# PHYTOCHEMICAL COMPOSITION OF TWO GINGER CULTIVARS (BLACK AND YELLOW CULTIVAR) FARM IN ZONKWA, KADUNA STATE

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**ABSTRACT**
*The study investigated some selected phytochemical contents of two ginger cultivars, black (UG2) and yellow (UG1), known locally as "Yatsun Biri" and "Tafin Giwa," respectively sourced from Zonkwa, Kaduna State. The laboratory studies were conducted at the National Research Institute for Chemical Technology in Zaria, Kaduna State. 10 grams of dried ginger from each cultivar was obtained and ground into a powder. Ten grams from each cultivar were then subjected to methanolic extraction for phytochemicals. Analysis of variance (ANOVA) was conducted on the collected data, and significant mean values were separated using the Duncan Multiple Range Test. The results revealed a significant difference ($p < 0.05$) in the phytochemical compositions of the two cultivars. The yellow ginger cultivar exhibited a ($p<0.05$) level of alkaloids, tannins, and saponins, which are beneficial for enhancing immunological function and promoting growth in chickens. In addition, these compounds possess antibacterial and antioxidant properties. The black ginger cultivar contained significantly high ($p<0.05$) levels (0.25mg/100g) of phytate and oxalate which could limit mineral availability in poultry diets. The study concluded that yellow ginger can serve as an effective functional additive in poultry diets, enhancing both immune function and growth performance. In contrast, the incorporation of black ginger into diets requires careful consideration due to its bioavailability challenges, stemming from its high levels of phytate and oxalate.*
**Keywords: Ginger cultivars, Phytochemicals, Poultry nutrition, Laboratory**

## DESCRIPTION OF PROBLEM

The increased demand for naturally and environmentally friendly alternatives to antibiotics in the field of poultry production creates a necessity for an examination of additives derived from plants, specifically ones rich in phytochemicals (Abd El-Hack *et al.,* 2022; Ayalew *et al.,* 2022). Phytochemicals refer to bioactive compounds present in plants responsible for a variety of traits including pigmentation, odour, and disease resistance. All these compounds contribute to important factors in humans in terms of antioxidant, anti-inflammatory, and antimicrobial activity. As a group, this collection of phytochemicals can promote growth performance, maximize efficiency in terms of feed, and promote immune status in poultry production (Attia *et al.,* 2017; Al-Sagan *et al.,* 2020).

Some of the phytochemicals present in ginger include phenolic compounds, flavonoids, gingerols, and shogaols. Biological activity present in ginger is manifested through its spiciness and odor, both of which are widespread and specifically appreciated in disease-resistance-related scenarios. For example, gingerols have anti-inflammatory activity, and such activity can contribute to less oxidative stress in poultry, while flavonoids have antioxidant activity proven to protect cells from potential damage (Srinivasan, 2017). The inclusion of such phytochemicals in feed mixtures helps in overall improvement in terms of poultry health, and such improvement can contribute to a rise in production level (Ahmadifar *et al.,* 2019).

Ginger, distinguished for its diversity in its phytochemical compounds, has proven to have the potential to enhance growth performance, boost immune function, and yield antioxidant benefits in poultry (Al-Khalaifah *et al.,* 2022). There, however, is a lack of an in-depth understanding of the individual phytochemical variation between such cultivars, namely, the black cultivar (UG2) and yellow cultivar (UG1), locally known as "Yatsun Biri" and "Tafin Giwa," respectively. In addition, there is also a gap in information on the role played by such phytochemicals in enhancing health and productivity efficiency in poultry. Thus, in a quest to bridge such a lack of information, this study aims to investigate black and yellow ginger cultivars' phytochemical composition, assessing their potential roles as functional feed additives in poultry nutrition

## MATERIALS AND METHODS

### Experimental site

The study was carried out at the Laboratory of the National Research Institute for Chemical Technology Zaria, Kaduna State. Zaria lies within Latitude 10°5' and 11°6' North of the equator, and Longitude 7°4' and 8°5' east of the Greenwich meridian (Azua *et al.,* 2020).

### Sample Size, Collection and Preparation

The study used an estimated 20 grams of ginger, 10 grams per cultivar, from a local farm in Zonkwa, Kaduna State. The samples were collected during peak harvest season, washed and peeled, and sliced into uniform pieces for drying. The rhizomes were air-dried at room temperature to prevent degradation of sensitive phytochemicals. The samples were ground into a fine powder, subjected to methanolic extraction, concentrated, and stored at -4ºC until use. The process ensures optimal phytochemical content and quality in ginger products.

**Phytochemical Tests**

Phytochemical tests were carried out on the powdered extract for the presence of alkaloids, tannins, saponins and protease inhibitors following standard procedures (Ji *et al.,* 2017). Quantitative determination of phytochemicals will be used.

**Statistical Analysis**

Data collected were subjected to analysis of variance (ANOVA) using the general linear model of SAS (2006) and the differences between means of various treatments were separated using the Ducan Multiple Range Test.

## RESULTS AND DISCUSSIONS

The comparative analysis of the black and yellow ginger cultivar phytochemical profiles showed significant ($P<0.05$) variation, as seen in Table 1. According to the observations, yellow ginger cultivar (grey) showed high contents of alkaloids (1.11 mg/100g), tannins (2.13 mg/100g), and saponins (8.38 mg/100g) compared to black ginger cultivar (dark), with lower contents of these compounds: alkaloids (0.67 mg/100g), tannins (1.13 mg/100g), and saponins (4.23 mg/100g). On the other hand, the black ginger cultivar showed high contents of phytate (0.25 mg/100g) and oxalate (0.25 mg/100g) compared to the yellow cultivar, with reduced values for phytate (0.12 mg/100g) and oxalate (0.22 mg/100g). This observation corroborated with Ghosh *et al.* (2023), who, in a similar observation, documented variation in phytochemical compositions in different cultivars of ginger. High contents of alkaloids, tannins, and saponins in the yellow ginger cultivar suggest that it could have increased protective factors beneficial for poultry welfare. Alkaloids have been seen to have antimicrobial activity, and such activity could contribute to minimizing infection prevalence in flocks (Othman *et al.,* 2019). Tannins have been seen to contribute towards increased efficiency in consumption and growth performance in poultry, through antioxidant activity, and could mitigate oxidative stress (Choi & Kim, 2020). Saponins have been seen to contribute towards gut wellness through beneficial gut microbiota and increased absorption of nutrients, and could, in a similar manner, contribute towards increased growth (Chaudhary *et al.,* 2018; Alghirani *et al.,* 2021).

The elevated phytate and oxalate contents in the black ginger cultivar can present bioavailability-related challenges for essential minerals. Phytates have a chelating property for important minerals such as calcium, zinc, and iron, and in doing so, can reduce their absorption efficiency in diets for poultry (Mazzuco & Bertechini, 2014), as cited by Abd El-Hack *et al.* (2022) Unless addressed through proper diet formulation, such factors can contribute to nutritional insufficiencies. Oxalate presence can hinder the absorption of minerals, most notably calcium, and complicate nutritional planning in poultry management. The fact that such observations have a statistical basis ($p < 0.05$) re-emphasizes proper cultivar selection for use in diets for poultry. Variability between cultivar types identifies a role for individual phytochemical profiles in defining suitability for its use in diets as supplements.

**Table 1: Phytochemical composition of Ginger**

| | **Cultivars** | | |
|---|---|---|---|
| **Phytochemicals (mg/100g)** | Grey | Dark | P-value |
| Alkaloid | $1.11\pm0.00^a$ | $0.67\pm0.00^b$ | $0.0000^*$ |
| Tannin | $2.13\pm0.01^a$ | $1.13\pm0.02^b$ | $0.0000^*$ |
| Phytate | $0.12\pm0.00^b$ | $0.25\pm0.00^a$ | $0.0000^*$ |
| Oxalate | $0.22\pm0.00^b$ | $0.25\pm0.00^a$ | $0.0340^*$ |
| Saponin | $8.38\pm0.02^a$ | $4.23\pm0.00^b$ | $0.0000^*$ |
| Protease inhibitors | $0.10\pm0.00^a$ | $0.07\pm0.00^b$ | $0.0015^*$ |

Values are presented as means ± SEM. $^{a, b}$ were different ($p<0.05$) within the same row.

## CONCLUSION

The study concludes that the yellow ginger cultivar contains a higher content of alkaloids, tannins, and saponins, whose positive impact in enhancing immune function and efficiency in chicken growth comes through its antimicrobial and antioxidant activity. On the other hand, the black ginger variety is distinguished through the high contents of phytate and oxalate, with a high chance of creating bioavailability obstacles for minerals in chicken nutrition, therefore, accentuating the importance of cultivar selection in attaining nutritional success.

## APPLICATION

Based on the findings, the yellow ginger variety can be a useful functional additive in chicken nutrition, enhancing both immune function and growth performance. On the other hand, the black variety, even with its beneficial impact in certain scenarios, requires careful nutritional planning in an attempt to counteract bioavailability-related obstacles with phytate and oxalate compounds. Application in such a manner reflects the utility of several types of ginger in enhancing chicken productivity and well-being through modulating immune function and absorption of nutrients.

## REFERENCES

Abd El-Hack, M. E., Alagawany, M., Arif, M., Emam, M., Saeed, M., Arain, M. A., ... & Khan, R. U. (2018). The uses of microbial phytase as a feed additive in poultry nutrition–a review. *Annals of Animal Science*, *18*(3), 639-658.

Abd El-Hack, M. E., El-Saadony, M. T., Salem, H. M., El-Tahan, A. M., Soliman, M. M., Youssef, G. B., ? and Swelum, A. A. (2022). Alternatives to antibiotics for organic poultry production: types, modes of action and impacts on bird's health and production. *Poultry science*, *101*(4), 101696.

Ahmadifar, E., Sheikhzadeh, N., Roshanaei, K., Dargahi, N., & Faggio, C. (2019). Can dietary ginger (Zingiber officinale) alter biochemical and immunological parameters and gene expression related to growth, immunity and antioxidant system in zebrafish (Danio rerio)?. *Aquaculture*, *507*, 341-348.

Alghirani, M. M., Chung, E. L. T., Sabri, D. S. M., Tahir, M. N. J. M., Kassim, N. A., Kamalludin, M. H., ... & Loh, T. C. (2021). Can Yucca schidigera be used to enhance the growth performance, nutrient digestibility, gut histomorphology, cecal microflora, carcass characteristic, and meat quality of commercial broilers raised under tropical conditions?. *Animals*, *11*(8), 2276.

Al-Khalaifah, H., Al-Nasser, A., Al-Surrayai, T., Sultan, H., Al-Attal, D., Al-Kandari, R., ... & Dashti, F. (2022). Effect of ginger powder on production performance, antioxidant status, haematological parameters, digestibility, and plasma cholesterol content in broiler chickens. *Animals*, *12*(7), 901.

Al-Sagan, A. A., Khalil, S., Hussein, E. O., and Attia, Y. A. (2020). Effects of fennel seed powder supplementation on growth performance, carcass characteristics, meat quality, and economic efficiency of broilers under thermoneutral and chronic heat stress conditions. *Animals*, *10*(2), 206.

Attia, Y. A., Bakhashwain, A. A., & Bertu, N. K. (2017). Thyme oil (Thyme vulgaris L.) as a natural growth promoter for broiler chickens reared under hot climate. *Italian Journal of Animal Science*, *16*(2), 275-282.

Ayalew, H., Zhang, H., Wang, J., Wu, S., Qiu, K., Qi, G., ? and Chanie, D. (2022). Potential feed additives as antibiotic alternatives in broiler production. *Frontiers in Veterinary Science*, *9*, 916473.

Azua, S., Nnah, S. I., & Ikwueze, H. U. (2020). Spatio-temporal Variability of Landuse Landcover and its Impact on Land Surface Temperature in Zaria Metropolis, Nigeria. *FUTY Journal of the Environment*, *14*(1), 1-11.

Chaudhary, S. K., Rokade, J. J., Aderao, G. N., Singh, A., Gopi, M., Mishra, A., & Raje, K. (2018). Saponin in poultry and monogastric animals: A review. *Int. J. Curr. Microbiol. Appl. Sci*, *7*(7), 3218-3225.

Choi, J., & Kim, W. K. (2020). Dietary application of tannins as a potential mitigation strategy for current challenges in poultry production: A review. *Animals*, *10*(12), 2389.

Ghosh, S., Das, B., Haldar, P. K., Kar, A., Chaudhary, S. K., Singh, K. O., ... & Mukherjee, P. K. (2023). 6-Gingerol contents of several ginger varieties of Northeast India and correlation of their antioxidant activity in respect to phenolics and flavonoids contents. *Phytochemical Analysis*, *34*(3), 259-268.

Ji K, Fang L, Zhao H, Li Q, Shi Y, & Xu C, (2017) Ginger oleoresin alleviated gamma-ray irradiation-induced reactive oxygen species via the Nrf2 protective response in human mesenchymal stem cells. Oxid Med Cell Longev. 1480294.

Mazzuco, H., & Bertechini, A. G. (2014). Critical points on egg production: causes, importance and incidence of eggshell breakage and defects. *Ciência e Agrotecnologia*, *38*, 07-14.

Othman, L., Sleiman, A., & Abdel-Massih, R. M. (2019). Antimicrobial activity of polyphenols and alkaloids in middle eastern plants. *Frontiers in microbiology*, *10*, 911.

SAS (2006). *Statistical analysis system institute, user's guide*. Version 11 for windows. North Carolina, U.S.A.

Srinivasan, K. (2017). Ginger rhizomes (Zingiber officinale): A spice with multiple health beneficial potentials. *PharmaNutrition*, *5*(1), 18-28.