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Comparative Study of Nutritional Composition and Phytochemical Constituents of *Cortinarius* Species and *Moringa oleifera* Seed

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ABSTRACT

Plants and plant resources have become the focus of researchers in the developing countries because of the high cost of imported animal feed ingredients as sources of protein. In this study, the evaluation of the nutritional values and phytochemical composition of Moringa oleifera and Cortinarius species found in a Western State in Nigeria was carried out. Proximate analysis, mineral contents, phytonutrient composition and vitamin contents were carried out according to standard methods. In proximate analysis, protein and crude fat contents were significantly higher in M. oleifera than in the Cortinarius species while the values of moisture content, crude fibre, ash content and carbohydrate were significantly higher in Cortinarius species than in the Moringa oleifera. All values of phytonutrients detected were significantly higher in M. oleifera than in Cortinarius species. There were significantly higher values of calcium, potassium, phosphorus in M. oleifera than in Cortinarius species while the values of iron and zinc vice versa. The study indicates that both Moringa oleifera and Cortinarius species can be used as feed supplements. However, the combination of both Moringa oleifera and Cortinarius species as feed supplement may serve as source of balance diet.

Keywords: *Moringa oleifera*, *Cortinarius* species, Phytonutrients, Feed supplements, Monogastic

INTRODUCTION

The escalating cost of imported animal feed ingredients as sources of protein and energy is forcing many small scale farmers out of production. Researchers and farmers have great interest in finding natural growth promoters to enhance production and to reduce feed cost. The discovery of some of underutilized fruits, vegetables and other plants derivatives used as human food is constantly receiving the attention of scientists. As a result of this, emphasis was directed towards the evaluation of alternative and indigenous sources of protein and energy for animal feeds from high yielding and ecologically plants and seeds. In addition, a large amount of people live in poverty; they do not have an adequate food supply and this situation results in a high index of malnutrition and other nutritional disabilities. A possible measure to overcome the malnutrition problem faced by population would be the cultivation of natural sources utilized in some countries and underutilized, in others, which could provide valuable nutrients, available to a large extent of population. Plants contain phytonutrients and phytochemicals (such as saponins, tannins, oxalates, phytates, trypsin inhibitors and cyanogenic glycosides), which are referred to as secondary metabolites and these metabolites are applied in nutrition and as pharmacologically active agents [1]. Plants are also known to have high amounts of essential nutrients, vitamins, minerals, fat and fiber [2,3]. There were reports on the presence of certain bioactive chemicals in plants or herbs and mushroom which have nutritional and medicinal benefits [4,5]. *Cortinarius* is the largest genus of mushrooms in the world, containing over 2000 different species and found worldwide [6]. In Nigeria, mushrooms are highly priced, both as food and in traditional medicine [7] assuming greater importance in the diets of both rural and urban dwellers. Many health promoting substances e.g. antimicrobial, anticancer, antioxidant, cholesterol lowering property, immunostimulatory, antiviral, antiparasitic, antiinflammatory, antiproliferative, anti-malarial, anti-Alzheimer, anti-tumour, cytotoxic, antidiabetic, anticoagulant, hepato-protective compounds, among other effects have been documented for some species [8-12]. Mushrooms can be a good supplement to cereals [13,14] reported that mushrooms are appreciated for their good taste and nutritional value and are used in soups as meat (protein) supplement as well as seasoners. Moringa is one of the most useful tropical trees. The relative ease with which it propagates through both sexual and asexual means and its low demand for soil nutrients and water after being planted makes its production and management easy.

Moringa oleifera seeds have antimicrobial effects [15,16], used to remove turbidity from water [17] and good source of animal nutrients [2,18]. The seeds have good nutritional and therapeutic value [19]. The seeds are eaten roasted. Moringa *oleifera* has been said to be a good source of essential amino acids which are all contained in an appreciable quantities [20], and can serve as equally good source of amino acids for man and livestock [21]. *M. oleifera* can be used as feedstuff for cattle, goats and lambs [22].

Thus, this research is aimed at the comparative study of the effectiveness of *Cortinarius* species and *Moringa oleifera* seeds as nutritional supplement of man and animals.

MATERIALS AND METHODS

Samples collection

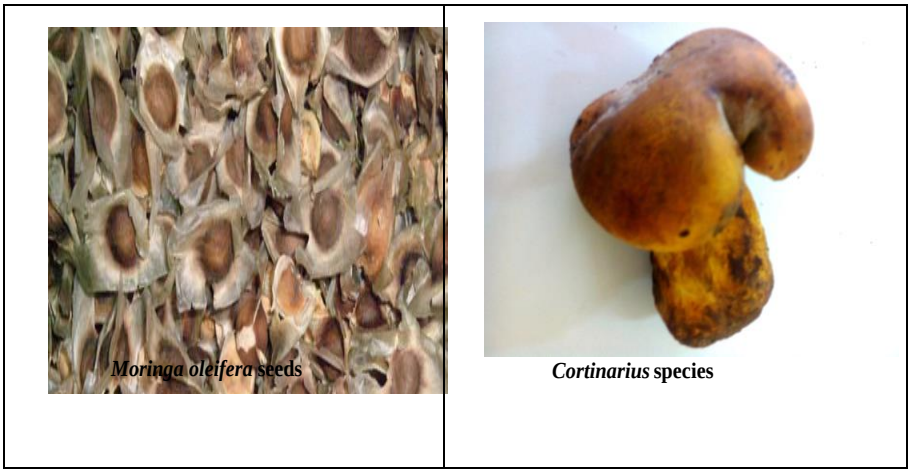
The mushrooms (*Cortinarius* species) used for this study were collected from a farmland in Moniya, Akinyele Local Government Area, Ibadan, Oyo State. *Moringa oleifera* seeds were collected from a private farm in Ibadan, Oyo State.

Preservation of samples

The mushroom samples were air dried for some days and stored in transparent polythene bags that are loosely tightened to allow for proper aeration and later pulverized and analyzed according to standard procedures. The *Moringa* seeds were dried under shade and were shelled by hand to obtain the Kernels. The kernels were ground in a coffee mill (National MX-J210PN) until a consistent powder was obtained.

Identification of samples

The mushroom samples were identified by Prof. S. G. Jonathan of Department of Botany, Faculty of Science, University of Ibadan, Nigeria.



***Moringa oleifera* and *Cortinarius* species**

Proximate analysis, mineral contents, anti-nutritional compositions and vitamin contents were carried out on *Moringa oleifera* seeds and *Cortinarius* species. Proximate analysis was carried out by the methods of the Association of Official Analytical Chemists [23]. Oxalate content was determined using the method [24]. Total tannins content was determined by spectrophotometric methods [25]. Total saponin content was determined using the spectrophotometric method [26]. Total phytate content was determined by a colorimetric procedure [27]. Total cyanogenic glycoside was assayed [28]. The extraction of alkaloids [29]. Vitamin contents were determined using the method of chemical analysis of food [30,31]. Each analysis was carried out in triplicate.

Statistical analysis

All assays were carried out in triplicate, and the means and standard error of means (SEM) were determined using SPSS version 20. Analysis of variance was performed to determine significant differences between the means. Differences in mean performance for each composition between the samples were tested by the Student's t-test <0.05 implies significance.

RESULTS

The result of the proximate analyzes of *Moringa oleifera* seed and *Cortinarius* species is shown in Table 1. They both contain moisture, protein, carbohydrate, fat, fiber and ash although in variable proportions. Protein and crude fat contents were significantly higher in the *Moringa oleifera* samples than the *Cortinarius* species samples while the values of moisture content, crude fibre, Ash content and carbohydrate were significantly higher in *Cortinarius* species samples than in the *Moringa oleifera* samples.

Table 1: Proximate analysis of *Moringa oleifera* seeds and *Cortinarius* species

Nutrients (%)	*Moringa oleifera* seeds	*Cortinarius* species
Moisture content	9.97 ± 0.09[a]	14.23 ± 0.15[b]
Protein	35.97 ± 0.19[a]	19.47 ± 0.11[b]
Crude fat	38.67 ± 0.03[a]	7.63 ± 0.11[b]
Ash	3.87 ± 0.09[a]	5.23 ± 0.11[b]
Crude fibre	2.87 ± 0.03[a]	6.80 ± 0.07[b]
Carbohydrate	8.67 ± 0.12[a]	48.60 ± 2.67[b]

Values are means (± SEM) of triplicate samples. Means with different superscripts in the same row show significant difference (P<0.05)

Table 2 shows the result of the phytochemical analyses. It shows that *Moringa oleifera* seeds and *Cortinarius* species contained tannins, phytates, saponins, oxalates and alkaloids. Cynogenic glycosides were only detected in *Cortinarius* species. However, all phytochemical parameters analyzed were significantly higher in *Moringa oleifera* samples than in the samples of *Cortinarius* species.

Table 2: Phytochemical composition of *Moringa oleifera* seeds and *Cortinarius* species

Phytochemical (mg/100 g)	*Moringa oleifera* seeds	*Cortinarius* species
Alkaloids	291.67 ± 33.33[a]	11.67 ± 2.04[b]
Cynogenic glycosides	0.00 ± 0.00[a]	0.23 ± 0.04[b]
Phytates	175.00 ± 0.00[a]	63.33 ± 0.04[b]
Tannins	131.67 ± 1.67[a]	33.33 ± 2.04[b]
Saponnins	33.33 ± 1.67[a]	21.67 ± 2.04[b]
Oxalates	110.00 ± 2.89[a]	16.67 ± 2.04[b]

Values are means (± SEM) of triplicate samples. Means with different superscripts in the same row show significant difference (P<0.05)

Analyzes of mineral composition is shown in Table 3. The values of calcium, potassium and phosphorus were significantly higher in *Moringa oleifera* samples than in *Cortinarius* species samples while that of magnesium is not significantly higher. Conversely, the values of iron and zinc were significantly higher in *Cortinarius* species samples than *Moringa oleifera* samples. The values of Ca/P, Ca/K and Ca/Mg were significantly higher in *Moringa oleifera* samples than in the samples of *Cortinarius* species.

Table 3: Mineral composition of *Moringa oleifera* seed and *Cortinarius* species

Minerals (mg/100 g)	*Moringa oleifera* seed	*Cortinarius* species
Iron	5.20 ± 0.15[a]	9.10 ± 0.07[b]
Zinc	0.05 ± 0.00[a]	0.57 ± 0.11[b]
Magnesium	45.00 ± 0.00[a]	35.00 ± 3.53[a]
Calcium	751.67 ± 4.41[a]	183.33 ± 5.4[b]
Potassium	75.00 ± 0.00[a]	42.33 ± 1.78[b]
Phosphorus	635.00 ± 8.66[a]	221.67 ± 5.43[b]
Ca/P	1.18 ± 0.02[a]	0.82 ± 0.02[b]
Ca/K	10.02 ± 0.06[a]	4.35 ± 0.23[b]
Ca/Mg	16.71 ± 0.10[a]	5.29 ± 0.31[b]

Values are means (± SEM) of triplicate samples. Means with different superscripts in the same row show significant difference (P<0.05)

Table 4 shows the vitamin compositions of *Moringa oleifera* and *Cortinarius* species. *Moringa oleifera* samples have significantly higher values in Ascorbic acid and non-significantly higher values in Niacin while *Cortinarius* species samples have non-significantly higher values in Riboflame and Thiamine.

Table 4: Vitamin composition of *Moringa* seed and *Cortinarius* species

Vitamin (mg/100 g)	*Moringa oleifera* seed	*Cortinarius* species
Ascorbic acid	4.50 ± 0.17[a]	2.23 ± 0.18[b]
Thiamine	0.05 ± 0.00[a]	0.07 ± 0.00[a]
Niacin	0.20 ± 0.00[a]	0.17 ± 0.02[a]
Riboflavin	0.06 ± 0.00[a]	0.08 ± 0.00[a]

Values are means (± SEM) of triplicate samples. Means with different superscripts in the same row show significant difference (P<0.05).

DISCUSSION

Generally, the results of the proximate analyses from this study showed that *Moringa* seeds and *Cortinarius* species contained valuable amounts of crude nutrients which are nutritional requirements of animals. Higher moisture content in *Cortinarius* species is an indication of its tendency to spoilage in comparison to *Moringa oleifera* seeds and so it will need greater preservative measures (extra cost) than *M. oleifera* seeds if used as animal feeds. *Moringa* seeds had higher protein content than *Cortinarius* species. This makes *Moringa oleifera* seed a good source of protein when compared with *Cortinarius* species. Higher fibre in *Cortinarius* species makes it more prone to prevention of colon cancers [32] as it aids in digestion by producing softer and bulkier stools. However, the results of the proximate compositions revealed that *Moringa oleifera* seeds and *Cortinarius* species may be used as a good source of balanced animal diets. The lower protein and crude fat contents in *Cortinarius* species will be balanced by higher protein and crude fat contents in *M. oleifera* seeds if they are combined as animal feeds. This is in agreement with the works [33-35] who reported that plants and macro-fungi (medicinal mushrooms) and their metabolites are beneficial in promoting health and immune response of chickens.

The results of the phytochemical compositions from this study revealed that *Cortinarius* species is likely to be a better animal food supplements than *M. oleifera* seeds because of the lower contents of phytochemicals which are not easily digested by non-ruminant (monogastric) animals. The cyanogenic glucoside levels observed in *M. oleifera* seeds and *Cortinarius* species, though higher in *Cortinarius* species, were much lower than those considered safe by European Commission (EC) regulations.

The analysis of the mineral compositions revealed that both *M. oleifera* and *Cortinarius* species have appreciable concentrations of calcium, magnesium, potassium and phosphorus while iron and zinc were in lower concentrations. However, *M. oleifera* seeds will serve as better source of these mineral elements than *Cortinarius* species. If the Ca/P is low (low calcium, high phosphorus) more than the normal amount of calcium may be lost in the urine thereby decreasing the calcium level in bones [36]. Food is considered 'good' if the ratio is above one and 'poor' if the ratio is less than 0.5 while Ca/P ratio above two helps to increase the absorption of calcium in the small intestine [37]. The Ca/P ratio observed in *M. oleifera* seeds is of better physiological benefit to animals than *Cortinarius* species and is particularly useful for children and the aged who need higher intakes of calcium and phosphorus for bone formation and maintenance [37].

The result of the vitamin compositions shows that if used in animals' feeds, thiamine, riboflavin and niacin are likely going to have similar effects on animals as components of vitamin B in *Moringa oleifera* and *Cortinarius* species while Ascorbic acid (vitamin C) in *Moringa oleifera* and *Cortinarius* species may have different effects on animals. The vitamins riboflavin, niacin, and thiamin play roles in the Krebs cycle which is responsible for the production of energy in the body. Thiamin is the coenzyme for all enzymatic decarboxylations of α-keto acids and has a vital role in nerve function and insulin biosynthesis. Riboflavin prevents beriberi and polyneuritis. It is essential to the utilization of carbohydrates, fat, and protein. Niacin prevents Pellagra [38].

CONCLUSION

This study indicates that both *Moringa oleifera* and *Cortinarius* species can be used as feed supplements. *Cortinarius* species is likely to be a better option as feed supplements in monogastric animals because of lower phytonutrient compositions. However, the combination of both *Moringa oleifera* and *Cortinarius* species as feed supplement may serve as source of balance diet.

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