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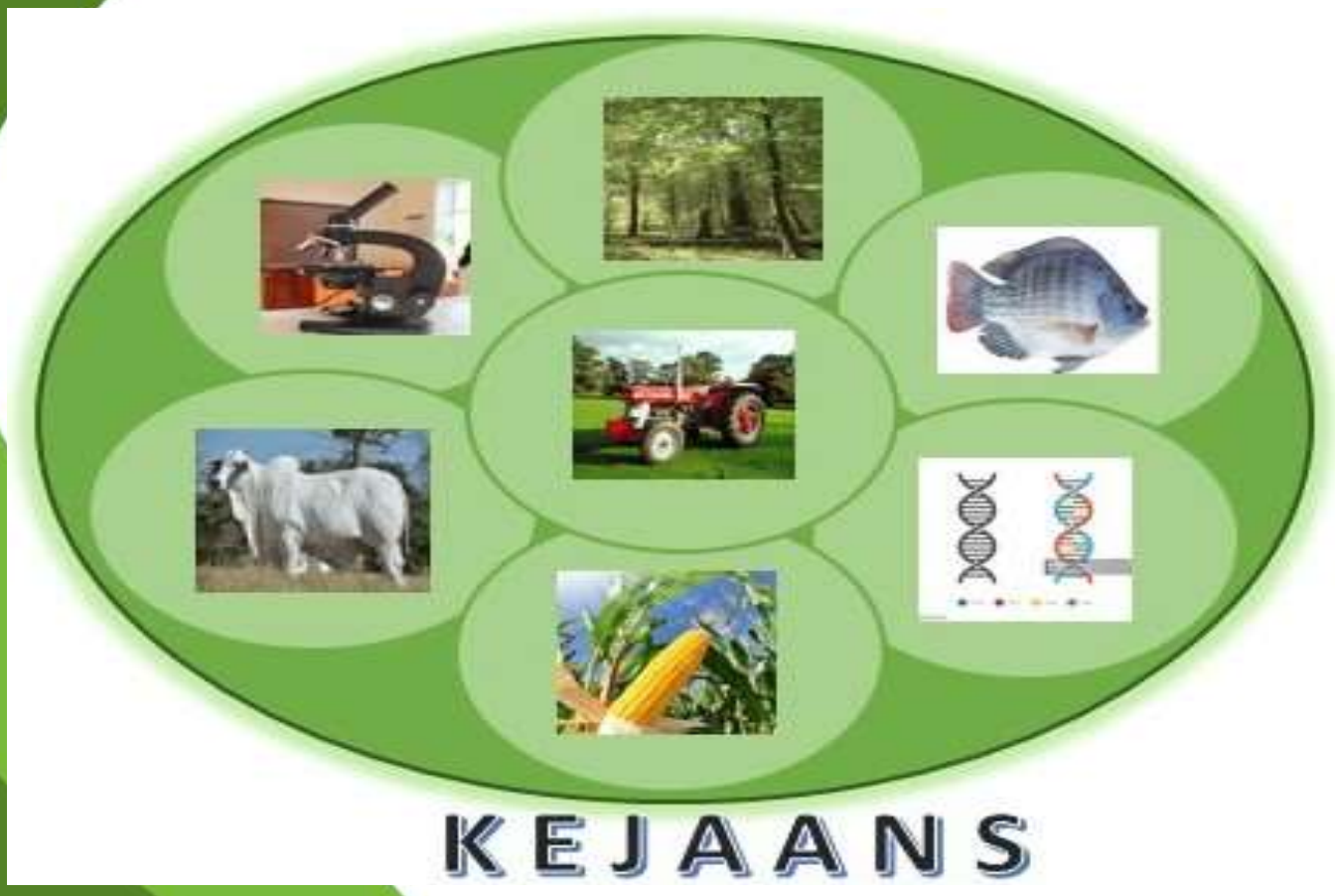

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The Kebbi Journal of Agriculture and Natural Sciences has the sole aim of providing an intellectual platform and ideas for scholars, by promoting interdisciplinary studies related to agriculture and natural science through publishing the latest scientific research findings that are of direct policy implications and beneficial to the research community. Consequently, the journal covers all aspects of Crop Science, Animal Science, Agricultural Economics, Agricultural Extension and Rural Development, Food Science, Fisheries and Aquaculture, Biotechnology, Soil Science and Agricultural Engineering, Forestry and Environment, Wildlife, Agricultural Education, Agro-allied Industries as well as all Natural Science researches related to Agriculture.

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The first page of the manuscript should contain the title of the article, which should be concise and explicit, typed with upper-case, bold, 14 font size, TNR and not more than 21 words. The surname and forenames (in full) of authors, affiliation of each author should be provided. Phone number and email address of the corresponding author (identified by an asterisk) should be provided. Superscripts should be used to relate authors to their affiliations.

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A conscience introduction of the background to the subject is required and should include a brief statement of the problem, significance and purpose of the research and relationship to earlier works with well acknowledged references.

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Results should be presented concisely. Only in exceptional cases will it be permissible to present the same set of results in both Table and figure. In discussion, point out the significance of the results and place the results in the context of other work and theoretical background. Results and Discussion part could be written separately if author so wish.

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DeVries, J. and Toenniessen, G. (2001). *Securing the Han/est Biotechnology, Breeding and Seed Systems for African Crops*. The Cromwell Press, Trowbridge, Wiltshire, UK. 208pp.

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Avoid the use of abbreviations at the beginning of the title, heading or sentence. The following abbreviations with numerals can be used without spelling out at first use. H, min, s, yr, mo, mm, kg, g, DNA, RNA, cpDNA, dNTP.

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Avoid the use of figures /numbers at the beginning of a sentence. Write out one through nine unless a measurement, a designator, or a range (e.g five seeds, 8cm, 3yr, 5-11 flowers)

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EXPLORING THE MINERAL COMPOSITION OF MACA ROOT OBTAINED FROM KAFANCHAN, JEMA'A LOCAL GOVERNMENT AREA, KADUNA STATE

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ABSTRACT

Maca root (Lepidium meyenii), also referred to as Gadali in Hausa language, and is a well-known medicinal plant being utilized traditionally as aphrodisiac and for treating infertility. However, limited scientific research to study its bioactive contents is available. This research aimed to study the mineral composition of Maca root grown in Kafanchan, Jema'a local government area, Kaduna state. Fresh Maca bulb was harvested and washed with distilled water, cut into pieces, shed dried and pulverized into powder which was digested and analyzed in the laboratory using atomic absorption spectroscopy (AAS). The study revealed the presence of Mg (0.24), K (0.17), Na (0.12), Ca (0.14), Fe (0.11), Cu (0.13), Zn (0.14), Mn (0.13) and Ni (0.13) mg/ Kg. We recommends for a further study to explore the potentials of maca as a natural remedy for mineral deficiencies in both humans and animals.

Keywords: Maca, minerals, atomic absorption spectroscopy

Introduction

Maca root (*Lepidum meyenii*, is a specie of plant belonging to the family Brassicaceae, it is a native to the high Andean regions in Peru and Bolivia (Lim, 2015). The cultivation of maca has been practiced for more than two thousand years, this has its evidence of its cultivation observed in the central Peruvian Andes, particularly in Óndores district, Junín province (Gonzales and Alarcón-Yaquetto, 2018). For the population of the Andeans, maca is highly seen as a very valuable commodity and its bulbs are dried which can be stored for many years (National Research Council, 1989). Its chemical properties are variable due to factors like crop genetics, environment cultivated, parts of the plant, growing conditions, management of crop and the method of analysis used (Wang and Zhu, 2019). Cobo and Ruiz were the first to report in the mid and late 17th century, establishing the fact that maca can thrive and grow in the coldest and wildest regions of the mountains, so also its nutritional properties and its ability to improve fertility, according to the natives (Cobo, 1956). Ending 17th century, they also noted its nutritional properties and its ability to improve fertility, boost immune system of the body and supply the body with adequate minerals according to the natives (Cobo, 1956). The high level of its health benefits attributed to the consumption of maca dietary supplement products gotten from maca. There was a report from the Innova Markets insights database saying that 1,401 products in the global market are containing maca on the label's ingredient list (Innova, 2023). Although, maca is seen as a traditional food or

"not novel" based on the regulations of many countries e.g., New Zealand and Australia, United Kingdom, European Union, while purified extracts from maca are not seen as traditional foods (Medsafe, 2006). The United States Pharmacopeia in 2009, conducted an evaluation to identify potential risks to health or other public health concerns related to the consumption of dietary ingredients extracted from maca with high mineral contents for their admission into the United States Pharmacopeia National Formulary (USP-NF) monograph development process (United States Pharmacopoeia, 2024). Ingredients/products evaluated during the USP-NF admission process were maca bulb, maca bulb powder and maca bulb dry extract. Example, hydroalcoholic extracts. However, it was reviewed that the use of traditional methods of processing e.g., hydroalcoholic extracts may have components that would not normally be ingested when maca is eaten raw or processed traditionally. The admission evaluation review was updated with relevant information in 2017, and of which suggested safety concerns. Currently, maca dietary ingredients comprise a wide range of ingredients including maca bulb gelatinized powder, and numerous types of maca bulb extracts having a specific group of bioactive compounds in maca which are, glucosinolates, macamides, numerous minerals and amino acids. There is special emphasis on the detailed description regarding the effects derived from numerous maca dietary ingredients (minerals) currently used in the global market as dietary supplement for feed formulations. This project could be used to update the current USP-NF admission evaluation report for maca.

Maca is not categorically recognized by many farmers in Nigeria, causing some level of ignorance to farmers. Synthetic drugs have serious side effects, drug residue development, and drug resistance development and are not always readily available. Therefore, increasing the interest of researchers to key into natural compounds from plants which are safer, environmentally friendly and more available. There are numerous extracts of maca that are biologically utilized by advanced nations as medications, so as to reduce synthetic drugs usage, as in antibiotics, laxatives, additives and other types of benefits from maca.

The aim of this research was to determine the mineral compositions present in the Maca bulb .(*Lepidum meyenii*) obtained from Kafanchan. This study may provide base line data on the minerals of Maca bulb collected from Kafanchan, Jema'a local government area, Kaduna state. It may be utilized by the public as a general enhancer or booster to reproductive system and modulator in poultry and other livestock production in Nigeria.

Materials and Methods

Study Area

This study was conducted in Kafanchan, Jema'a Local Government Area of Kaduna State, Nigeria.

Kafanchan is located between the longitude 8° 29°E and latitude 9° 59°N. It raining season's ranges between May to October months, while the dry season ranges between Novembers to April months. *(*Abaje, *et al.,* 2018*).*

Type of vegetation.

The town lies within the southern guinea savannah zone, consisting of forests and savannah lands and is located southwest of the Jos Plateau escarpment on the windward region. (Kaduna State. Everyone's Handbook, 1982)

Sourcing and Preparation of Maca Bulb

Mature maca bulbs were used for the experiment. The maca bulbs were obtained from Kafanchan and were taken to a professional botanist from A.B.U Zaria herbarium to further professionally identify the plant. The maca bulbs were washed with

distilled water, sliced into smaller flakes, shed dried and then grinded into powder. The dried flakes and powdered maca bulb were sealed in a polyethene bag and transported to National Research Institute for Chemical Technology [NARICT], Zaria, Kaduna State for both qualitative and quantitative mineral analysis.

Laboratory Methodology

Principles of Atomic Absorption Spectroscopy [AAS] and Inductively Coupled Plasma Mass Spectrometry [ICP-MS] was followed using the AAS machine, Model: AA 6800, Shimadzu Japan.

Sample Preparation

The maca powder was measured up to 1g and digested with 5 mL of nitric acid and 1 mL of hydrogen peroxide, heated at 100°C for 1 hour, cool and diluted with deionized water. It was aspirated to the nebulizer via nebulizer rubber to its burner. Then a flame photometer was also burned with the aspirated drop of digested samples to vaporize within the mobile phase of the Atomic Absorption Spectroscopy [AAS atomization]. On the process, a detector was also directly captured with the concentration in the vapour in ppm. As well as the beam of cathode lamp that also works with the detector. Then it proceeded to the system as it was saved to the monitor for the data and was inserted as sample name or client name for print out command.

The Inductively Coupled Plasma Mass Spectrometry (ICP-MS) Analysis:

The calibration of the ICP-MS instrument were ensured the right standards in operating the device.

The digested sample for magnesium, potassium, sodium, calcium, iron, copper, zinc, manganese, and nickel.

Atomic Absorption Spectroscopy (AAS) Analysis

The sample solution in the sample bottles were carefully analyzed for the concentration of the individual elements. Each element has a specific cathode discharge lamp and these lamps were used to determine a particular element. The discharged lamps emitted radiations at a wavelength specific for each element being analyzed. This specifically, were obtained only from a pure sample of the element that was excited electrically to produce an arc spectrum on that element.

Results and Discussion

The Laboratory Analysis results obtained revealed the presence of the following elements (minerals) along with its corresponding concentration from the maca bulb as shown in the table below.

Table 1: Mineral (Elemental) Composition and Concentration in Maca Bulb

S/NO	Parameters	Concentration (mg/kg)
1	Magnesium (Mg)	0.24
2	Potassium (K)	0.17
3	Sodium (Na)	0.12
4	Calcium (Ca)	0.14
5	Iron (Fe)	0.11
6	Copper (Cu)	0.13
7	Zinc (Zn)	0.14
8	Manganese (Mn)	0.13
9	Nikel (Ni)	0.13

From the results obtained, it indicates that the maca contains appreciable concentration of minerals.

Minerals are very vital in maintaining homeostasis. They are essential for the health and function of humans and animals

Copper (Cu) plays a vital role as an enzyme cofactor, which involved in antioxidant defense (e.g., superoxide dismutase), energy production, and connective tissue formation. It aids in iron absorption and hemoglobin synthesis. It is also essential for myelin formation and neurotransmitter synthesis and it is needed for melanin production. From this findings, the Cu content in the sample (0.13mg/Kg) was higher than the one reported by Zhang *et al*., 2020.

Sodium (Na) controls extracellular fluid volume and osmolality, it is essential for action potential propagation in neurons, it also works alongside potassium to maintain electrical gradients as well as helps regulate thirst and hydration. Na content in the sample (0.12mg/Kg) was a little bit higher (0.14mg/Kg) in comparison to the one reported by Zhang *et al*., 2020.

Nickel (Ni) acts as a cofactor for certain enzymes (e.g., urease in plants and bacteria), it may influence hormone activity and metabolism and emerging evidence suggests its roles in cellular signaling and immune response. Ni contents in the sample (0.13mg/Kg) was higher than the one found by Zhang *et al*., 2020 (0.0022mg/Kg).

Zinc (Zn) is essential for a number of physiological functions and plays a significant role in many enzyme actions in the living systems, involved in over 300 enzymatic reactions, including those for DNA synthesis, protein metabolism, and wound healing, supports T-cell function and immune response, Critical for cellular proliferation and differentiation, and it is important for fertility and hormone regulation. The value obtained (0.14) was lower in comparison to the one obtained by Zhang *et al*., 2020.

Magnesium (Mg) activates enzymes in energy production, DNA synthesis, and protein metabolism, regulates muscle contractions and relaxation, Supports nerve transmission and neuromuscular conduction and is essential for bone structure and calcium homeostasis. Mg content in the sample (0.24mg/Kg) was higher than the one found by Zhang *et al*., 2020 (1.05mg/Kg).

Potassium (K) maintains intracellular fluid volume and acid-base balance, crucial for action potential generation in nerve and muscle cells, regulates heart rhythm and reduces blood pressure and facilitates smooth and skeletal muscle function. The K content in the sample (0.24mg/Kg) was higher than the one found by Zhang *et al*., 2020 (1.05mg/Kg).

Calcium (Ca) provides structural integrity, required for skeletal, cardiac, and smooth muscle function, essential for activating clotting factors and acts as a second messenger in various cellular processes. The Ca content in the sample (0.14mg/Kg) was lower than the one found by Zhang et al., 2020 (1.8mg/Kg).

Iron (Fe) is a central component of hemoglobin and myoglobin, part of cytochromes in the electron transport chain, supports proliferation and differentiation of immune cells and involved in DNA synthesis and detoxification. The Fe content in the sample (0.11mg/Kg) was higher than the one found by Zhang *et al*., 2020 (0.045mg/Kg).

Manganese (Mn) is vital for cartilage and bone matrix development, supports antioxidant activity (e.g., manganese superoxide dismutase), amino acid metabolism, and

glucose regulation, plays a role in collagen formation and involved in the production of dopamine and glutamate. The Mn content in the sample (0.13mg/Kg) was higher than the one found by Zhang *et al*., 2020 (0.022mg/Kg).

In comparison of the current results with literature, the concentrations were higher except for Ca and Zinc, these differences might be attributed to the differences in the geographical location, soil contents, sample drying methods and laboratory procedures. The results suggest that the maca in Kafanchan is a rich source of essential minerals both macro and micro minerals.

Conclusion and Recommendations

Based on this study, Maca bulb is a very rich source of minerals generally. The methodology and procedures employed can also be adopted for mineral analysis as it clearly indicates higher values when compared to other reviewed literatures. Thus, it is recommended that:

1. A uniform and standardize drying and processing methods should be adopted to minimize variations (Wang *et al*., 2016).
2. Shade-dried processing of maca bulb prior to digestion maybe adopted for retention of high mineral concentration.
3. Conduct clinical trials to evaluate the health benefits of maca supplementation especially in animal production.
5. Explore the potential of maca as a natural remedy for mineral deficiencies
6. Investigate the impact of geographical and environmental factors on mineral composition.
7. Develop value-added products from maca, such as mineral-enriched supplements or functional foods.

References

Abaje, I.B., Achiobo, P.J. and Matazu, M.B. (2018). Spatio-Temporal Analysis of Rainfall Distribution in Kaduna State, Nigeria. Ghana Journal of Geography, 10 (1), 1-21

Angelo G., Drake V. J., Frei B. Efficacy of multivitamin/mineral supplementation to reduce chronic disease risk: a critical review of the evidence from observational studies and randomized controlled trials. Critical Reviews in Food Science and Nutrition.2014;55(14):1968–1991. doi:0.1080/10408398.2014.912199. [DOI] [PubMed] [Google Scholar] doi: 10.4028/www.scientific.net/amr.978.19. [DOIGoogle Scholar

Gonzales, G. F., and Alarcón-Yaquetto, D. E. (2018). "Maca, A nutraceutical from the andean highlands," in Therapeutic foods (Amsterdam, Netherlands: Elsevier), 373–395. doi:10.1016/B978-0-12-811517-6.00012-X

Han H. B Dong Q., Diao Y., Wei H. P., Li M. J. Determination of metal elements in MACA from, different areas by inductively coupled plasma-atomic emission spectrometry. Advanced Materials Research. 2014; 978:19–22. https://doi.org/10.1007/978-94-017-9511-1information. Dietary supplement admission evaluations. Maca. Available at: https://

Innova (2023). Innova markets insights. Available at: https://www. innovamarketinsights.com/ (Accessed September 20, 2023).

Kaduna State: Everyone's Handbook. Kano, Nigeria: Triumph Publishing Company Ltd. 1982. P. 29. ISBN 978-188-006-6.

Lim, T. K. (2015): Edible Medicinal and Non-medicinal Plants: Volume 7, Flowers. Springer

Medsafe (2006). Interim joint expert advisory committee on complementary medicine. Meeting 3 Available at: http://www.medsafe.govt.nz/Profs/class/classintro.asp.

N.R.C. National Research council .1994. Nutrient Requirement of Poultry. (9th rev. ed.). National Research Council National Academy Press, Washington, D.S., USA. online.uspdsc.com/uspdsc.

United States Pharmacopoeia (2024). Dietary supplements compendium. Supporting

Wang, S., and Zhu, F. (2019). Chemical composition and health effects of maca.

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