EVALUATION OF THE PROXIMATE, PHYTOCHEMICAL AND ESSENTIAL OIL COMPOSITION OF CLOVE (*SYZYGIUM AROMATICUM*) AS PHYTOGENIC FEED ADDITIVE

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ABSTRACT
Potential of clove as a phytogenic feed additive lies in its reported antimicrobial, antioxidant, and anti-inflammatory properties. Clove buds contain approximately 15 to 20% volatile essential oils dominated by eugenol. Thus, this study was carried out to evaluate proximate, phytochemical and essential oil composition of Syzygium aromaticum as potential source of phytogenic feed additive in poultry diet. Samples of Syzygium aromaticum was obtained, processed and subjected to laboratory analyses to determine proximate, phytochemical and quantitative essential oil (EO) composition using steam distillation procedure. Result showed that Syzygium aromaticum contained crude protein (CP), crude fibre (CF), ether extract (EE), nitrogen free extract (NFE) and ash content of 4.96, 31.20, 6.13, 61.57 and 5.24 %, respectively. Additionally, the phytochemical analysis showed that Syzygium aromaticum contained 1.74, 2.68, 1.37, 5.16 and 2.10 % alkaloids, flavonoids, saponins, phenols and tannins. The quantitative determination of the EO content of Syzygium aromaticum showed it contain 10.68 % EO. In conclusion, ztudy showed that Syzygium aromaticum contains an appreciable levels of nutrients which may supply certain nutrients to diets in addition to their health promoting properties. Hence, Syzygium aromaticum can be included in livestock diet for balanced microbiota and possibly to improve growth performance.
Keywords**: Feed Additives, Essential Oil, Microbiota, Phytobiotics**

INTRODUCTION
Livestock industry has witnessed a growing interest in phytogenic feed additives as alternatives to traditional growth promoters and antimicrobial agents. These natural substances, derived from plants, offer potential benefits for animal health, performance, and overall well-being (Salihu *et al*., 2020). Clove buds (*Syzygium aromaticum*), renowned for its rich phytochemical profile and essential oil content, emerges as a promising phytogenic feed additive. The potential of clove as a phytogenic feed additive lies in its reported antimicrobial, antioxidant, and anti-inflammatory properties. Clove buds has been reported to contain approximately 15 to 20% volatile essential oils dominated by eugenol (70-85%) (Ramadan *et al.,* 2013; El-Maati *et al.,* 2016) and has been reported to improve performance in poultry by enhancing the gut microbiota (Mohammadi *et al.,* 2014). These properties may contribute to improved nutrient utilization, enhanced growth performance, and overall health in livestock. Hence, this study aimed at evaluating the proximate composition, phytochemical constituents, and essential oil composition of clove buds (*Syzygium aromaticum*) as potential, effective and sustainable feed supplement in livestock production.

MATERIALS AND METHODS
Source and processing of *Syzygium aromaticum*
Syzygium aromaticum samples were purchased from Sabo market in Sabon-Gari Local Government Area of Kaduna State, Nigeria; the samples were crushed by grinding using hammer mill before laboratory analyses.

Chemical analysis of *Syzygium aromaticum*
Samples of *Syzygium aromaticum* were analyzed for proximate composition using the methods described by AOAC (2005) at the Biochemical Laboratory of the Department of Animal Science, Ahmadu Bello University, Zaria. Phytochemical contents and quantitative determination of essential oil in the experimental materials were analyzed using the standard method described by Ejikeme *et al*.

(2014) for plant materials in the Department of Pharmacognosy and Drug Development, Ahmadu Bello University, Zaria.

RESULTS AND DISCUSSION

Proximate composition of cloves

Table 1 shows the proximate composition of cloves used for this study. The result showed that dry matter (DM), ash, crude fibre (CF), crude protein (CP), ether extracts (EE) and nitrogen free extracts (NFE) were 93.15 %, 5.24 %, 31.20 %, 4.96 %, 6.13 % and 61.57%, respectively. This is an indication that clove has some considerable levels of nutrients aside from its phytogenic properties. Considering the lower CP content of 4.96%, cloves can only be used as feed additives and not as conventional protein or energy source.

The high DM content reported in this study is in line with reports of Abdel-Moneim *et al*. (2007) who reported 90%, 51.5% and 5.2% for DM, NFE and ash content of clove, respectively. The author reported 1.2%, 20% and 12.1% for CP, CF and EE respectively. Milind and Deepa (2011) reported clove seeds had 5.8%, 20%, 61.21% 34.2% and 5.88% for CP, EE, NFE, CF and ash respectively. The 61.57%, 5.24% and 31.20% for NFE, ash and CF reported in this study is similar to the values reported by Milind and Deepa (2011) who reported 61.21%, 5.8% and 34.2%. The variations observed on the proximate compositions of cloves compared to the results of Abdel-Moneim *et al*. (2007) could be attributed to certain factors such as: the part of cloves used, growing condition of the plant, soil management practice, geographical location, and method of laboratory analysis.

Table 1: Proximate composition of clove (*Syzygium aromaticum*)

Parameter	Composition (%)
Dry matter	93.15
Ash	5.24
Crude fibre	31.20
crude protein	4.96
Ether extracts	6.13
Nitrogen free extracts	61.57

Values were averages of three (3) determinations

Phytochemical and essential composition of cloves (*Syzygium aromaticum*)

The phytochemical and quantitative composition of essential oil in *Syzygium aromaticum* is presented in Table 2. The phytochemical analysis of *Syzygium aromaticum* (cloves) showed that 1.74%, 2.68%, 1.37%, 5.16%, 2.1% and 10.68% for alkaloids, flavonoids, saponins, phenols, tannins and percentage yield of essential oils. These various constituents and their percentage composition indicate the great potential of clove as a phytobiotic source. The presence of these phytochemical properties from cloves observed and reported in this study corroborates the findings of Lone and Jain (2022) who reported the presence of carbohydrates, lipids, alkaloids, flavonoids, tannins, sterols and triterpenes when cloves was placed under phytochemical analysis.

Table 2: Phytochemical analysis of clove (*Syzygium aromaticum*)

Constituents	Composition (%)
Alkaloids	1.74
Flavonoids	2.68
Saponins	1.37
Phenols	5.16
Tannins	2.1
Yield of Essential oil	10.68

Values were averages of three (3) determinations

CONCLUSION

The study showed that *Syzygium aromaticum* contain levels of nutrients which may supply certain nutrients to diets. More so, the plants contain tannins, saponins, glycosides, flavonoids, alkaloids, phenols and essential oils which may confer additional health benefits.

RECOMMENDATIONS

Syzygium aromaticum can be included in livestock diet for balanced microbiota and possibly improved performance.

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