Nutritional and Biochemical Compositions of Turmeric (*Curcuma longa Linn*) Rhizome powder – A Promising Animal Feed Additive

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Abstract
The investigations were carried out to determine the proximate, vitamins, minerals and phytochemical compositions of turmeric *(Curcuma longa*) rhizome powder. The results of the analyses indicated that the rhizome powder contains appreciable and high quantities of crude protein and carbohydrates of 10.07% and 66.76% respectively. It also possesses significant levels of ash (2.76%), crude fiber (4.87%), ether extract (6.64%) and moisture content (8.91%). The total ash content revealed that the powder contain the following minerals in mg/g: 1.67 Ca, 0.92 Mg, 1.29 K, 1.07 P, 0.73 S, and minute quantities of Cu, Se and Fe. Quantitative phytochemicals' screening showed the presence of the following in turmeric (mg/g): saponins, (1.36); tannin, (1.87) and flavanoid (0..68), steroid, (0.99) terpenoides (0.54); alkaloids, (10.04) cardiac glycosides, (14.61) and phytate (10.30). The outcome of vitamins analyses revealed that turmeric rhizome contains the following vitamins in mg/g of sample weight: vitamin A (3.44), vitamin B1 (0.09), vitamin B2 (1.20), vitamin B3 (0.32), vitamin C (0.84), vitamin D (0.64) and vitamin E (0.39).

Key words: Turmeric, nutritional, phytochemicals, proximate, vitamins, minerals, feed additive

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Introduction

Animal agriculturists and food scientists have continued to screen plants for the possibility of finding novel natural growth promoters that will enhance livestock performance and products' quality. Arora *et al.* (2013) reported that plants have been and will remain vital to mankind, animals as well as environment. Botanicals (plants) produce primary and secondary metabolites known as phytochemicals aside being used as food by humans and animals due to their nutritional importance. Balandrin *et al.* (1985) and Croteau *et al.* (2000) asserted that these phytochemicals encompass a wide array of functions, many of which have been exploited for their beneficial roles in diverse array of applications. Plant products have been used for centuries by humans as food and to treat ailments and also as feed additives for farm animals (Guo, 2003). Onibi and Osho (2007) specifically mentioned that *Hibiscus sabdariffa calyses,* a botanical specie contain potential antioxidant and antibacterial agents that are beneficial to broiler chickens. The most important bioactive constituents of plants are the secondary metabolites which include alkaloids, phenolic compounds, tannins, phytosterols and terpenoides (Arora *et al.,* 2013). Phytomedicine is becoming popular in both developing and developed countries owing to its natural origin and lesser side effects (Brahmachari, 2001). The science of phytonutrition and phytomedication are currently becoming popular in animal agriculture as means of improving livestock productivity and to meeting the needs of health conscious animal products' consumers. Onibi, *et al.* (2009) reported that abdominal fat was lowered when broiler chickens were fed diets containing garlic (*Allium sativum*). As the whole world is tending towards organic production, plants remain the richest and safest bio-reserve of feed supplements which, if fully explored will help to avert the problems of side effects associated with the frequent usage of synthetic medicine such as antibiotics. Hence the need to replace antibiotics with probiotics in livestock industry since what animal consume will influence the quality of its products and consequently, the wellbeing of the

consumers. Guo *et al.* (2003); Ogbe *et al.* (2008, 2009) and Osho *et al.* (2014) reported beneficial responses of chickens treated with herbs and mushrooms as feed or water supplements. Certain bioactive substances inherent in plants were also implicated for prophylactic and therapeutic benefits imposed on animals. It has also been established that plants' bioactive compounds have been variously used to enhance human health such as anticancer, antihypertension, antihypoglycemia, antioxidants, antimicrobial, antitumor, antiinflammatory, antihyperlipidemic and diabetes risk reduction (Arora, 1999; Bandyopadhyay *et al.*, 2004; Onibi and Osho, 2007; Surveswaran *et al.*, 2007; Polombo, 2009 and Hosseini-Vashan *et al.*, 2012). More so, botanical species have bioavailable nutrients such as carbohydrates, energy, protein, fibre, vitamins, minerals and lipids which are essential for the good growth and performance of livestock. Turmeric is a medicinal plant that is commonly used as a spice in human foods (Durrani *et al.,* 2006). It is a rhizomatous herbaceous plant, a member of the family zingibercaea (Rajesh *et al.,* 2013), it contains curcumin, demethoxycurcumin, bisdemethoxycurcumin and tetrahydrocurcuminoides as active constituents (Kiuchi *et al.,* 1999). Turmeric is native to Asian sub-continent and is known to possess antiinflammatory, antifungal, antiviral, antimicrobial, antimutagenic, immunomodulatory and antioxidative (free radical scavenging) properties (Osawa *et al.,* 1995; Anthony *et al.,* 1999; Raghdad, 2011 and Rajesh *et al.,* 2013). The objective of the current study is therefore to determine the proximate, minerals, vitamins and phytochemical constituents of turmeric.

Materials and Methods

Preparation of turmeric rhizome powder

Fresh turmeric rhizomes were procured from a local market in Owo, Ondo State, Nigeria. These rhizomes were carefully sliced into thin flakes to enhance air drying within five days, followed by grinding into powder. The turmeric powder was tightly packaged in a polythene bag and kept at room temperature until required. Standard methods were used for the determination of proximate composition and phytochemicals of turmeric rhizome powder. Mineral and vitamin contents of these samples were also determined.

Proximate analysis

Methods of the Association of Official Analytical Chemists (AOAC, 2000) were used for the determination of crude protein, moisture, crude fibre, and fat contents of the samples. All analyses were duplicated. The proximate values were reported in percentage. Determination of ash content was done by ashing at 550 °C for 3hours. The Kjeldah method (AOAC, 2000) was used to determine the crude protein contents by multiplication of the nitrogen value with a conversion factor (6.25). The crude fibre content of the samples was determined by digestion method and the lipid content was determined by Soxhlet extraction method (AOAC, 2000). Total soluble carbohydrate was determined by the difference of the sum of all the proximate compositions from 100%.

Mineral analysis

Mineral contents of turmeric rhizome powder: Ca, Mg, K, Na, Fe, Zn, Mn and Cu were determined using the atomic absorption spectrophotometer (AAS-Buck 205), as described by the methods of the Association of Official Analytical Chemists (AOAC, 1990). Phosphorus was determined calorimetrically as described by AOAC, 1990. The values of calcium, magnesium and potassium were reported in percentage while sodium, iron, zinc, phosphorus, manganese and copper were reported in parts per million (ppm).

Determination of phytochemicals

Alkaloids and sterol were determined by the method described by Haborne (1998). Saponin was determined by the method described by AOAC (2000). Flavonoid and phytate were determined by the method described by Haborne (1998). Phenol and Tannins were determined by the method described by Person (1976) and Ipeama *et al.* (2014)

Determination of vitamins

Vitamins A, D and E were determined using methods described by Pearson (1976), vitamin C was analysed as described by Benderitter *et al.* (1998) and vitamins B1 and B3 were determined using methods described by Okwu and Josiah (2006).

Results and discussion

Proximate and mineral compositions of turmeric rhizome powder (TRP)

Table1 contains the proximate and mineral compositions of turmeric rhizome powder which revealed that it has appreciable amounts of crude protein (10.07%), ash (2.76%), crude fibre (4.87%), ether extract (6.64%) and nitrogen free extract (66.76%). It also contains the following minerals (ppm): Ca (1.67), Mg (0.92), K (1.29), P (1.07), S (0.73), Cu (0.04), Se (0.04) and Fe (0.06). The results of the present study on the proximate composition of turmeric are in agreement with those reported by Ikpeama *et al.* (2014) who reported that turmeric contains 9.40 % crude protein, 67.38 % carbohydrate, 8.92% moisture, 2.85% ash, 4.60 % crude fibre and 6.85 % fat. Turmeric rhizome in this study was also shown (Table 3) to contain 0.89 % thiamine, 0.16 % riboflavin and 2.30 % niacin. Which implies that constant feeding on turmeric could be important in sustaining strong bone, muscle contraction and relaxation, blood clothing, reduce blood pressure, and help in haemoglobin formation based on the presence of essential nutrients and minerals (Latunde - dada, 1980; Kubmarawa *et al.*, 2007 and Ikpeama *et al.*, 2014). The presence of essential nutrients and minerals in TRP imply it could be utilized to improve growth performance and health status of poultry. Selenium, vitamins C and E have been found to have antioxidative potentials which by implication may improve performance and product quality of livestock.

Phytochemicals compositions of turmeric rhizome powder (TRP).

Table 2 showed the qualitative and quantitative phytochemicals constituents of TRP. The results revealed that quantitatively TRP contains saponins (1.36), tannins (1.87), flavanoids (0.68), steroid (0.99), terpenoides (0.54), cardiac glycosides (14.61), phytate (10.30) and alkaloid (10.04%) in mg/g. Phytate is an organically bound form of phosphorus in plants. Phytates in feed stuff are known to bind with essential minerals such as calcium, iron, magnesium and zinc in the digestive tract, resulting in their unavailability, they bind minerals to form insoluble salts, thereby decreasing their bioavailability or absorption by the animals (Thompson, 1993; Guil and Isasa, 1997 and Muhammad *et al.*, 2011). Tannins are plant polyphenols, which have ability to form complexes with metal ions and with macro-molecules such as proteins and polysaccharides (De-Bruyne *et al.*, 1999; Dei *et a*l., 2007). Dietary tannins were reported to reduce feed efficiency and weight gain in chicks (Armstrong *et al.*, 1974; Dei *et al.*, 2007). Saponins are glycosides, which include steroid, saponins and triterpenoid saponins (Dei *et al.*, 2007). High levels of saponins in feed affect feed intake and growth rate in poultry (Sim *et al.*, 1984; Potter *et al.*, 1993; Dei *et al.*, 2007). Reduction in feed intake has been ascribed to the bitter taste of saponins (Cheeke, 1971) and due to its irritating taste (Oleszek *et al.*, 1994). Excess saponins, can cause hypocholestrolaemia because it binds cholesterol making it unavailable for absorption (Soetan and Oyewole, 2009, Ogbe and Affiku, 2013). Saponins also have haemolytic activity against red blood cells (Khalil and Eladawy, 1994). Saponin-protein complex formation had been reported to reduce protein digestibility (Potter *et al.*, 1993 and Shimoyamada *et al.*, 1998). However, the levels of these phytochemicals detected in TRP were low and have been found tolerable to livestock at moderate inclusion levels. Phytochemicals in tolerable levels have been found to have positive health implications on livestock and humans. Certain bioactive compounds (like saponins, tannins and other phytochemicals), which are known as secondary metabolites in plants are said to have pharmacologically active agents (Soetan and Oyewole, 2009). They also possess antibacterial and anti-parasitic properties.

Table 1: Proximate and mineral compositions of turmeric rhizome powder

Parameters	Content (%)
Proximate composition	
Moisture content	8.91
Protein	10.07
Ash	2.76
Crude fibre	4.87
Ether extract	6.64
Nitrogen free extract	66.76
Mineral composition	**Content (ppm)**
Calcium	1.67
Magnesium	0.92
Potassium	1.29
Phosphorus	1.07
Sulphur	0.73
Copper	0.04
Selenium	0.04
Iron	0.06

Table 2: Phytochemical compositions (qualitative and quantitative) of turmeric rhizome powder .

Phytochemicals	TRP
Qualitative	
Saponins	+
Tannin	+
Flavanoid	+
Steroid	+
Terpenoides	+
Alkaloid	+
Cardiac glycosides	+
Phlobatannin	-
Anthraquinone	-
Quantitative	
Saponins (mg/g)	1.36
Tannin (mg/g)	1.87
Flavanoid (mg/g)	0.68
Steroid (mg/g)	0.99
Terpenoides (mg/g)	0.54
Alkaloid (%)	10.04
Cardiacglycosides (mg/g)	14.61
Phytate (mg/g)	10.30

Table 3: Vitamins composition of turmeric rhizome powder

Vitamins	mg/g
Vitamin A	3.44
Vitamin B1	0.89
Vitamin B2	1.20
Vitamin B3	0.32
Vitamin C	0.84
Vitamin D	0.64
Vitamin E	0.39

Conclusion

The results obtained from the analysis of turmeric rhizome powder indicated that it contained appreciable quantities of nutrients, minerals and vitamins that can enhance livestock performance. It also contained phytochemicals at moderate levels which could be of pharmacological importance to animals and humans.

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