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EVALUATION OF THE EFFECTS OF ORGANIC AND INORGANIC AMENDMENTS ON THE GROWTH OF CHILLI PEPPER (Capsicum annum L.) PLANT

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Abstract
This study examined the effects of poultry, cow dung, household waste and synthetic fertilizer (NPK 10:10:10), on the growth of the chilli pepper (*Capsicum annum* L.*)* plant. The experiment was laid out in a Completely Randomized Design (CRD), with four treatments which were replicated four times. The fresh and dry weight of the plant, total fresh matter, proximate contents of fruits and chlorophyll and b contents of the leaves were assessed. Data generated were analyzed using analysis of variance (ANOVA) and the means were compared using the least significant difference (LSD) at a 0.05% level of probability. The result obtained from the study showed that poultry waste produced the highest fresh and dry weight (114g and 58g) respectively, total fresh matter (220g) and chlorophyll (8.5%) content. Cowdung produced the highest phosphorus (P) (5.5/100g) and carotenoid (11.78mg/kg) contents. Plants amended with household waste gave the highest protein (1.4%), crude fibre (4.41%), potassium (K) (243.13mg/100g) and Nitrogen (0.22%) contents. The result suggests that the incorporation of poultry, cow dung and household waste into the soil was better than that with the NPK and the control. Findings, therefore, indicate that the organic manures enhanced the growth and yield performance of *Capsicum annum.*

Keywords: Capsicum annum; Poultry; Cowdung; Household; NPK.

Introduction

Chilli Peppers, are varieties of the berry-fruit of plants from the genus *Capsicum,* which are members of the family Solanaceae, cultivated for their pungency. Chilli Peppers are widely used in many cuisines as a spice to add heat to dishes. Which led to a wide variety of cultivars, including the *annum species* of *C.baccatum,C. chinense, C. frutescence* and *C. pubescens.* In 2019, the world's production of raw green peppers amounted to 38 million tons, with China producing half. Red hot chilli pepper contains 88% water, 9% carbohydrates, 2% protein, and 0.4% fat. In 100gram amounts, chilli peppers supply 40 calories, and are a rich source of vitamin C and vitamin B6 (USDA, Food Data Central 2019). According to Fattori et al (2016) Capsaicin as one of the chemicals in chilli peppers that makes them hot, is used as an analgesic in topical ointments, nasal sprays, and dermal patches to relieve pain. Household waste refers to waste usually generated in the residential environment. Waste with similar characteristics may be generated in other economic activities and can thus be treated and disposed of together with household waste. For this research, household waste consists of plant and animal waste such as vegetables, fruit peel, bone and meat waste, which are considered wet wastes (FOASTAT, 2021).

Organic farming is a form of agriculture that completely relies on techniques and methods such as green manure, compost, and bone meal from animals and excludes the use of synthetic petrochemical fertilizers. As of April 1995, the USDA National Organic Standard Board (NOSA), defined "Organic agriculture as an ecological production management system that promotes and enhances biodiversity, biological cycles and soil biological activities". It is based on minimal use of off-farm imputes and management practices that restore and maintain ecological harmony. This system of farming requires a relationship between humans and natural resources in the production of quality food products for human consumption. According to Deforestation (2000), this system of farming is to create an integrated environmentally sound and economically sustainable agricultural production, soil fertility in the tropics, supplying the soil with a range of macro and micro-nutrients and organic matter. Manure

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generally improves soil tilth, the water-holding capacity of the soil, promotes the growth of beneficial soil organisms, and aeration (Fulhage, 2000). Poultry waste is consisting of bird faeces and urine, litter from bedding materials (wood shavings or sawdust) and feathers that result from intensive poultry production.

Materials and Methods

The experiment was carried out in plastic pots measuring about (35cm in diameter), behind the (Biology Department) Research laboratory of the Ignatius Ajuru University of Education, Rumuolumeni, Port Harcourt. The pots were perforated on the sides and base to allow excess water to drain out. A total of four (4) treatments and their effects at different levels of O, (control) 20, 40 and 60g were considered. Each treatment and level were replicated four (4) times. The experiment was carried out between June and November 2020. Fruits of Chilli pepper were obtained from the fruit garden market in Diobu Port Harcourt. Poultry, cow dung and household wastes or manure were collected from poultry houses, slaughter areas, and household waste that were made available by those in the business of roasting plantain, yam and potato, respectively. Inorganic fertilizer (NPK) was obtained from Agricultural Development Project (ADP) office in Rumuodumaya Obio/Akpor Local Government Area Rivers State. Poultry, cow dung and Household wastes were applied into the pots four (4) weeks before transplanting of seeding to allow effective decomposition, while NPK fertilizer (10:10:10) was applied three (3) weeks after transplanting. The pots without treatment served as the control.

Results

The effect of Poultry, cow dung, household wastes and synthetic fertilizer on the fresh weight of chilli pepper plants is presented in Figure 1. The plants grown on the soil amended with poultry waste had more fresh weight with different concentrations applied than the ones treated with other organic amendments and synthetic fertilizer.

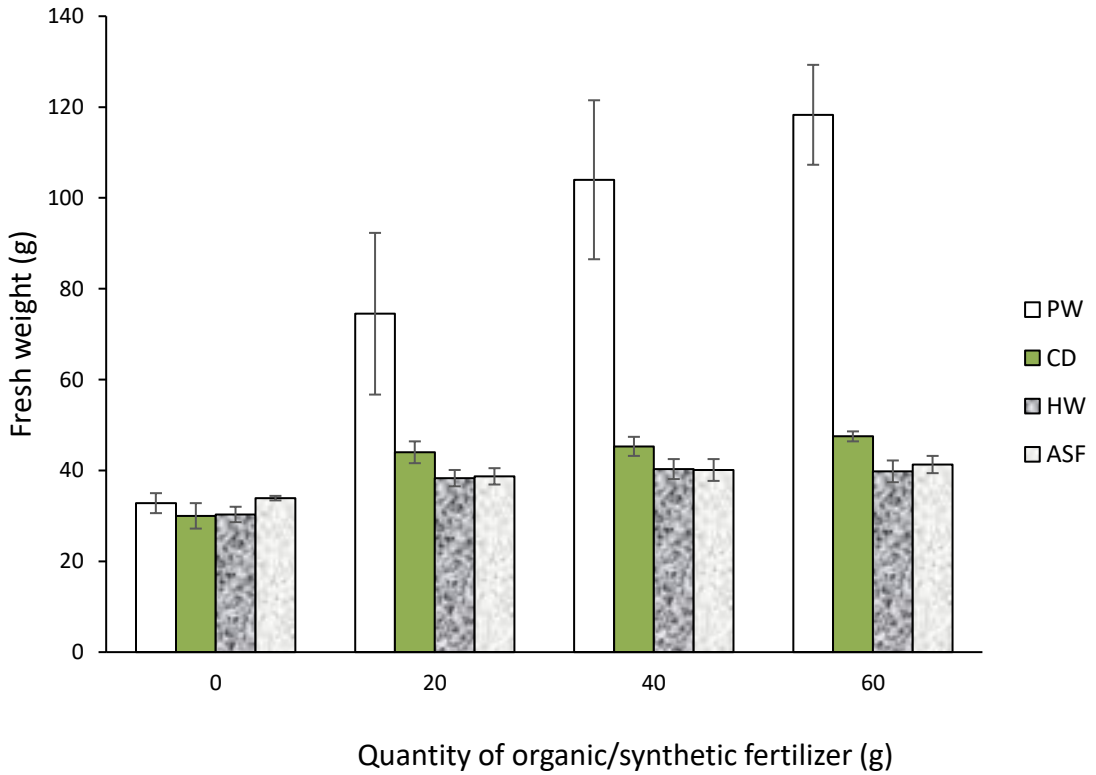

Figure 1: Fresh weight of Chilli Pepper Plants on soils amended with organic wastes and synthetic fertilizer.

PW: Poultry Waste, CD: Cowdung, HW: Household Waste, SF: Synthetic Fertilizer

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The dry weight of chilli pepper on soils is amended with organic wastes and synthetic fertilizer.
The effect of Poultry, cow dung and household wastes and synthetic fertilizer on the dry weight of chilli pepper plant shows that plants grown on soil amended with poultry waste had higher dry weight than the plants grown on soil amended with cow dung, household waste, and synthetic fertilizer at the different quality of the application. However, the standard error margins for replicates grown on soil amended with poultry waste were wider compared to the others (Figure 2).

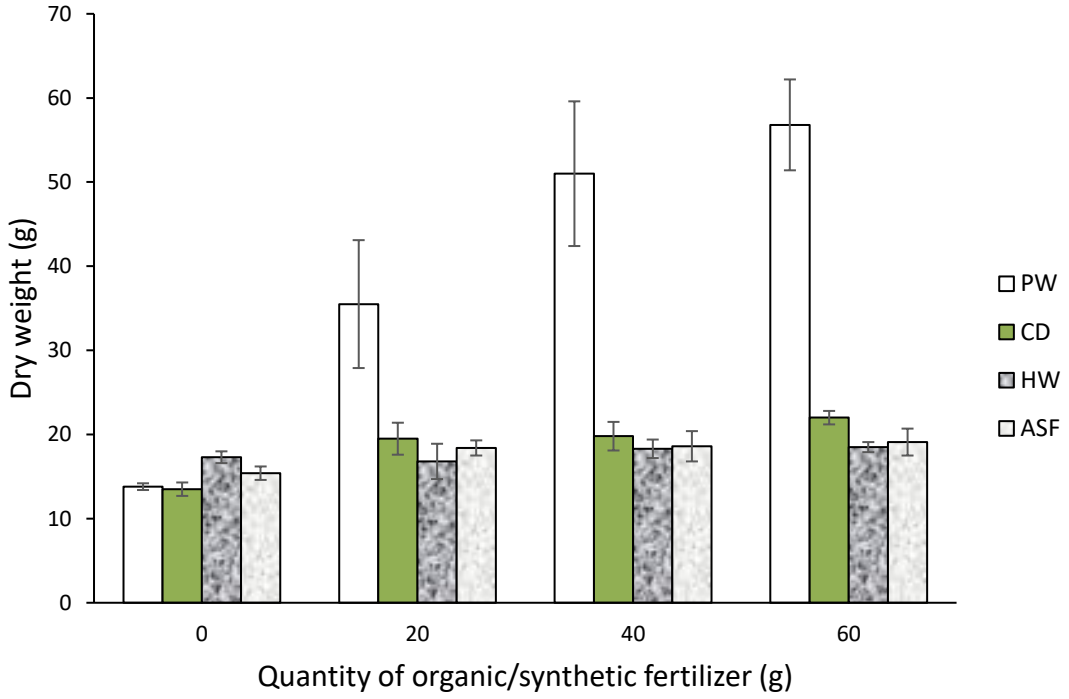

Figure 2: Dry weight of Chilli Pepper Plants on soils amended with organic wastes and synthetic fertilizer.
PW: Poultry Waste, CD: Cowdung, HW: Household Waste, SF: Synthetic Fertilizer

The effects of organic and inorganic fertilizer on the total fresh matter in the Chilli pepper plant in figure 3, showed that plants grown on soil amended with poultry waste had the highest total fresh matter of the fruits. However, statistical analysis of the total fresh matter in the plants grown on soil amended with the organic wastes and synthetic fertilizer at the different quantities applied shows that at a 95% confidence interval ($\alpha - 0.05$), there is a significant difference only at 40 and 60g application. Thus, the plants grown on soil amended with poultry waste significantly had a more total fresh matter of the fruits than the other organics and synthetic fertilizer.

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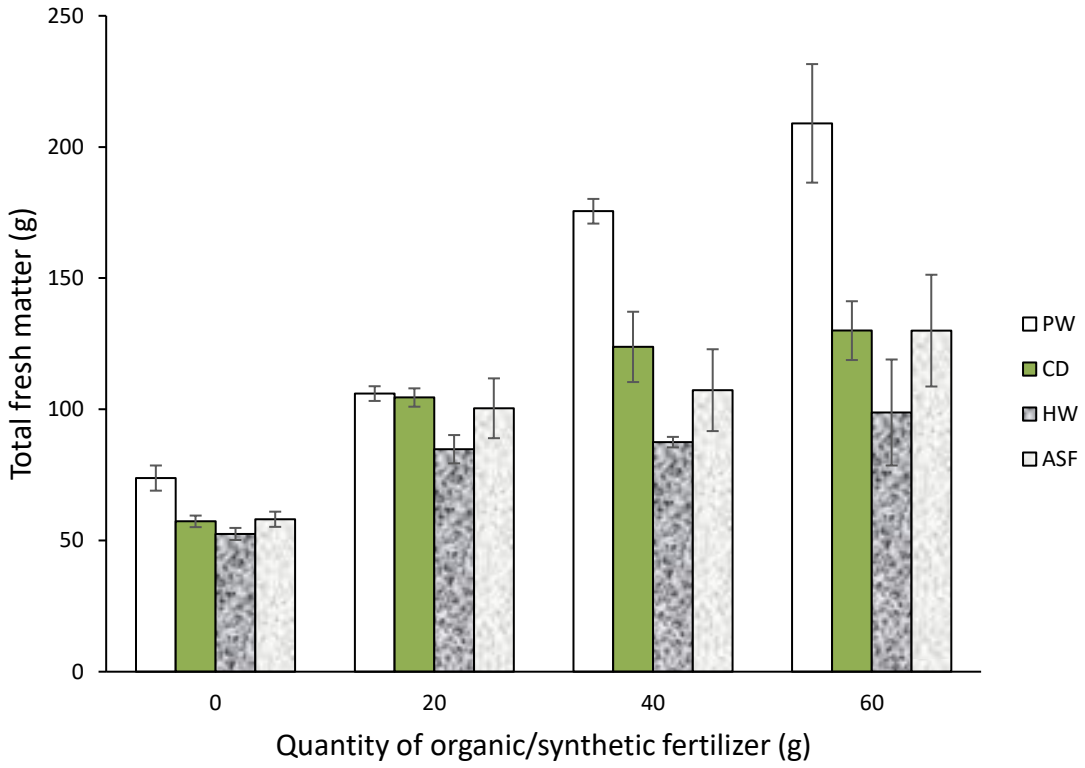

Figure 3: Total Fresh Matter of Chilli Pepper Fruits on soils amended with organic wastes and synthetic fertilizer.

PW: Poultry Waste, CD: Cowdung, HW: Household Waste, SF: Synthetic Fertilizer.

The effect of poultry, cow dung, household wastes and synthetic fertilizer on chlorophyll **a** and **b** contents in chilli pepper plant leaf is presented in figure 4. From the figure, plants grown on the soil amended with poultry waste had the highest frequency of chlorophyll a. however, statistical analysis of total chlorophyll a and b contents in the plants grown on soil amended with organic wastes and synthetic fertilizer at the different quantities applied shows that the mean difference is significant at the 0.05% level in all the amended soil.

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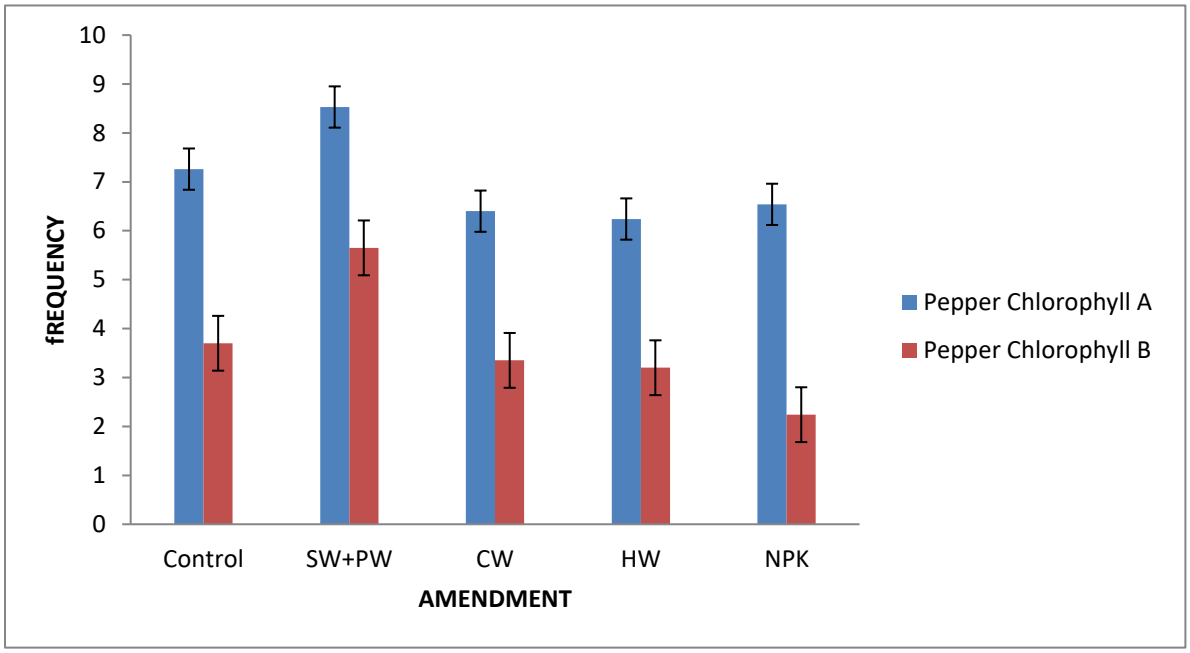

Figure 4: **Effect of soil amendments on chlorophyll a and b content of pepper leaf**
PW - poultry waste CW - cow dung waste HW- Household waste SF: synthetic fertilizer

A comparison of the proximate composition of fruits from chilli pepper plants grown on un-amended and amended soils is presented in Figures 5 and 6. From figure 5 the ash and fat contents were highest (1%) for fruits from plants grown on un-amended soils, and least (0.69 and 0.26%) respectively for fruits from pepper plants grown on soils amended with poultry waste and synthetic fertilizer respectively.The protein and crude fibre contents were highest (1.41 and 4.41%) respectively for fruits from pepper plants grown on soils amended with household waste, and least (1%) for fruits from pepper plants grown on unamended soil. The carbohydrate content was highest (3.26%) with cow dung waste than other organics and un-amended soil (2%) or control.

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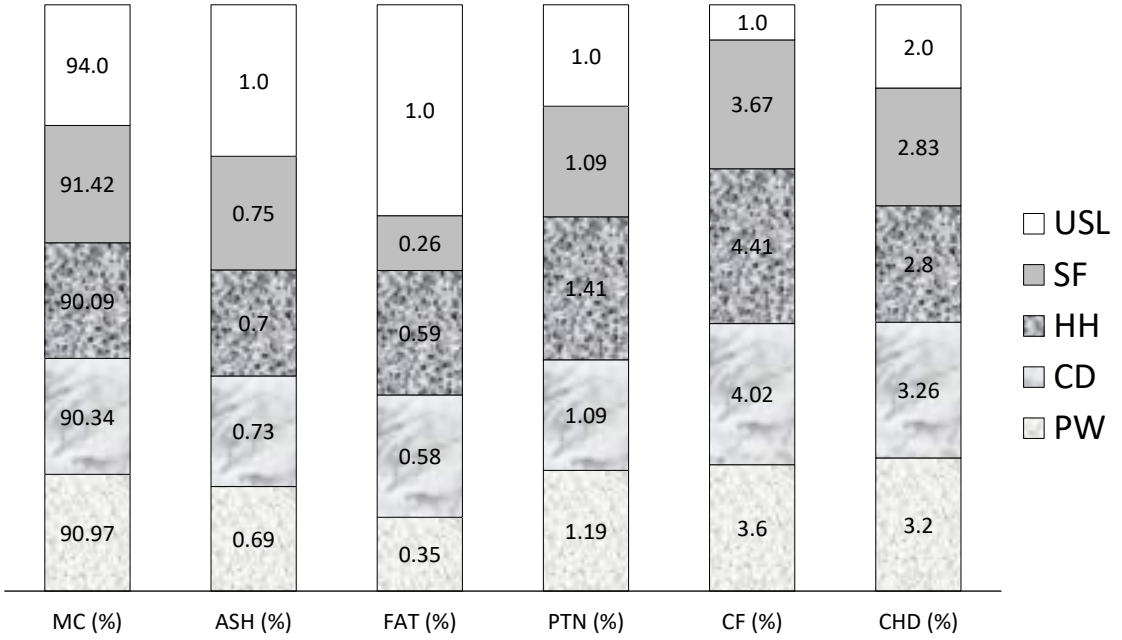

Figure 5: Comparison of the composition of fruits from pepper plants grown on unamended and amended soils.

Usl: fruits from pepper plants grown on unamended soil (control), SF: fruits from pepper plants grown on soil amended with synthetic fertilizer (positive control), HW: fruits from pepper plants grown on soil amended with household wastes, CD: fruits from pepper plants grown on soil amended with cow dung, PW: fruits from pepper plants grown on soil amended with poultry waste, MC: moisture content, PTN: Protein, CF: crude fibre, CHD: Carbohydrate.

The potassium, phosphorus, nitrogen, and carotenoid content of fruits from chilli pepper plants grown on un-amended and amended soils is presented in figure 6. Pepper plants grown on soil amended with household waste had the highest potassium content (243.13mg/100g) among other organics, while fruits from pepper plants on un-amended soil had the lowest potassium content (90.34mg/100g).Fruits from pepper plants on soil amended with cow dung had the highest phosphorus content (5.54mg/100g) among other fertilizers, and that of un-amended soil with the lowest (4.04mg/100g).Those from the household waste had the highest nitrogen content (0.22%), better than those from poultry, cow dung, synthetic fertilizer and un-amended soils. The highest carotenoid was observed on the fruits from soil amended with cow dung waste (18.09mg/kg), while the control or unamended had the lowest carotenoid contents (11.78mg/kg).

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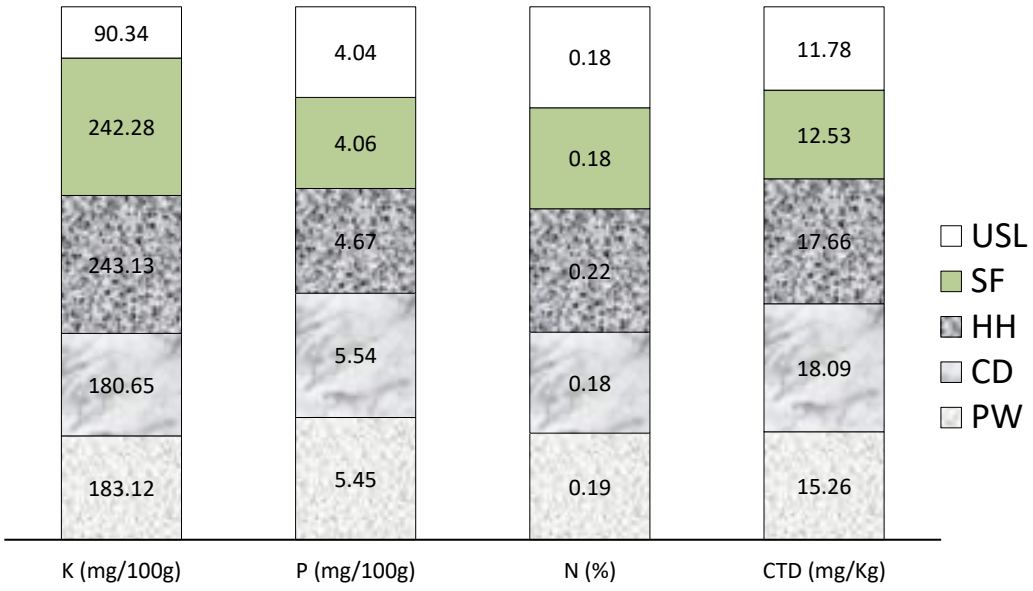

Figure 6: Potassium, phosphorus, nitrogen, and carotenoid content of fruits from pepper plants grown on unamended and amended soils.
USL: unamended soil or control (negative control), SF: synthetic fertilizer HW: household wastes, CD: cow dung, PW: poultry waste, K: potassium, P: phosphorus, N: nitrogen, CTD: carotenoid.

Discussion

The result of the effects of poultry, cow dung, household waste and synthetic fertilizer on fresh plant weight of chilli pepper (*Capsicum annum)* showed that those grown on soil amended with poultry waste had more fresh weight at the different quantity applied than the plants grown on soil amended with cow dung, household wastes and synthetic fertilizer. Observation following earlier reports by Oyewole and Aloehile (2020), and Fabiyi et al. (2015). Similar results were obtained in the case of dry weight and total fresh matter of the fruits. It has earlier been reported by Wang et al., (2017) that poultry waste promoted plant growth in all parameters as compared with other organic and NPK fertilizer amendments. This might be a result of the highest release of nitrogen and phosphorus from poultry wastes. According to Nwafor, (2019), and Oyewole and Aloehile, (2020) organically amended soils possess essential nitrogen twice the nitrogen as conventional soils. This is also consistent with the report of Adewole and Llesanmi (2012) in which it was demonstrated that inorganic fertilizers like NPK worsen soil degradation resulting from loss of inorganic matter which leads to higher acidity, nutrient imbalance and low crop yield. On the other hand, organic manures promote microbial degradation and the gradual release of nutrients over time.

The result of the proximate analysis of the fruits of chilli pepper as presented in figure 5, the moisture content in all the treatments was almost the same except in un-amended soil (control). The protein and fibre content was highest (1.41 and 4.41%) respectively for fruits from pepper plants grown on soil amended with household waste. Carbohydrate content was highest (3.26%) than other organics, with the least (2%) from the fruits of unamended soil. This result is in agreement with the previous report of Botir et al. (2019) and Stephen et al., (2014). Potassium, phosphorus, nitrogen and carotenoid content analyzed showed that household waste had the highest potassium (K) and Nitrogen (N) content (243.13mg/100g) and (0.22%) and un-amended soil with the lowest (90.34mg/100g), while cow dung had the highest phosphorus and carotenoid content (5.54mg/100g) and (18.09mg/kg). While poultry waste, synthetic fertilizer and control had the least (0.18%).

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Conclusion

The study revealed that both fertilizers and manure or waste (Poultry, cow dung and house waste and inorganic (NPK) improved the growth performance of chilli pepper (*Capsicum annum)* at different degrees. Organic fertilizer performed better than NPK and control on most of the parameters assessed. Treatment with poultry waste was found to be the best. Therefore, the use of organic manure in the production of chilli pepper should be encouraged.

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