African Journal of Agriculture and Food Science
ISSN: 2689-5331
Volume 8, Issue 2, 2025 (pp. 1-8)
www.abjournals.org

CHARACTERIZATION OF TURMERIC AND WEST AFRICAN BLACK PEPPER AS POTENTIAL LIVESTOCK FEED ADDITIVES

Running Title: Phytochemicals: Turmeric and West African Black Pepper

A. B. Ogunjesa[1*] and O. F. Alamuoye[2]

[1]Federal University Oye Ekiti, Ekiti State, Nigeria.

[2]Ekiti State University Ado-Ekiti, Ekiti State, Nigeria.

[*]Corresponding Author's Email: atinuke.awe@fuoye.edu.ng

Cite this article:

Ogunjesa, A. B., Alamuoye, O. F. (2025), Characterization of Turmeric and West African Black Pepper as Potential Livestock Feed Additives. African Journal of Agriculture and Food Science 8(2), 1-8. DOI: 10.52589/AJAFS-HFZVTHX1

Manuscript History

Received: 27 Feb 2025

Accepted: 9 Apr 2025

Published: 25 Apr 2025

ABSTRACT: *Phytochemicals, derived from plants such as turmeric and West African black pepper (WABP), have drawn attention as natural feed additives in animal nutrition. These bioactive compounds possess anti-oxidant, anti-inflammatory and antimicrobial properties. However, their concentration in these plants vary across geographical locations, hence the need for location-specific characterization which would produce more accurate applications in livestock feeding. This study was therefore aimed at determining the proximate and phytochemical compositions of turmeric rhizomes and WABP seeds cultivated in Southwestern Nigeria. These rhizomes and seeds were separately cleaned of debris, solar dried and pulverized, after which each sample was subjected to laboratory analysis for proximate and phytochemical compositions using the AOAC (2005) and phytochemical screening methods respectively. Results showed that turmeric rhizomes contained 14.63±0.27% moisture, 9.35±0.35% ash, 5.16±0.00% crude fat, 13.70±0.35% crude fibre, 5.95±0.25% crude protein and 51.22±0.02% carbohydrate. It also contained 30.48±0.08mg/g flavonoids, 68.76±0.49mg/g alkaloids, 57.70±0.42mg/g phenols, 12.12±0.18mg/g tannins, 16.12±0.04 mg/g saponins and 4.08±0.03mg/g curcumin. West African black pepper seeds also contained 11.82±0.25% moisture, 5.21±1.32% ash, 9.19±2.69% crude fat, 9.88±0.20% crude fibre, 9.88±0.62% crude protein and 54.03±1.54% carbohydrate. Its phytochemical contents were 57.70±0.42mg/g flavonoids, 12.12±0.18mg/g alkaloids, 6.53±0.42 mg/g phenols, 68.76±0.49mg/g tannins, 30.48±0.08mg/g saponins and 9.58±0.21mg/g piperine. The results of this study give background information on the constituents of Nigerian-grown turmeric and WABP, thus supporting quality control studies for the establishment of effective and safe doses of Curcuma longa and Piper guineense for inclusion in livestock diet.*

KEYWORDS: Phytochemicals, turmeric, West African black pepper.

Article DOI: 10.52589/AJAFS-HFZVTHX1
DOI URL: https://doi.org/10.52589/AJAFS-HFZVTHX1

African Journal of Agriculture and Food Science
ISSN: 2689-5331
Volume 8, Issue 2, 2025 (pp. 1-8)
www.abjournals.org

INTRODUCTION

The animal feed industry in Nigeria faces challenges in ensuring sustainable and safe production, one of which is the use of synthetic supplements which have harmful effects on animal organs and ultimately compromise animal health. Phytochemical-rich feed additives offer a promising alternative to synthetic supplements. Turmeric (*Curcuma longa*) and West African black pepper (*Piper guineense*) are widely cultivated in Nigeria and they possess bioactive compounds with potential benefits for animal health and productivity (Ikpeama *et al*., 2014; Oluwafemi *et al.*, 2022; Osasemeaga *et al.,* 2022; Adu, 2023).

Various studies involving the uses of turmeric rhizomes and WABP seeds have shown that they can be used in livestock feeding and are non-toxic to them (Abou-Elkhair *et al.,* 2014; Okanlawon *et al.*, 2016; El-Houseiny *et al*., 2019; Ashayerizadeh *et al.*, 2023; Ohiagu *et al.,* 2024; Uhegbu *et al.*, 2015; Oyinloye *et al.,* 2017; Adu, 2023).

Turmeric contains curcumin, a potent antioxidant and anti-inflammatory agent, while West African black pepper (WABP), also known as Uziza in Igbo and Iyere in Yoruba, contains piperine, a bioavailability enhancer. These phytochemicals can improve nutrient utilization, immune function, and disease resistance in livestock. West African black pepper in particular has demonstrated the ability to enhance nutrient absorption and bioavailability in animals, contributing to improved growth and feed conversion efficiency. It has also been reported that nutrient profile of plants vary across geographical zones due to differences in soil and climate (Attah *et al.,* 2012; Faucon *et al.,* 2017; Osasemeaga *et al.,* 2022; Adu, 2023; Iweala *et al.,* 2023).

This study therefore aimed to characterize the phytochemical and proximate composition of turmeric and black pepper cultivated in Southwestern Nigeria. The findings will provide valuable information for formulating phytochemical-rich animal feed using turmeric and WABP with known composition based on harvest location, thereby enhancing sustainable livestock production, and promoting food security.

MATERIALS AND METHODS

Sourcing and Processing Rhizomes of *Curcuma longa* and Dried Seeds of *Piper guineense*

Fresh, mature rhizomes of *Curcuma longa* and fresh seeds of *Piper guineense* were sourced from Oja Bisi market at Ado Ekiti, Ekiti State and identified by Mr. F.O. Omotayo (a taxonomist) at the Herbarium and Botanical Garden Section of the department of Plant Science and Biotechnology, Faculty of Science, Ekiti State University, Ado-Ekiti, Ekiti State, Nigeria. Turmeric and West African black pepper keys were 2025012 and 2025013 respectively.

Both rhizomes and seeds were sorted separately for the removal of dirt and damaged rhizomes. Thereafter, the whole rhizomes were washed in clean, cool water and patted dry with a paper towel for removal of excess moisture. These rhizomes were then placed in boiling water for 15 minutes and solar dried at an average temperature of 36.5±1.48^{o}C for 10 days. The dried rhizomes were then pulverized in an Orange Nutra Blend Pro 3 Blender (Harsh Enterprises, India) and subjected to laboratory analyses.

The fresh West African black pepper seeds were rinsed in cool, clean water and sun-dried on a wire mesh overlaid with a net having 1-2 mm holes per square inch to prevent the seeds from falling through. The seeds were then covered with dark-coloured polythene for 15 days at an average

Article DOI: 10.52589/AJAFS-HFZVTHX1
DOI URL: https://doi.org/10.52589/AJAFS-HFZVTHX1

temperature of 36.5±1.48ºC. The dried seeds were then pulverized using an Orange Nutra Blend Pro 3 Blender (Harsh Enterprises, India) and the powder was stored in a dark glass jar. The phytochemical composition was determined following standard procedure according to AOAC (2005).

Figure 1: Fresh *Curcuma longa* rhizomes

Figure 2: Fresh *Piper guineense* seeds

Laboratory Analyses for Determination of Phytochemicals of Pulverised *Curcuma longa* Rhizomes and *Piper guineense* Seeds

Determination of Flavonoids and Alkaloids

Flavonoids and alkaloids were determined following the method described by Harbone (1973).

Determination of Total Phenols

Total phenols were determined using the Folin-Ciocalteu method as described by Singleton *et al*. (1999).

Determination of Tannins

The total tannin content was assessed by the standard protocol of Keerthana *et al.* (2013).

Determination of Saponin

The saponin content was determined using the spectrophotometric method described by Brunner (1984).

Determination of Curcumin

About 1 g of the powdered sample was accurately weighed and transferred into a small beaker or test tube. About 10 mL of ethanol or methanol was added to the sample and the mixture was stirred thoroughly and made to stand for 30 minutes. The mixture was filtered using filter paper to remove solid particles, collecting the filtrate in a clean test tube. A series of dilutions of the curcumin standard was then prepared in ethanol or methanol to obtain concentrations in the range expected for the sample. Absorbance values of the standard solutions were measured at the characteristic wavelength of curcumin, typically around 420 nm, using the Spectrum Lab 70 spectrophotometer.

Article DOI: 10.52589/AJAFS-HFZVTHX1
DOI URL: https://doi.org/10.52589/AJAFS-HFZVTHX1

Determination of Piperine

Piperine was determined using the method described by Subramanian *et al.* (1998).

Proximate Analyses of Pulverised *Curcuma longa* Rhizomes and *Piper guineense* Seeds

Dry matter, ash, crude protein, crude fat, crude fibre and total carbohydrates were determined as described by AOAC (2005).

RESULTS AND DISCUSSION

The phytochemical composition of *Curcuma longa* rhizomes and *Piper guineense* seeds are shown in Table 1.

Curcuma longa rhizome powder contains 30.48±0.08mg/g flavonoids, 68.76±0.49mg/g alkaloids, 57.70±0.42mg/g phenols, 12.12±0.18mg/g tannins, 16.12±0.04 mg/g saponins and 4.08±0.03mg/g curcumin. *Piper guineense* seed powder contains 57.70±0.42mg/g flavonoids, 12.12±0.18mg/g alkaloids, 6.53±0.42 mg/g phenols, 68.76±0.49mg/g tannins, 30.48±0.08mg/g saponins and 9.58±0.21mg/g piperine. Oluwafemi *et al.* (2022) also reported the presence of flavonoids, alkaloids, tannins and saponins.

Flavonoids possess antioxidant, anti-inflammatory, and antimicrobial properties which can enhance animal health and performance. Alkaloids have potential bioactive properties which at high levels can be toxic. The high alkaloid content in this sample may require careful consideration when using it in animal feed. Phenols, though a broad class of compounds possess antioxidant properties that can help protect animals from oxidative stress.

Tannins are polyphenolic compounds that can bind to proteins and reduce nutrient availability, thus inhibiting the growth of microorganisms (Prasad *et al.,* 2008). They could however be detrimental to animal health at high levels. Saponins have potential health benefits, including antioxidant and anti-inflammatory effects but they can cause gastrointestinal upset in animals when included in diet at high levels.

Curcumin, categorized under curcuminoids, is the major bioactive compound in turmeric with potent antioxidant and anti-inflammatory properties (Iweala *et al.,* 2023). The higher its concentration in the rhizome, the more therapeutic it is.

Piperine, a major constituent in *Piper nigrum*, has been reported in humans to increase the absorption of curcumin in the body by as much as 2000% (Gupta *et al.,* 2013). It reduces the damage caused by free radicals and may help to regulate the immune system (Kumar & Singhal, 2017). Since *Piper guineense* has been reported to compete favourably with *Piper nigrum* in terms of phytochemical composition, it may therefore be a common substitute for *Piper nigrum* (which is native to India) in Nigerian livestock feed production (Pruthi, 1993; Oyemitan, 2017; Sen *et al.,* 2019). The presence of these constituents are indicators that animal health and performance can be improved by the inclusion of these plants in animal feed.

Article DOI: 10.52589/AJAFS-HFZVTHX1
DOI URL: https://doi.org/10.52589/AJAFS-HFZVTHX1

Table 1: Phytochemical composition of *Curcuma longa* rhizome powder and *Piper guineense* seed powder

SUBSTANCE	PHYTOCHEMICALS (mg/g)						
	FLAVONOIDS	ALKALOIDS	PHENOLS	TANNINS	SAPONINS	CURCUMIN	PIPERINE
Curcuma longa	30.48±0.08	68.76±0.49	57.70±0.42	12.12±0.18	16.12±0.04	4.08±0.03	--------
Piper guineense	57.70±0.42	12.12±0.18	6.53±0.42	68.76±0.49	30.48±0.08	----------	9.58±0.21

Table 2 shows the proximate composition of *Curcuma longa* rhizomes and *Piper guineense* seeds. *Curcuma longa* contains 14.63±0.27% moisture, 9.35±0.35% ash, 5.16±0.00% crude fat, 13.70±0.35% crude fibre, 5.95±0.25% crude protein and 51.22±0.02% carbohydrate, while *Piper guineense* has 11.82±0.25% moisture, 5.21±1.32% ash, 9.19±2.69% crude fat, 9.88±0.20% crude fibre, 9.88±0.62% crude protein and 54.03±1.54% carbohydrate.

Table 2: **Proximate composition of *Curcuma longa* rhizome powder and *Piper guineense* seed powder**

SUBSTANCE	COMPONENTS					
	MOISTURE (%)	ASH (%)	CRUDE FAT (%)	CRUDE FIBRE (%)	Crude Protein (%)	Carbohydrate (%)
Curcuma longa	14.63±0.27	9.35±0.35	5.16±0.00	13.70±0.35	5.95±0.25	51.22±0.02
Piper guineense	11.82±0.25	5.21±1.32	9.19±2.69	9.88±0.20	9.88±0.62	54.03±1.54

Curcuma longa rhizomes, when dried, have high dry matter content that make them likely suitable for storage and processing (Adeyeye *et al.*, 2022). They also contain moderate levels of crude protein and crude fibre. This suggests that they may be useful as protein supplements in animal diet and that they may support their digestive health (Jha *et al.*, 2019). The low crude fat and relatively high carbohydrate contents indicate that they contain starch-rich carbohydrates and are less fatty (Ekanayake *et al.*, 2024).

The high dry matter content of *Piper guineense* seeds indicates that they may be suitable for storage and processing while their moderate crude protein content suggests that they may be useful as supplements to animal diets, particularly for poultry and swine. The relatively high crude fat and carbohydrate contents show that they may contribute to the energy value of the seeds and their palatability for animals. They also contain moderate crude fibre which may support the digestive health in animals (Yahaya & Muhammed, 2021).

CONCLUSION

The phytochemical and proximate compositions of turmeric rhizomes and West African black pepper seeds suggest that they may be valuable ingredients in animal feed in Nigeria. Both plant parts are rich in phytochemicals which may provide antimicrobial and antifungal benefits to animals, let alone their antioxidant and anti-inflammatory effects and promotion of cardiovascular and digestive health. These should be explored as a means of eliminating the use of synthesized drugs in animal production.

Article DOI: 10.52589/AJAFS-HFZVTHX1
DOI URL: https://doi.org/10.52589/AJAFS-HFZVTHX1

However, further research is necessary to determine their optimal inclusion levels in animal feed, as well as their potential interactions with other feed ingredients. Studies on the safety and efficacy of turmeric rhizomes and black pepper seeds as feed supplements in Nigerian animal production systems are necessary.

REFERENCES

ABOU-Elkhair, R., Ahmed, H. A. and Selim, S. (2014). Effects of black pepper (*Piper nigrum*), turmeric powder (*Curcuma longa*) and coriander seeds (*Coriandrum sativum*) and their combinations as feed additives on growth performance, carcass traits, some blood parameters and humoral immune response of broiler chickens. *Asian-Australasian Journal of Animal Sciences*, 27(6): 847–854.

Adeyeye, S., Ashaolu, T.J. & Babu, A.S., (2022). Food Drying: A Review. *Agricultural Reviews*. 10.18805/ag.R-2537.

Adu, O.A., (2023). Varying Inclusions of *Piper guineense*, *Aframomum melegueta* and their Composite in the Diets of Broiler Chickens: Effects on Growth and Antioxidative Status. *Asian Journal of Research in Animal and Veterinary Sciences.* 6(2):106–114.

Ashayerizadeh, O., Dastar, B., Shams Shargh, M., A. Soumeh, E. and Jazi, V. (2023). Effects of black pepper and turmeric powder on growth performance, gut health, meat quality, and fatty acid profile of Japanese quail. *Frontiers in Physiology*, 14: 1218850.

Association of Official Analytical Chemists (AOAC). (2005). Official methods of analysis (18th ed.). Gaithersburg, MD: AOAC International.

Attah, A.F., O'Brien, M., Koehbach, J., Sonibare, M.A., Moody, J.O., Smith, T.J., Gruber, C.W., (2012). Uterine contractility of plants used to facilitate childbirth in Nigerian ethnomedicine. *Journal of Ethnopharmacology*. 143(1): 377–382.

Bhattacharya, V., Alagusundaram, M., Mandal, S., Siva, R., Karodi, R., Jilani, A. K., Nigam, A. K., & Parab, V. A. V. (2023). Phytochemical Analysis of Curcumin from the rhizome of Curcuma Longa. *Tuijin Jishu/Journal of Propulsion Technology*, 44(6). https://doi.org/10.52783/tjjpt.v44.i6.3880

Brunner, J.H., (1984). Direct spectrophotometer determination of saponin. Analytical Chemistry 34:1314–1326.

Chainani-Wu, N. (2003). Safety and anti-inflammatory activity of curcumin: a component of turmeric (*Curcuma longa*). *Journal of Alternative and Complement medicine* 9: 161–168.

Ekanayake, E. M. A. C., Ishii, R., Nagata, R., Shimada, K. -i., Han, K. -H., & Fukushima, M. (2024). Dose-Dependent Effects of Turmeric (*Curcuma aromatica* S.) Starch on Colonic Fermentation in Rats. *Metabolites*, *14*(11), 572. https://doi.org/10.3390/metabo14110572

EL-Houseiny, W., Khalil, A. A., Abd-Elhakim, Y. M. and Badr, H. A. (2019). The potential role of turmeric and black pepper powder diet supplements in reversing cadmium-induced growth retardation, ATP depletion, hepatorenal damage, and testicular toxicity in *Clarias gariepinus. Aquaculture*, 510: 109–121.

Faucon, M.P., Houben, D., Lambers, H., (2017). Plant functional traits: Soil and Ecosystem Services. *Trends Plant Sci.* 20, 385–394.

Gupta, S. C., Patchva, S., & Aggarwal, B. B. (2013). Therapeutic roles of curcumin: lessons learned from clinical trials. *The AAPS journal*, *15*(1), 195–218. https://doi.org/10.1208/s12248-012-9432-8

Harborne, J.B., (1973). Methods of plant analysis. In: Phytochemical Methods. Chapman and Hall, London

Article DOI: 10.52589/AJAFS-HFZVTHX1
DOI URL: https://doi.org/10.52589/AJAFS-HFZVTHX1

Hasegewa, T., Nakatani, K., Fujihara, T., Yamada, H., (2015). Aroma of turmeric: Dependence on combination of group of several odour constituents" *Natural Products Communication* 10(6): 1047–1050.

Ikpeama, A., Onwuka, G.I., and Nwankwo, C., (2014). Nutritional Composition of Tumeric (Curcuma longa) and its Antimicrobial Properties. *International Journal of Scientific & Engineering Research*, 5 (10): 1085–1089.

Iweala, E. J., Uche, M. E., Dike, E. D., Etumnu, L. R., Dokunmu, T. M., Oluwapelumi, A. E., Okoro, B. C., Dania, O. E., Adebayo, A. H., & Ugbogu, E. A. (2023). Curcuma longa (Turmeric): Ethnomedicinal uses, phytochemistry, pharmacological activities and toxicity profiles—A review. Pharmacological Research - *Modern Chinese Medicine*, 6, 100222. https://doi.org/10.1016/j.prmcm.2023.100222

Jha, R., Fouhse, J.M., Tiwari, U.P., Li, L. and Willing, B.P., (2019) Dietary Fiber and Intestinal Health of Monogastric Animals. *Front. Vet. Sci.* 6:48. doi: 10.3389/fvets.2019.00048

Keerthana, G., Kalaivani, M. K. and Sumathy, A. (2013). In-Vitro Alpha Amylase Inhibitory and Anti-Oxidant Activities of Ethanolic Leaf Extract of Croton bonplandianum. *Asian Journal of Pharmaceutical and Clinical Research*: 32–36.

Kumar, S., & Singhal, S. (2017). Piper nigrum (Black Pepper) Extract Exhibits Antioxidant and Anti-Inflammatory Activities. *Journal of Dietary Supplements*, 14(3), 257–267.

OHIAGU, C. J., ACHI, N. K., OHAERI, O. C. and OSUJI, C. A. (2024). Phytochemical composition and toxicological profiling of *Curcuma longa* (Turmeric) root extract in rats. *International Journal of Biochemistry Research and Review*, 33(1): 1–12.

OKANLAWON, E. O., BELLO, K. O., AKINOLA, O. S. and OLUWATOSIN, O. O. (2016). Growth performance and economic benefits of male and female rabbits fed diets supplemented with turmeric (*Curcuma longa*) powder. Pages 452–455. *In: Proceedings of the 41st Conference of the Nigerian Society for Animal Production*, 20 – 24 March 2016, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria.

Oluwafemi, A. G., Ajayi, O.B. and Oseni, O.A., (2022). "Phytochemical screening, nutritional composition, and antioxidant activities of turmeric (*Curcuma longa*) found in Ado-Ekiti, Nigeria". *Journal of Applied Life Sciences International* 25 (1):1-8. https://doi.org/10.9734/jalsi/2022/v25i130278.

Osasemeaga, O. A, AND Ohioghie A. M., (2022). Effects of *Piper guineense* (African Black Pepper) Seeds on Lipid Profile, Renal Function Parameters, and Antioxidant Status of *Cavia porcellus*. *Medical Laboratory Journal.* 16(5): 3-8 DOI: 10.29252/mlj.16.5.3

Oyemitan, I., (2017). African medicinal spices of genus *Piper*. In *Medicinal Spices and Vegetables from Africa*; Elsevier: Amsterdam, The Netherlands; pp. 581–597

Oyinloye, B.E., Osunsanmi, F.O., Ajiboye, B.O., Ojo, O.A., Kappo, A.P., (2017). Modulatory effect of methanol extract of *Piper guineense* in CCl4-induced hepatotoxicity in male rats. *International Journal of Environmental Research and Public Health*;14(9):955. https://doi.org/10.3390/ijerph14090955

Prasad, N.R., Viswanathan, S., Devi, J.R., Nayak, V., Swetha, V.C., Archana, B.R., Parathasarathy, N., Rajkumar, J., (2008). Preliminary phytochemical screening and antimicrobial activity of *Samanea saman*. *Journal of Medicinal Plants Research* 2(10):268–270.

Sen, S., Dayanandan, S., Davis, T., Ganesan, R., Jagadish, M., Mathew, P., Ravikanth, G., (2019). Origin and evolution of the genus Piper in Peninsular India. *Mol. Phylogen. Evol. 138*, 102–113.

Singleton, V.L., Orthofer, R., and Lamuela-Raventos, R.M., (1999). Analysis of total phenols and other oxidation substrates and antioxidants by means of folin-ciocalteu reagent, methods in Enzymology. Academic press. 299: 152–178. doi.org/10.1016/S0076-6879(99)99017-1

Article DOI: 10.52589/AJAFS-HFZVTHX1
DOI URL: https://doi.org/10.52589/AJAFS-HFZVTHX1

Subramanian, R., Subbramaniyan, P, Ameen, J.N., and Raj, V. (2016). Double bypasses Soxhlet apparatus for extraction of piperine from *Piper nigrum*, *Arabian Journal of Chemistry* 9(1): S537-S540 https://doi.org/10.1016/j.arabjc.2011.06.022

Uhegbu F.O., Imo, C., Ugbogu, A.E., (2015). Some biochemical changes in serum of female albino rats administered aqueous extract of *Piper guineense* Schumach Seeds. *International Journal of Biochemistry Research and Reviews*; 8(1):1–7.

Yahaya, U.S. and Muhammed, N., (2021). Effect of black pepper (*piper nigrum*) on growth parameters of broilers. *NIGERIAN SOCIETY FOR ANIMAL PRODUCTION (NSAP) 46TH ANNUAL CONFERENCE – DUTSIN-MA 2021 BOOK OF PROCEEDINGS*. 318–322.

Article DOI: 10.52589/AJAFS-HFZVTHX1
DOI URL: https://doi.org/10.52589/AJAFS-HFZVTHX1