



An Overview of the Ethnobotanic, Ethnopharmacological and Medicinal Importance of Edible Wild Root Tuber Orchids in Cameroon

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ABSTRACT

Orchids are well known for their beautiful exotic flowers, and food-flavoring products which make them a resource of great economic importance in the global horticultural and food industries. In Cameroon, orchids are particularly important for their tubers which are used for food and traditional medicine. Orchids are therefore of considerable economic importance, traded within and across the regions and out of the country. Few research works have reported for these orchids in Cameroon

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exploring mostly identification and taxonomy. It is therefore the responsibility and duty of the local population to valorize the tubers for national use based on their awareness of the hidden potentials for food and medicine. Many people will have eaten orchids without realizing, due to the countless products in international trade that contain the seeds of artificially propagated *Vanilla* orchids. However, this legal trade is only one example of orchids being used as ingredients in food and drink. One example is the trade in chikanda, a cake made from the ground tubers of terrestrial orchids and consumed in several countries in Central and East Africa. Another product made from the ground tubers of terrestrial species is salep, which is used as an ingredient in hot drinks and ice cream and consumed mainly in Turkey and neighboring countries.

The high exploitation with no biodiversity and conservation strategic plan by indigenes is a call for concern about the sustainability as future existence of these wild edible orchids is highly threatened; reason why orchids are on the international red list. This paper reviews the ethnobotanical and medicinal uses of orchid roots and tubers with a focus on Cameroon. The review highlights some of the areas that require more focus in terms of research and policy interventions, namely identification of all edible orchids, domestication of edible orchids, and trade controls. Focusing on Cameroon, this paper reviews and examines the edible root and tuber orchids developments based on information from some of the work that has been done in Cameroon, the ethnobotanic, ethnopharmacological and medicinal uses of these orchids.

Keywords: *Edible wild root tuber orchids; ethnobotany; medicinal potential; Cameroon; Biodiversity; conservation.*

1. INTRODUCTION

Orchids belong to a very diverse, attractive and economically important family Orchidaceae, distributed from tropical to temperate zones, with nearly 30,000 known wild species and about 100,000 hybrids [1]. All orchids are herbaceous plants in life forms and classified into four categories in natural habitat: Orchids are popularly known for their beautiful flowers which make them a plant resource of great exotic, economic importance in the global horticultural industry. The attractive colour and shape of their flowers has made them very popular, attractive and as a result, these plants have great ornamental potential, in sub-Saharan Africa, particularly in Tanzania, Zambia, and Malawi [2,3]. Orchids are mostly important for their tubers which are used as a source of food, and are commercialized within and across the countries. The tubers are harvested from the wild and processed into a meatless sausage locally called in Malawi as *chinaka*, *chikande* and *kikande* which is consumed as relish or just as a snack [4]. The tubers are also reported to be used in the preparation of soup which is said to be served on the buffet tables and found on menus of some international tourist hotels [2,5]. Orchids grow most abundantly in tropical and subtropical forests, where they are largely epiphytic. In Cameroon, the genera to which species of edible orchids belong include *Habenaria*, *Satyri-um* and *Disa*. The family Orchidaceae have recorded the largest number

of species than any other family of flowering plants, with possibly as many as 25,000 species [6].

Early studies on orchids in Southern Africa concentrated on taxonomic aspect, but recently more researchers have focused on the increasing demand for edible orchids which has led to an increase in cross-border trade and therefore raising concerns about its sustainability as high exploitation pressure threaten its future existence [6,7,8]. Focusing on Cameroon, this paper attempts to give an overview of orchids developments based on information from some of the studies that has been done on edible orchids in the country, and from ethnobotanical and social economic surveys. Early studies on orchids in Central and East Africa can be traced back in the 70s by the work of Morris (1970), who studied and provided numerous drawings of epiphytic orchids. More than a decade later this study was expanded on the epiphytic orchids of Malawi with descriptions of other new species.

The Terrestrial orchids (eg. *Cymbidium*, *Arundina* etc.), Epiphyte orchids (eg. *Dendrobium*, *Vanda* etc.), Lithophyte orchids (eg. *Eria*, *Pholitoda* etc.) and the Saprophyte orchids (eg. *Gastrodia*, *Aphyllorchis* etc.) [9,2,3]. In some countries like China recorded orchid species are 1,247 species in 171 genera; of which Yunnan province has 764 species making up 61% of total orchid species of and over 300 species of the orchids are used in Chinese medicine [4,5]. The most

important medicinal orchids are the *Gastrodia alata*; *Dendronbium officinale*; *D. nobile*; *D. chrysotoxum*; *D. fimbriatum* listed in China Pharmacopeia and *Bletilla striata*; *Gymnadenia*; *Bulbophyllum* etc [5,6]. In Cameroon and the rest of Africa, there is a gap of information on edible orchids [7,8]. Biodiversity and conservation are an essential approach for present and future needs of human being. Sustainable use of biodiversity including cultivation of orchids is the solution for conservation [10]. Therefore, habitat protection, germplasm development and conservation and cultivation of useful orchids are the appropriate approaches for sustainable use of edible orchids [2,11].

The use of orchids for traditional medicine have been documented in China as far back as 3,000 years ago with the earliest records found in 'Shijing' on the *Spilanthesis sinensis* in 300BC; the book 'South China Flora' recorded use of *Dendronbium* orchids for anti-toxic treatment, *Dendronbium* was recorded as 'lucky herb' while in the Tang Dynasty *Dendronbium* was considered as one of the nine 'fairy (herbs from paradise) [11-13].

There are about 300 important orchid species worldwide used in traditional medicines [3,12,13-15], the most common used species are:

1. ***Gastrodia alata***: tuber is used for improving memory and brain tonic purposes. Commonly cultivated or grown in the wild in high land areas of Northwest region of Cameroon, some parts of East and Central Africa, China and used as medicine and herbal food [3,16].
2. ***Dendronbium species***: including *D. officinale*; *D. nobile*; *D. chrysotoxum*; *D. linifonmis*; *D. nobile*; *D. devonianum*; *D. primulinum*; *D. firmbreatum*; *D. densiflorum*; *D. chrysanthum*; *D. pendulum* etc.; are the commonly used ones. *Dendronbium* roots and stems is widely used in treatment of blood circulation, cordial system and throat sore [11,17]. Presently various products are being marketed including processed stem, herbal tea and herbal drinks are approved and used as tisane and herbal tea in Europe, China, but the products must have usable certification [17].
3. ***Bletilla striata***: tuber is widely used for cough, lung problem, TB and to stop bleeding etc; It is collected from wild and cultivation on small scale is in practice [4,18,19].
4. ***Bulbophyllum spp.***: used in treatment of cough, lung problem and injury. It is harvested from wild mostly in hilly dry areas in Africa [7]
5. ***Arundina graminifolia***: Used in traditional medicine well-known detoxification herb for all diseases before taking medicine and obtained from wild [11,19].
6. ***Eria pannea***: whole plant is used for tonic of lung, digestive system inflammation etc, and harvested from wild [20].
7. ***Vanda roxbunghii***: roots are used for rheumatism treatment, recent studies by Indian scientists showing reduce acute inflammation functions. *Anoectochilus roxbunghii* and *A. formosancns*: both are important medicine in Taiwan for lung, kidney, diabetes and snake-bites etc. [21].
8. ***Calanthe alismaefolia***; *C. alpina*; *C. graciliflora* and *C. clarata* are widely used in the West region of the Noun savannah plain as herbal medicines among the communities for improving blood circulation and anti-toxication [22-24].
9. ***Coeloglossum viride var. bracteatum***: tonic medicine used in Ndop and the Bamenda highlands and harvested from wild. *Cremastra oppendiculata*: its pseudo-bulb is used for cough, lung, blood circulation, snake and insects' bites; anti-cancer, skin-burning etc., and is available from wild [1,25].
10. ***Cymbidium spp.*** commonly used in the grass field agroecological regions for various purposes like meat substitute. Commonly seen at the onset of raining season at the Ndop and Sabga hill growing in the wild. Attempts are now made for cultivation for its medicinal and commercial importance [26].
11. ***Gymnadenia conopsea*** and ***G. crassinervis***: tuber used for tonic kidney, lung, TB, asthma etc. Very common in the wild [27].
12. ***Thunia alba***: whole fresh plant is used for bone-break treatment and injury. Found from wild and used locally [28].
13. ***Amitostigma***; ***Alparis***; ***Anthogenium***; ***Cephalauthera***; ***Changnienia***; ***Oreorchis***; ***Peristylus***; ***Cypripedium***; ***Goodyera***; ***Platanthera***; ***Habenaria***; ***Satyrrium***; etc. have records of medicinal uses in traditional medicines by the herbalist in the

Bamenda highlands. Harvested from wild [29,30].

2. NEW DEVELOPMENT OF ORCHIDS UTILIZATION IN FOOD SUPPLEMENTS AND COSMETICS

Since 1990's many new products from orchids have been developed as healthy and functional food mostly in China and other Asian herbal medicine initiative groups. Cameroon and other countries in Africa consume orchid tubers as source of bioactive compounds, for micronutrients [31]. Many of these products are from the *Gastrodia* and *Dendronbium spp.* Traditional knowledge of orchid uses are found from numerous early works in Cameroon and contemporary ethno-medical and ethnobotanical studies [30-35]. Since 1970's relevant records of hundred orchid species are found on the Cameroon pharmacopoeia, published papers by Cameroon Researchers, Africa and Asia [33].

Food supplements: Stem and flower of *Dendronbium officinale* and other *Dendronbium species* are used for making functional products such as healthy drinks, food, and chewing materials [34]. *Gastrodia alata* : tuber is common used for cooking dishes and soup with chicken and meat for improving memory and *Cymbidium* flowers, used as herbal tea and drinks [23,36].

Cosmetics: *Cymbidium* flowers are used in perfume, skin cream and anti-aging cosmetics. In the Chinese culture orchids is a symbol of beauty, elegant and clean, many believe that there is great potential of new development orchids products in cosmetics [37].

Ornamental: *Cymbidium dendronbium*, *Vanda*, *Paphiopedilum*, *Papilionanthe* and *Phalaenopsis* are cultivated commercially for ornamental purpose. The attractive colour and shape of their flowers has made them very popular and as a result, these plants have great ornamental value but not exploited in Cameroon as is the case in the Southern African region particularly in Tanzania, Zambia, and Malawi. In Cameroon orchids are mostly important for their tubers which are used as a source of food, and are therefore traded within and across the local community small markets, mostly soled on traditional market days [9,36-38]. The tubers are collected from the wild and processed into a meatless sausage locally called nyamgub in Bali, Cameroon. In other African countries like Malawi,

Tanzania with similar product they are called chinaka, *chikande* and *kikande* , which is consumed as relish or just as a snack.

Orchids grow most abundantly in tropical and subtropical forests, where they are largely epiphytic [39-42]. In Cameroon, the genera to which species of edible orchids belong include *Habenaria*, *Satyrium* and *Disa*. These are all terrestrial orchids bearing underground tubers. Botanists believe that the family Orchidaceae contains the largest number of species than any other family of flowering plants, with possibly as many as 25,000 species [42-45].

Early studies on orchids in Cameroon concentrated on taxonomic aspects [46]. But of recent, a number of researchers [22] have focused on the dramatic rise in demand for edible orchids which has led to an increase inter community trade thereby raising concerns about its sustainability as high exploitation pressure threaten its future existence [47-49].

3. LEGAL REGULATION

The prevalence and diversity of orchid trade is not yet important in Cameroon. However, the increasing popularity as plant protein meat substitute is important because orchids are among the best-protected plant taxa globally [50]. Orchids are subject to unique levels of legal protection, including wide protections from the pressures of international trade, and national legislation in many countries further restricts their harvest from the wild [51]. The Convention on International Trade in endangered species (CITES) regulation which is a multilateral environmental agreement that regulates the international movement of species that are, or may become, threatened as a result of international trade is very applicable to orchid trade. Species of concern are included in one of three appendices, with > 35 000 species currently listed. Notably, orchids constitute > 70% of CITES-listed species. This broad inclusion of orchids under CITES, which dates back to the 1970s, is the result of a precautionary approach, as many members of the family resemble other species [21,52-55] and are therefore likely candidates for misidentification by the non-experts often responsible for inspecting trade shipments. Although some exemptions have been made for certain types of orchid material (e.g. seeds, seedlings in sterile flasks) or taxa (e.g. Vanilla, some ornamental hybrids), the international movement in most orchids,

whether for personal, commercial or scientific purposes, must be monitored and sanctioned by the relevant CITES agencies [48,56].

3.1 The Evolution of Illegal Orchid Trade and its Economic Implications for Global Conservation and Biodiversity

The communities think of illegal wildlife trade first from the images that spring to mind likely to be of an African elephant killed for their ivory, rhino horns being smuggled for medicine, or huge seizures of pangolins. However, there is a huge global wildlife trade in orchids exotic products that is often overlooked, despite it involving thousands of species that are often traded illegally and unsustainably. Orchids are perhaps best known for the over one billion mass-market pot plants traded internationally each year, but there is also a large-scale commercial trade of wild orchids for food, medicine and as ornamental exotic plants. This is due to the fact that all species of orchids are listed by the Convention on the International Trade in Endangered Species of Wild Flora and Fauna (CITES), which regulates and monitors the commercial trade of wild plants and animals that may be threatened by exploitation. Whilst CITES discussions often focus on elephants and other mammals of touristic value, orchids make up over 70% of all of the species listed by the Convention. To highlight the problems associated with the illegal and unsustainable orchid trade there has been publications by an international team of authors from the IUCN orchids specialist group's global trade programme.

3.2 Medicinal Orchids

Various different orchid species are used in traditional medicines in several countries and on a lot of different scales, including on a commercial level in some cases. For example, the stems and tubers of several species are used in Traditional Chinese Medicine, in products to improve general health condition as well as in medicines for specific problems.

3.3 Edible Orchids

Many people will have eaten orchids without realizing, due to the countless products in international trade that contain the seeds of artificially propagated *Vanilla* orchids. However, this legal trade is only one example of orchids

being used as ingredients in food and drink. One example is the trade in chikanda, a cake made from the ground tubers of terrestrial orchids and consumed in several countries in Central and East Africa. Another product made from the ground tubers of terrestrial species is salep, which is used as an ingredient in hot drinks and ice cream and consumed mainly in Turkey and neighboring countries.

3.4 Ornamental Orchids

Orchids have been grown as ornamental plants for several thousands of years, most commonly for their attractive flowers but also for their scent, patterned leaves or unusual growth habit. In Victorian Europe the ornamental trade was characterized by obsessive collectors suffering from orchidelirium (also known as orchid fever) that led them to pay huge sums for rare or unusual species. Whilst the majority of ornamental orchids traded internationally today are cut flowers and plants grown in greenhouses, there is still a large-scale commercial trade in wild, often illegally-collected plants. Harvesting for illegal trade is a particular problem in Southeast Asia, where species such as Canh's slipper orchid (*Paphiopedilum canhii*) overexploited due to collection for international trade. Whilst diverse, all of these trades have been linked to over-harvesting, causing decline and loss of species from the wild. In addition, the nature of the trade presents significant challenges to conservationists trying to regulate and monitor the trade. These include the direct threat from many different types of illegal harvest and trade, rapidly shifting patterns of consumer and supplier behaviour, the huge number of orchid species in trade that make identification difficult, and the fact that very little is known about the ecology of traded species, or how threatened they are in the wild. Finally, whilst the illegal trade in animals may get a lot of attention from the public, from conservation organizations and from policy makers, plants are often not seen as a priority, resulting in little funding being devoted to research or action to address the unsustainable trade.

To address these challenges, it is highly recommended that the conservation community should focus on conducting further research on trade dynamics and the impacts of collection for trade; strengthening the legal trade of orchids whilst developing and adopting measures to reduce illegal trade; and raising the profile of

orchid trade among policy makers, conservationists and the public.

4. EDIBLE ORCHIDS OF CAMEROON

Orchids are nature's most extravagant group of flowering plants distributed throughout the world from tropics to high alpine [57-59]. They exhibit incredible range of diversity in shape, size and colour of their flowers. They are important aesthetically, medicinally and also regarded as ecological indicators [5,60]. Several orchid species are cultivated for their various economic uses especially in floriculture. Orchids are grown primarily as ornamentals and are valued as cut flowers because of their exotic beauty and their long-lasting blooming period [3,60-62]. Though orchids are grown primarily as ornamentals, many are used as herbal medicines, food, and other cultural value by many different cultures and tribes in the different parts of world [6,15,63]. Though large population of orchid is still confined in their natural habitat, in many parts of the world their number is decreasing due to their high demand and population pressure. Many orchid species are threatened due to their habitat destruction and indiscriminate collection [18,64]. At present, the orchids also figure prominently in the Red Data Book prepared by International Union for Conservation of Nature (IUCN). In fact, the entire family is now included in Appendix-II of Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) [14,66], where the international trade is strictly controlled and monitored. Use of orchids in traditional medicine Orchidaceae is regarded as the largest family of plant kingdom comprising 25,000-35,000 species [3,67]. Very less study has been done on the orchids in Cameroon and the transformation process into different food product and the popular meat protein substitute [21,68]. There is a lot of research work in progress by Cameroonian researchers on edible root and tuber orchids transformation and sustainable development.

Cameroon orchids have gained more popularity in the last 3 decades for its ornamental, food and medicinal values [7,69]. Some orchids like *Eulophia campestris*, *Orchis latifolia*, and *Vanda roxburgii* have drawn the attention of the scientific community because of their medicinal uses [8,9]. Medicinal orchids mainly belong to the genera: *Calanthe*, *Coelogyne*, *Cymbidium*, *Cypripedium*, *Dendrobium*, *Ephemerantha*, *Eria*, *Galeola*, *Gastrodia*, *Gymnadenia*, *Habenaria*, *Ludisia*, *Luisia*, *Nevilia*, and *Thunia* [6,10].

Research has shown that *Dendrobium* spp., *Gastrodium* spp., and the hyacinth orchid (*Bletilla striata*) have been used in the treatment of ailments like hemorrhages of the stomach or lungs, uterine bleeding, and nose bleeds, as well as whooping cough [1,33], and more medicinal uses are being uncovered across the world [11,60].

However, in Cameroon, most studies of orchids have been centered mostly on inventory and diversity [12,13], in spite of the various ways in which Cameroonians use orchids daily, and as a result, very little is known or published about the socio-economic importance and the ethno uses of orchids in Cameroon [20]. Most of the edible orchids species have been reported in the highlands of the western regions and northwest regions of Cameroon. Other special species has been reported in the Mount Cameroon Region.

Early studies on orchids in Cameroon can be traced back to the works of Nkongmeneck et al. [27] Focho et al. [35], Fonge et al. [62], who studied and provided numerous drawings of epiphytic orchids. More than a decade later expanded on the epiphytic orchids of Cameroon with descriptions of other new species. Each species has been described in terms of its appearance, habitat, flowering time, and distribution within Cameroon and in other countries.

Recent works on orchids include that of the National Herbarium of Cameroon involved in systematic collections of the representatives of the major plant families, and the vegetation types including indigenous plant species of both economic and medicinal value such as orchids [7,58]. Most orchids are terrestrial or occasionally lithophytic plants with round or cylindrical tubers, one dying back each year and a new one being formed for the following season's growth [69].

Table 1 describes some of the identified edible orchids in Cameroon in terms of their habitat, flowering time, and distribution in the country and elsewhere. The species include *Disa engleriana*, *S. ambylosacco* and *S. carsonii* have limited distribution within the Noun plateau, Mezam and Bui highlands and they mostly occur in the north northern region of the country at the onset of the rain in the wild [36,44]. On the other hand, *D. engleriana*, *D. robusta* and *H. clavata* have limited distribution within Cameroon because they do not seem to occur in many parts of Africa. Thus, *D. engleriana* and *S. ambylosacco*

have limited distribution both in Cameroon and within Africa.

The geographic distribution of wild edible orchid tubers in Cameroon are found in Buea mountain zone, Ndop, Bati plateau, Mezam, Momo upper highlands as shown in Table 1. The species identified so far includes *Disa spp*, *Hebenaria spp* and *Satyrium spp*.

Propagation Potential, Indigenous Conservation and Management Practices:

Presently edible orchids are not artificially propagated. From time immemorial people have sustained the productivity of edible orchids through selective harvesting whereby only those plants that have tasseled are harvested and also only a plump tuber is extracted from the ground leaving a shriveled tuber to regenerate the next season [13,20]. The traditional knowledge of pests and diseases of edible orchids is obscured.

However, rodents, mice, grasshoppers and monkeys, were reported to feed on them, thus may be considered pest if artificially grown [66].

5. ORCHID'S UTILIZATION

Edible orchids play an important role in the livelihoods of most people who live around the areas where they occur, as a good meat substitute [35,40]. The edible orchids in Cameroon are mostly used for food, medicine and as a source of income in the local farming communities. Processed orchids are eaten either as relish or just as a snack. As medicine, orchids are used in the treatment of many diseases. Furthermore, trading in edible orchids is profitable such that it is becoming a major source of income for those people who are involved in its marketing [21,37].

Table 1. Geographical distribution of wild edible orchid tubers in Cameroon [20-22]

Scientific Name	Habitat	Flowering time	Distribution in Cameroon	Other locations in Africa
<i>Disa robusta</i>	Montane grassland (1500 - 2000 m)	November - January	Buea mountain zone, ndop, Bati plateau	D R Congo, Tanzania and Zambia.
<i>Disa englerian</i>	Fairly open woodland (7280 - 1700 m)	February - April	Mezam, Momo, Upper highlands, Buea Mountain regions	D R Congo, Tanzania, Zambia, Ghana
<i>Hebenaria clavata</i>	Brachystegia woodland or montane grassland (1100 - 2285 m)	February - April	Ndop hills, Santa, Tubah, Bambili upland area	South Africa.
<i>Disa zombica</i>	Montane grassland (1300 - 2350 m)	January - April	Sabga, Bali, Pinyin, Santa, Ndop	Burundi, Tanzania, Zambia, Mosambique, Zimbabwe, Tanzania, Zambia
<i>Satyrium ambylosaccos</i>	Montane grassland (1300 - 2250 m)	January - March	Buea highlands, Mbouda, Sabga, Ndop	
<i>Satyrium buchananii</i>	Wet montane grasslands (700 - 2400m)	December - January	Bali, Momo upland area, Widikum uplands, Batibo hills	D R Congo, Tanzania, Zambia, Zimbabwe, Angola.
<i>Satyrium cursonii</i>	woodland (1300 - 1750 m)	January - February	Ndop highland, Bui hills, Nkambe, Bali, Santa	Nigeria, Cameroon, D R Congo, Uganda, Kenya, Tanzania and Zambia.

Food: Most of those who consume cooked or processed have them as regular menu during the period that is grown or blossom in the wild (at least once a week) when in season [2,11]. In countries like Malawi the locals believe that *chinaka* a processed meal from Orchid tubers protect them from diseases, and provides energy and serve as a delicacy [55]. The most preferred species of processed Orchid food is from the *S. cursonii*, but in general female orchids are most preferred to male. Mixing female and male orchids is done to improve quality (texture and colour) and taste. The quality of *chinaka* is also influenced by expertise and experience in cooking.

The cooking process involves cleaning the tubers and pounding them in a mortar using a pestle. The pounded tubers are then cooked together with a locally made baking powder called sodium bicarbonate for a few minutes until a hard-starchy substance is produced [1,9,43]. This is normally left for some time to cool and solidify. Upon cooling, the starchy substance becomes thick and viscous. It is then cut into small pieces

and cooked with groundnut sauce, or tomatoes, ready to be eaten as relish. The cooked pieces can also be simply eaten as a snack. The food composition of the raw edible orchids' tuber has been illustrated in Table 2. The tubers show high calcium, fiber and iron content.

Medicinal orchids have not been widely exploited in Cameroon due to its non-ubiquitous nature and the seasonality of the different species [48]. However, some ethnobotanical and ethnopharmacological inventory has been done in the South west mountains of Buea and in the upper plateau, and the grass fields savannah zones of Cameroon [50]. The documented medicinal orchids used in Cameroon have been listed in table 3. Most of the orchids are used for specific pathological conditions and plant parts can be the tubers, leaves or whole plants identified by local tradipracticitionners or botanists in the field. Over exploitation of the different varieties poses a problem of extinction of some mountain habitat species and thus the need for biodiversity and conservation programmes.

Table 2. Food composition of edible root and tuber orchids [1]

Food component	Composition (in terms of 100 g of edible portions)	Measure
Food energy	115	Calories
Moisture	70	Percent
Protein	13	Grams
Fat	0	Grams
Carbohydrates (including fiber)	27.6	Grams
Ash	1.1	Grams
Calcium	48	Milligrams
Iron	7.8	Milligrams

Table 3. Uses of medicinal orchids in Cameroon

No	Botanical name	Habitat	Part used	Medicinal uses
1	<i>Aerides multiflora</i> Roxb	Epiphytic	Leaves, Bulbs, Roots	Leaf paste applied to treat cuts and wounds. Plant parts possess antibacterial properties [1,2,4,5]
2	<i>Anoectochilus roxburghii</i> (Wall.) Lindl	Terrestrial	Whole plant	Powder mixture solution consumed to treat tuberculosis [4]
3	<i>Bulbophyllum odoratissimum</i> (Sm.) Lindl.	Epiphytic	Whole plant	Whole plant Fresh pulp or juice is used in treatment of burns [4,8]
4	<i>Calanthe plantaginea</i> Lindl	Terrestrial	Rhizome	Dry powder with milk is taken as tonic and also as an aphrodisiac [5]
5	<i>Calanthe puberula</i> Lindl.	Terrestrial	Root	Dry powder mixture is taken as tonic energizer, antibacterial [5]
6	<i>Coelogyne corymbosa</i> Lindl	Terrestrial	Rhizome	Rhizome Appetizer, tonic, it heals wound [1,9]

No	Botanical name	Habitat	Part used	Medicinal uses
7	<i>Coelogyne cristata</i> Lindl	Epiphytic s	Pseudobulb	Pseudobulbs are given in constipation, aphrodisiac. Juice of pseudobulbs is applied in wound and boils. Gum from psudobulb are used [23,55] for sores [3,4,5,6]
8	<i>Cymbidium devonianium</i> Lindl. ex Paxton	Epiphytic	Whole plant	Root paste is applied to treat boils; concentrated decoction is taken in cough and cold [3,4]
9	<i>Dactylorhiza hatagirea</i> (D. Don) Soo	Terrestrial Tubers	Tubers	Tonic, wound healing and control bleeding, burns. Also used as a farinaceous food. Used to treat fever and various other body disorders [3,4,5]
10	<i>Dendrobium densiflorum</i> Lindl	Epiphytic	Pseudobulbs	Pulps of the pseudobulbs are used in boils and pimples and other skin eruption [3,4,5]
11	<i>Dendrobium macaraei</i> (Lindl.)	Terrestrial	Whole plant	Paste is used against snake bite, general stimulant and demulcent [5], Used in Asthma, Bronchitis, throat trouble, and fever, aphrodisiac[4]
12	<i>Dienia cylindrostycha</i> Lindl	Terrestrial	Pseudobulb	Pseudobulb Power is used as a tonic [5]
13	<i>Eulophia dabia</i> (D. Don) Hochr	Terrestrial	Epiphytic Stem	Paste is taken internally to reduce stomachache and applied externally to reduce, headache [1,4,5]
14	<i>Flickingeria fugax</i> (Rchb. f.)	Terrestrial	Whole plant	Powder is used as a tonic general debility stimulant [5]
15	<i>Habenaria commelinifolia</i> (Roxb.) Wall. ex Lindl	Terrestrial	Whole plant	Also used for liver and urinary disorders and gastric [1,3,4,5], various orchids, and also used as spices[4]
16	<i>Habenaria pectinata</i> (Sm.) D. Don	Terrestrial	Tubers	Tubers juice applied in snake bites, against arthritis [5].
17	<i>Herminium monorchis</i> (Linn.) R.Br.	Terrestrial	Roots	Terrestrial Whole plant Extract of plant given in suppressed urination [45] Tonic [6].
18	<i>Liparis nervosa</i> (Thunb) Lindl.	Terrestrial	Tubers	Used to treat stomachache, malignant ulcers [9,4].
19	<i>Nervilia aragoana</i> Gaudich	Terrestrial	Whole plant	Used in uropathy, haemoptysis cough asthma, vomiting, diarrhoea & mental instability [1,4].
20	<i>Platanthera sikkimensis</i> (Hook. f.)	Terrestrial	Bulbs, Pseudobulb	Juice is applied to relieve naval pain, abdominal [29].
21	<i>Vanda tessellata</i> (Roxb.) Rchb. f	Epiphytic	Roots and tubers	Used in rheumatism and allied disorders and for fever [9,25]
22	<i>Zeuxine strateumatica</i> (L.) Schltr	Terrestrial	Roots and tubers	Dry powder is used as tonic energizer [11,32].

5.1 Framework for the Development of New Bioactive Plant-Products from Orchids

The interest in medicinal plant studies on the Orchids family has stimulated a global paradigm shift in the development of potential bioactive molecules and nutraceuticals. The methods and

approaches of developing a new product is presented in to the following stages; data mining/literature survey, market potential survey of product, ethnobotanical and ethnopharmacology history, discovery, development and quality development as illustrated in Table 4 and summarized in Fig. 1 [52-55].

Table 4. Methods and approaches of new products development from orchids [10,17]

Data mining/Literature survey	<ul style="list-style-type: none"> To identify scientific names of orchids and its distribution area recorded in ancient records and books as a starting point and followed by study its usages on the records. To search all records of orchid species on modern publications and its uses including mode of use, value of uses etc.
Product Market survey	<ul style="list-style-type: none"> Traditional market is very rich in local products of orchids Using ethnobotanical methods to investigate, record and evaluate local products of orchids is very useful. Modern market survey is also very important to gather information on new products from orchids, for instance, functional food, cosmetics, essential oil and herbal tea
Ethnobotanical field survey and inventory	<ul style="list-style-type: none"> ✓ Interview with informants (rural people herbal doctors, house wives, forest-products collectors etc.) ✓ Field observation on orchids and habitat environment. ✓ Voucher specimens collection with field records. ✓ Identification and inventory. ✓ Chemical property investigating at laboratories. ✓ Evaluation and validation and ✓ New products design and production
Valorization of product	Phytomedicine

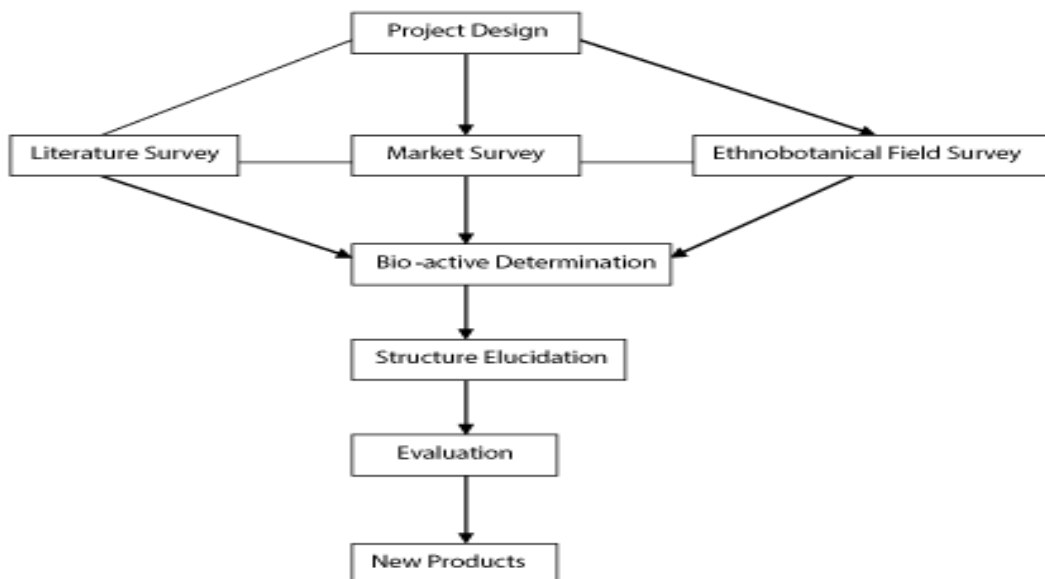


Fig. 1. Framework of development new plant-products [5]

6. CONCLUSION

Orchids are well known for their beautiful exotic flowers, and food-flavoring products which make them a resource of great economic importance in the global horticultural and food industries. In Cameroon, wild orchids tubers are very important for their food and traditional medicine values. Wild tuber orchids are therefore of considerable economic importance, traded within and across the regions and out of the country. The high exploitation with no biodiversity and conservation strategic plan by indigenes is a call for concern about the sustainability as future existence of these wild edible orchids is highly threatened; reason why orchids are on the international red list. Cameroon is endowed with a cocktail of rich orchid species diversity as well as traditional knowledge on orchids. However, there is still the need to put in action a strategic development plan for potential exploitation, which are the fundamental basis of new products development for orchids. Cameroon will be successful in the development of its rich traditional botanical knowledge into new medicine in the future with the capacity building and technical resource mobilization to develop functional and healthy food products with more research empowerment in the orchid family.

Cameroon and members of the subregions should work together to build-up a bridge for sharing knowledge for development of new products from orchids and many other common medicinal plants for health care and potential benefit to the community, considering the valuable contribution of edible orchids to people's livelihood and the indications that its availability is decreasing while its consumption is increasing. The state within her development programmes needs to put in place a number of interventions focusing on the biodiversity and conservation of orchids for a sustainable production. Such interventions may include, identification of all edible orchids, domestication of edible orchids through artificial regeneration, and trade regulation. Orchids is very promising in Cameroon as a meat substitute, and a plant protein-based product, comparing with soybean. Most of the orchids identified in Cameroon are used for specific illnesses, using the different plant parts like the tubers, leaves or whole plants identified by local tradipractitionners or botanists in the field. Over exploitation of the different varieties is causing the problem of possible extinction of some mountain habitat varieties,

that needs the intervention of biodiversity and conservation programmes.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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