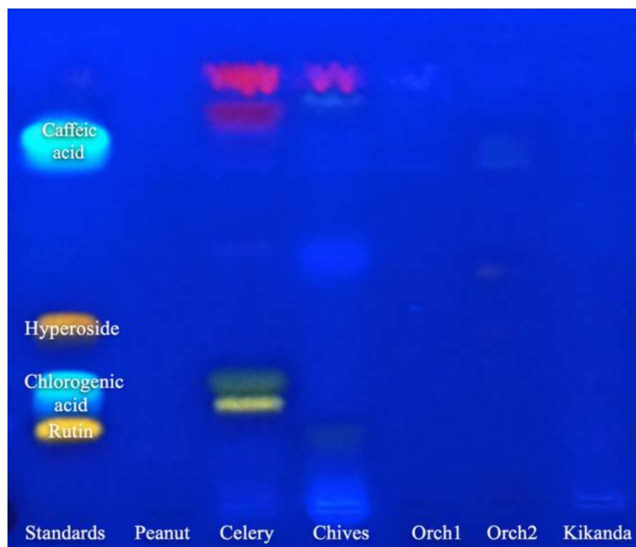

Figure 5: TLC chromatograms of the methanolic extracts of *Kikanda* and its individual ingredients in the presence of reference standards. Mobile phase: ethyl acetate/methanol/water/formic acid (20:5:4:0.5, v/v/v/v); stationary phase: silica gel 60 F_{254}.

Antioxidant activity

The IC_{50} values obtained from the ABTS and DPPH assays for orchid tuber extract, *Kikanda* extract, and positive control, gallic acid, are presented in (Table 2). Orchid tuber extract showed the lowest IC_{50} value in the ABTS assay (5.57 ± 0.77 µg/mL), indicating strong radical scavenging capacity, and a moderate DPPH IC_{50} of 42.17 ± 7.73 µg/mL. The *Kikanda* preparation exhibited an ABTS IC_{50} of 37.84 ± 1.6 µg/mL and a DPPH IC_{50} exceeding 150 µg/mL. Although all IC_{50} values were higher than those of gallic acid used as the reference standard, the extracts demonstrated biologically relevant radical scavenging activity, particularly in the ABTS assay.

Table 2: IC_{50} values (µg/mL) of extracts and gallic acid for the ABTS and DPPH radical scavenging assays (mean ± SD, *n* = 3).

Sample	ABTS IC_{50} (µg/mL)	DPPH IC_{50} (µg/mL)
Orchid tuber extract	5.57 ± 0.77	42.17 ± 7.73
Kikanda extract	37.84 ± 1.6	>150
Gallic acid	0.71 ± 0.08	1.07 ± 0.10

DISCUSSION

Microscopic characterization

Microscopic analysis of powdered plant materials represents one of the most practical, cost-effective, and reliable tools for botanical authentication and detection of adulteration (Mukherjee, 2019; Gurav and Gurav, 2014). The identification of diagnostic cellular elements in orchid tuber powder is particularly relevant in the context of *Kikanda*, because multiple orchid species from different genera are traded interchangeably on Congolese and regional markets, often without species-level differentiation (Veldman *et al.*, 2018; Pérez-Losada *et al.*, 2017). The adulteration or inadvertent substitution of orchid species is a documented problem in the chikanda trade: fewer desirable species are mixed with preferred ones when sold (Veldman *et al.*, 2018), and microscopic analysis can provide supporting evidence for quality control when combined with other parameters such as chromatographic fingerprinting (Mukherjee, 2019).The microscopic elements identified in this study, including polyhedral starch grains, raphides (calcium oxalate crystals in needle-like bundles), sclereid fibers, multicellular non-glandular trichomes, spiral vessel fragments, and parenchyma fragments, are consistent with features reported for the tubers and pseudobulbs of various terrestrial orchid species. Raphides are particularly prevalent: they are abundantly present in orchid tissues, and their dimensions and arrangement can serve as additional discriminating markers at the genus or species level. The polyhedral starch grains observed are also characteristic of storage organs such as orchid tubers, where carbohydrate reserves are accumulated to support perennial regrowth (Mtemang'ombe *et al.*, 2024). To the best of our knowledge, this is the first study to describe the microscopic histological profile of the powder of orchid tubers specifically used in the formulation of *Kikanda* as sold on Congolese local markets. Previous work by Mbale *et al.* provided introductory ethnobotanical notes on orchids used in DRC (Mbale *et al.*, 2013) but did not include microscopic characterization. Future work should complement these observations with precise measurements of starch grain dimensions and raphide morphometry, which represent valuable quantitative authentication parameters.

Phytochemical profile

The TLC phytochemical screening of *Kikanda* and its ingredients revealed the presence of polyphenols, phenolic acids, flavonoids, tannins, and terpenes, a finding consistent with the general phytochemical profiles reported for terrestrial orchid species and for peanut. Within the Orchidaceae, phenolic compounds represent a well-documented class of secondary metabolites. Minh *et al.* identified 11 phenolic acids in *Phalaenopsis* spp., including caffeic, ellagic, and ferulic acids (Minh *et al.*, 2016). Yang *et al.* isolated phenolic compounds, including kaempferol and triterpenes from *Dendrobium aurantiacum* (Yang *et al.*, 2006). Sut *et al.* reported coumarins and flavonoids from the endangered orchid

Himantoglossum adriaticum (Sut *et al*., 2017) while Giri *et al.* described alkaloids and phenolic constituents in *Dactylorhiza hatagirea*, a Himalayan medicinal orchid (Giri and Tamta, 2012). More recently, Mtemang'ombe *et al.* confirmed the presence of phenolic compounds and flavonoids in four orchid species used in the chikanda preparation in Malawi, with phytochemical content across species (Fonmboh *et al*., 2020).

The detection of flavonoids and phenolic acids in chives is consistent with the known phytochemistry of *Allium schoenoprasum*, which is rich in quercetin derivatives, kaempferol glycosides, and hydroxycinnamic acids. Celery (*Apium graveolens*) is similarly established as a source of flavonoids, particularly apigenin and luteolin derivatives, as well as phthalides with claimed anti-inflammatory properties. The presence of tannins in all samples analyzed is noteworthy from a nutritional standpoint, as tannins can reduce the bioavailability of dietary proteins and minerals; however, at moderate levels, they also contribute to the antioxidant and antimicrobial properties of traditional preparations (Mbale *et al*., 2014; Isamura *et al*., 2023). The presence of polyphenols and terpenes across all ingredients of *Kikanda* suggests that this traditional food constitutes a multi-source reservoir of bioactive compounds. These preliminary data provide a rationale for further isolation and structure elucidation of individual compounds, as well as the investigation of their potential biological activities in relevant bioassay models. Polyphenols are recognized as potent antioxidants, and their antiradical activity has been computationally confirmed for plant-food benzoic acid derivatives such as gallic acid and protocatechuic acid through hydrogen atom transfer and SPLET mechanisms (Isamura *et al*., 2023).

Antioxidant activity

The antioxidant results revealed a clear divergence between the performance of extracts in the ABTS and DPPH assays, particularly for the *Kikanda* preparation itself. This divergence is not unexpected and can be attributed to the distinct mechanistic and physicochemical properties of the two assays. ABTS measures the capacity of compounds to quench both hydrophilic and lipophilic radicals, whereas DPPH reacts predominantly with hydrophilic compounds through hydrogen atom transfer or electron transfer reactions (Prior *et al*., 2005; Arnao, 2000). Because *Kikanda* contains peanut as its major ingredient (approximately 5/6 of the preparation), and peanuts are rich in lipids, including unsaturated fatty acids such as oleic and linoleic acids (Reed, 1924), the poor DPPH performance of *Kikanda* extract can be explained by the dominance of lipophilic compounds, which are poorly detected by the DPPH assay. Lipid-associated radical scavengers such as tocopherols and resveratrol, which are present in peanuts, are better captured by the ABTS method (Isanga and Zhang, 2007).

The orchid tuber extract showed considerably stronger antioxidant activity than the *Kikanda* preparation in both assays, with an ABTS IC_{50} of 5.57 ± 0.77 µg/mL and a DPPH IC_{50} of 42.17 ± 7.73 µg/mL. The dilution of orchid-derived antioxidants by the bulk peanut component, as well as possible matrix interactions during cooking, likely accounts for the lower activity observed in the final preparation. These results are consistent with published reports on the antioxidant activity of orchid species. Chand *et al.(2016)* evaluated the DPPH scavenging activity of six wild orchid species from Nepal and reported IC_{50} values ranging from 72.3 to 412.6 µg/mL depending on the species (Chand *et al*., 2016). Minh *et al*., (2016) similarly reported moderate antioxidant activity in *Phalaenopsis* spp., attributed to their phenolic acid content (Minh *et al*., 2016). A study on six endangered medicinal orchid species from the northeastern Himalayan region of India found significant variation in both DPPH and ABTS IC_{50} values across species, supporting the view that antioxidant capacity in orchids is strongly species-dependent (Bhatt *et al*., 2017). The comparatively low IC_{50} values obtained for orchid tubers in the ABTS assay in the present study are therefore noteworthy and place these tubers among the more active orchid species documented in the literature.

The relatively weak activity of both samples compared to gallic acid (IC_{50}: 0.71 ± 0.08 µg/mL for ABTS; 1.07 ± 0.10 µg/mL for DPPH) is expected, as gallic acid is a pure phenolic compound known for exceptional antioxidant potency. Natural extracts are complex mixtures where individual antioxidants may interact in additive, synergistic, or antagonistic ways, and direct comparison with a single reference compound must be interpreted cautiously (Prior *et al*., 2005; Muipata *et al*., 2025). The antioxidant properties described here should be further contextualized within a nutritional framework. The consumption of *Kikanda* as part of the traditional diet in Katanga represents a regular intake of phytochemical-rich food. The combination of orchid-derived polyphenols and phenolic acids with peanut-derived resveratrol, flavonoids, and tocopherols could, in principle, provide meaningful dietary antioxidant supplementation to communities where the preparation is consumed regularly. This hypothesis merits investigation through validated dietary assessment and bioavailability studies. Furthermore, the thermal treatment involved in the preparation of *Kikanda* (prolonged boiling and baking) may influence the stability of heat-sensitive phytochemicals, and future studies should compare the antioxidant and phytochemical profiles of raw versus cooked ingredients.

Conservation and valorization perspectives

The orchid species used in the preparation of *Kikanda* are harvested exclusively from the wild, and growing demand, both within DRC and through regional trade

networks toward Zambia, represents a documented threat to the sustainability of local orchid populations (Veldman *et al*., 2018; Kwenye *et al*., 2025). Davenport and Ndangalasi documented an escalating trade in orchid tubers across Tanzania's Southern Highlands as early as 2003 (Davenport and Ndangalasi, 2003), and subsequent DNA barcoding work confirmed that 16 species across six genera are involved in the regional chikanda trade (Veldman *et al*., 2018). In this context, the scientific characterization of orchid tubers, including microscopic, phytochemical, and antioxidant parameters, contributes directly to the building of reference standards that would support quality control, prevent adulteration, and guide policy on sustainable harvesting. From a nutritional valorization standpoint, the findings of this study provide the first experimental data on the bioactive potential of *Kikanda* as consumed in the DRC, adding scientific weight to its longstanding recognition as a nutritious and culturally significant food. The nutritional contribution of orchid tubers to this dish, alongside the well-established bioactive profile of peanut and aromatic spices, positions *Kikanda* as a food preparation worthy of further systematic nutritional and pharmacological evaluation.

CONCLUSION

This study reports for the first time the microscopic features and antioxidant evaluation of the orchid tubers used in the preparation of *Kikanda*, a traditional plant-based meat from the Katanga province of the Democratic Republic of Congo. Microscopic analysis revealed a set of diagnostic histological features, including polyhedral starch grains, raphides, sclereid fibers, non-glandular trichomes, spiral vessel fragments, and parenchyma, which can serve as reference markers for future authentication and quality control of *Kikanda*. Phytochemical screening confirmed the presence of polyphenols, flavonoids, tannins, and terpenes in all ingredients of *Kikanda*. All extracts displayed high ABTS and DPPH radical-scavenging activities with IC_{50} values ranging from 5.57 to 42.17 µg/mL, and orchid tuber extract and *Kikanda* extract were the most active against ABTS (IC_{50} of 5.57 ± 0.77 and 37.84 ± 1.6 µg/mL, respectively). Our results support the nutritional value of *Kikanda* and its scientific valorization. Further research is needed, especially *in vivo* studies and quantitative nutritional analysis, to demonstrate the full potential and health benefits of *Kikanda* as a functional traditional food and its possible role in preventing oxidative stress-related diseases.

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CONFLICT OF INTEREST

The authors declare they have no competing interests.

CONTRIBUTIONS

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Ethics approval and consent to participate
Not applicable.

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