Effect of Garlic Fortified Drinking Water on Intestinal Parasites and Egg Laying Performance of Japanese Quail (*Cortunix cortunix* japonica)

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ABSTRACT

This study investigated the effect of garlic fortified drinking water on intestinal parasites and egg laying performance of quails. Forty-five point-of- lay Japanese quails (Cortunix cortunix japonica) were randomly allocated to three treatments; T1 which served as the control had no test ingredients while T2 and T3 had 2g of aqueous garlic filtrate added to 1 litre of drinking water daily and 5g of the dewormer ((Bactro-expeller) added to 1 litre of their water at the 3rd and 5th week of the experiment respectively. . Each treatment had fifteen quails, with three replications of five quails per replicate in a completely randomized design experiment. Intestinal mucosae of the quails were determined before and after the administration of the of the test materials. The trial lasted for eight weeks during which period the laying performance of the quails were monitored. Results showed presence of of intestinal parasites (93.75% Capillaria spp) for quails subjected to garlic treated water as well as 6.25% Ascaridia spp for the control group while the dewormer (Bactro-expeller) treated group had no intestinal parasite record. There was no significant ($P<0.05$) effect of treatments on the external egg quality parameters. The study concluded that exposing Japanese quails to garlic fortified water had no detrimental effect, rather it improved egg laying performance. Garlic treated drinking water however, did not show desirable effect on the control of intestinal parasites as to the dewormer treated water.

INTRODUCTION

In Nigeria, chicken egg is the most consumed poultry product, but the recent hike in cost of production resulting from high cost of feed has increased the cost of production; making chicken eggs unaffordable to most Nigerians. However, alternative production of poultry meat and eggs within a relatively shorter time and cheaper cost has been found in Japanese quails (Ojo *et al.,* 2011). Quails are one of the best alternative sources of poultry meat and egg (El-Katcha, *et al.,* (2015). Owen and Dike (2013) stated that quails are small sized (requiring small floor space) and attain egg production between 5 and 6 weeks of age, they are hardy, early maturing and at the same time prolific (280 eggs/year) (Garth *et al*, 2020) as compared to chicken eggs. The eggs are small, multicoloured and weigh between 8 and 10 g each (Musa *et al*., 2008). Shoemaker (2020) outlined the health benefits of quail eggs especially its rich contents of Vitamin B_{12}, Selenium, Choline and Riboflavin as well as antioxidants. The meat and eggs are low in body fats and cholesterol which is of public health significance (Edache *et al*. 2018). Agbalaya *et al.* (2017) stated that Japanese quails are mainly reared for the production of meat, eggs and for use as laboratory animals. They are also viable due to their short generation interval, early maturity, growth rate, excellent disease resistance, low feed and floor space requirement (Lawrence *et al.,* (2008). Quails are excellent eggers too. A quail hen can lay up to 280-300 eggs in their first year (Garth *et al.,* 2020).

For years, dewormers such as piperazine have been employed in egg production to effectively remove intestinal parasites, enhance intestinal health, boost growth performance, and safeguard against diseases Chege *et al* (2017). However, the long-term abuse of these chemicals has increased public concerns regarding antibiotic drug residues and resistant bacteria (Yang *et al.*, 2019). In recent years, the European Union has banned the use of antibiotics as growth promoters for poultry (Barug *et al*., 2006). A similar resistance is observed with worm expellers like piperazine, leading to investigation into some prebiotics, probiotics, organic acids and phytogenics as alternativesto antibiotics and anti-parasites (Premavalli and Omprakash, 2020).

Phytogenics are plant-derived group of feed additives including herbs, spices, fruits and other plant parts and extracts (Windich *et al*., 2005). Researchers have been exploring safe and effective ways to raise poultry without sacrificing productivity; especially in egg production, making phytogenics like garlic, turmeric, black pepper, ginger, oregano, onion, thyme, peppermint, green tea, licorice welcomed alternatives (Olayinka *et al.* 2022).

Garlic (*Allium sativum*) is a species of bulbous flowering plantsin the genus Allium. It was known to ancient Egyptians and has been used as both food flavouring and a traditional medicine (Somasundaran *et al*., (2002), and Batiha *et al.,* (2020). Garlic (*Allium sativum*) and turmeric (*Curcumin longa*) are widely used to cure and prevent diseases in human beings and animals (Somasundaran *et al.,* (2002) and National Center for Complementary and Integrative Health, (NCCIH) (2012). Khan *et al*. (2003) and Gujral *et al.* (2002) reported better performances of broilers by feeding herbal products. Batiha (2020) reported that phytoconstituents of garlic such as glycosides, alkaloids, saponins, steroids, flavonoids, tannins and terpenoids have antimicrobial, antifungal, anti-protozoal and anti-aging as well as anti-cancer properties. Khanmohammadi and Rasi-Bonab (2018) as well as Velkers *et al*., (2010) and Dardona (2024) reported antihelmintic properties of garlic. In South east Nigeria, many quail farmers use garlic as a local dewormer (Pers. Obs), but there is paucity of scientific information to validate these claims, hence this study was aimed at evaluating the effect of fortification of drinking water of with aqueous garlic filtrate on intestinal parasite and egg laying performance of Japanese quails.

MATERIALS AND METHODS

Study Area

The study was carried out at the Poultry Unit of the Teaching and Research Farm of the Department of Animal Science, Nnamdi Azikiwe University, Awka, Anambra State, located within the forest vegetation zone of the southeastern Nigeria at Latitude 6^0 5^1 10.1^1N of the equator and Longitude 7^0 8^1 31.9^1 E of the Greenwich Meridien. The mean daily maximum temperature is usually 27^0 C all through the year, although it could reach 34^0C in March and lowest during harmattan months of December and January. The mean annual rainfall in the region is 1600mm with relative humidity of 80% at dawn (Ezenwaji *et al.*, 2013).

Preparation of the experimental pens

One week to the arrival of the experimental animals the pens were thoroughly washed and fumigated, feeding troughs and drinkers were also washed and made available. On arrival of the point of lay (POL) quail hens were transferred to the pens and fed with Hybrid layers mash feed and water *ad libtum*.

Sourcing and preparation of the experimental materials and test ingredients

Fresh garlic bulbs used in this study were purchased from Eke-Awka market, Awka North, Anambra State, Nigeria. They were oven - dried at 80°C for 20 hours and blended into powder with Silvercrest Kitchen Blender at the Food Science and Technology Laboratory, Nnamdi Azikiwe University, Awka. The blended garlic was stored in an airtight container for later use. The dewormer (Bactro-Expeller) was bought from Jofez Agro Veterinary Shop, Aroma, Awka for use in the experiment.

Procurement and acclimatization experimental birds

Forty-five (45) point of lay Japanese quail *(Cortunix cortunix japonica)* hens were purchased dealer in Awkuzu and transported to the experimental site at the cool hours of the day. The birds were allowed to acclimatize for one week during which time they were fed with Hybrid layers Mash and plain clean water before administering experimental treatments in accordance with the experimental design.

Experimental design

The experimental design used was Completely Randomized Design (CRD). Three tier-battery cage was used for the experiment. The battery cage was divided into three equal parts and labeled as T_1, T_2, T_3 each treatment was replicated three times. The forty-five (45) quail were randomly allocated to the three treatments, such that each treatment had fifteen birds, five birds per replicate and three replicates per treatment.

Management of the experimental birds

The birds were housed in battery cages and were fed Hybrid layers mash offered twice daily, in the morning and in the evening throughout the duration of the study. Drinking water was offered *ad libitum* either plain or fortified in accordance with the design of the experiment. Birds in T_1 were offered plain water throughout the period of the experiment; birds on T_2 had 2 grams of garlic powder added to every one liter of water offered to the birds daily throughout the duration of the experiment while birds on T_3 had 5g of dewormer (Bactro-expeller) added to their water two times (3^{rd} and 5^{th} Week of the experiment) for the two months period of the experimental. The drinkers and feeders were washed and cleaned every morning and faeces swept out from under the cages and disposed properly.

Data collection

External egg quality traits

Data collected for the assessment of external egg qualities were as follows:

i. Egg Number: this represents number of eggs picked from each treatment.

ii. Egg weight (EWT): It was measured in grams by weighing the egg laid by all quails of the same experimental diet, on aweekly basis using Precision digital weighing scale.

iii. Egg Length (EL): It was measured in centimeters (cm) and was taken on the longest egg parts using Vernier calipers.

iv. Egg width (EWI): It was measured in centimeters (cm) and was taken on the widest egg parts using Vernier calipers.

v. Shell Thickness (ST): It was measured in millimeter (mm) using micrometer screw gauge.

vi. Egg Shell Weight: It was measured in grams using a digital sensitive scale

Internal egg quality traits

Data collected for the assessment of internal egg qualities were as follows:

i. **Yolk weight (YWT)**: Each egg was cracked neatly with a table knife and the yolk was separated from the albumen into a petri dish, then the petri dish containing the yolk was placed on the digital scale and the reading was taken in grams (g)
ii. **Yolk height (YH):** It was measured by dipping the rod of the Vernier calipers into the petri dish containing the yolk and reading from the Vernier calipers in cm after the egg was cracked and the yolk separated from the albumen in a separate petri dish. It was measured in centimeters (cm)
iii. **Yolk width (YW):** was measured as the distance from one end of the chalazae to the other using a Vernier caliper. It was measured in centimeters (cm)
iv. **Yolk index (YI):** was determined as the ratio of YH (yolk height) to YW (yolk width).
v. **Yolk Ratio (YR**): was determined by dividing the yolk weight by the egg weight multiplied by 100%.
vi. **Albumen Weight (AWT**): Each egg was cracked neatly with a table knife and the yolk was separated from the albumen into two Petri dishes then the Petri dish containing the albumen was placed on the digital scale and the reading was taken in grams (g).
vii. **Albumen Height (AH):** It was measured by dipping the rod of the Vernier calipers into the petri dish containing the albumen and reading from the vernier calipers in cm after the egg was cracked and the yolk separated from the albumen in a separate Petri dish. It was measured in centimeters (cm)

Haugh unit (HU): It was computed as 100 log (H+7.57-1.7W0.37), Where H was the observed albumen height and W, the observed weight of egg**Intestinal Mucosae**

One quail hen was randomly picked from each of the treatments at the on-set of the experiment and at the end of the experiment, respectively and were taken to Zoology Laboratory of Nnamdi Azikiwe University, Awka for assessment of intestinal parasites with a microscope.. A drop of intestinal mucosa from various parts of the intestine was suspended in normal saline water on a microscope slide, then covered with a glass slip and viewed under the microscope.

Statistical analysis

The data collected were subjected to One- Way (ANOVA) in a completely randomized design and significant mean were separated using Duncan's New Multiple Range Test described by Silva and Azevedo (2009).

RESULTS

Proximate Composition of Garlic Powder

The proximate composition of garlic powder is presented in Table 1

Table 1: Proximate Composition of Garlic Powder

Parameters	Composition %
Moisture	5.52
Carbohydrate	66
Ash	5.85
Crude Protein	16.23
Ether Extract	2.24
Crude fibre	3.9

Phytochemical Composition of Garlic Powder

The phytochemical composition of garlic powder is presented in the Table 2

Table 2: Phytochemical Composition of Garlic Powder

Phytochemical	Composition (mg/100g)
Tannins	0.90
Polyphenols	69.13
Terpenes	1.80
Saponins	86.15
Flavonoids	2.10
Alkaloids	128.11
Glycosides	39.00

Egg Quality Parameters of Japanese Quail hens Exposed to Experimental Treatments

The result of external quality parameters of the quails is presented in Table 3

a). External Egg Quality parameters

Table 3. External Egg quality of Japanese Quail Exposed to garlic fortified water

Parameters	T1 Control	T2 Garlic	T3 Dewormer
Egg weight (g)	9.29	9.71^{a}	9.55^{b}
Egg length (cm)	3.28^{b}	3.42^{a}	3.28^{b}
Egg width (cm)	2.56^{b}	2.62^{a}	2.65^{a}
Egg shell thickness (mm)	0.45	0.49	0.52^{a}
Egg shell wt.(g)	1.29^{b}	1.51^{a}	0.94

^{abc}Means on the same row with different superscript differ significantly (P<0.05)

b). Internal Egg Quality Parameters of Japanese Quail Hens Exposed to Experimental Treatments

The Internal egg quality parameters of Japanese quail fed the experimental diets is presented in Table 4Table 4: Internal Egg Quality Parameters of Japanese Quail Hens Exposed to Experimental Treatments

Parameters	T1 Control	T2 Garlic	T3 Dewormer
Yolk weight (g)	3.34	3.24	2.99
Yolk length (cm)	2.94	2.84	2.90
Yolk width (cm)	2.19	2.19	2.23
Yolk index	2.04	2.95	3.35
Yolk ratio	1.95	1.51	0.94
Albumen weight (g)	4.74	4.80	4.91
Albumen Height (cm)	3.28	3.41	4.91
Haugh unit	82.86	82.27	82.44

[abc]Means on the same row with different superscript are significantly (P>0.05)

iv). Final Weight of Japanese Quail Hens and Intestinal Parasite on the Mucosae Subjected to Experimental Treatments

The final weight of Japanese quail hens and number of intestinal parasites found on the mucosae are presented in Tables 5 and 6 respectively.

Table 5: Final weight and number of Intestinal Parasites found on the Mucosae Japanese Quail Hens Exposed to Experimental Treatments

Treatments	Final wt. (g)	Length of intestine	No of Worms
T_1 (Control)	130.4g	152.4cm	1
T_2 (Garlic)	120.0g	151.89cm	15
T_3 (Dewormer)	156.5g	160.2cm	Nil

v). Intestinal Parasites on the Mucosae of Japanese Quail Hens Exposed to the Experimental Treatments

The intestinal parasites found on birds subjected to the three experimental treatments are presented in Table 6

Table 6: Intestinal Parasites on the Mucosae of Japanese Quail Hens Exposed to Experimental Treatments

Treatments	Parasites	% Occurrence
T_1 (Control)	*Ascaridia spp.*	6.25%
T_2 (Garlic)	*Capillaria spp.*	93.75%
T_3 (Dewormer)	Nil	0

DISCUSSION

Table 1 show the proximate composition of garlic powder, FoodData Central US Department of Agriculture of 2019 reported that garlic powder has 73% carbohydrate (including 9% dietary fibre), 17% protein, 1% fat and 6% water. Sangwan *et al.,* (2010) assessed the proximate composition of garlic powder dried using four different methods and observed differences in the proximate composition.

The phytochemical composition of garlic obtained in this study (Table 2) corroborates Batiha *et al*., (2020a), but differences with other authors (Yusuf *et al*., 2018) may also be attributed to the drying methods. Ali and Ibrahim (2019) qualitative phytochemical screening of *Allium sativum* aqueous and ethanol extracts indicated

the presence of Alkaloid, terpenoids, flavonoids, steroid, phenol, anthraquinones, saponin, tannin and glycoside. Batiha *et al*. (2020b) reported the pharmacological and toxicological activities of bioactive constituents in garlic. Yunus *et al*., (2021) reported phytochemical compound of garlic (*Allium sativum*) as an antibacterial to *Staphylococcus aureus* growth.

The effect of garlic fortified water and dewormer (Bactro-Expeller) treated water on the external egg quality parameters of Japanese quails in Table 3 is in line with other authors (Ogbuewu *et al.,* (2021 and Lim *et al*., (2008) but contrary to Canoglulari *et al.,* (2010). Ogbuewu *et al.,* (2021) meta-analysis of the responses of laying hens to garlic (*Allium sativum*) supplementation revealed that layers on dietary garlic supplementation had significantly increased hen day egg production, egg weight, egg shell thickness compared to control. Lim *et al*., (2008), also reported enhanced Haugh unit in eggs of laying hens fed garlic powder based feed. The findings was contrary to Canoglulari *et al.,* (2010) who observed that addition of 10g garlic powder/kg feed in layer diet decreased egg shell index and haugh unit without significant effects on egg weight, egg shell weight and egg shell thickness. Thus, there is still some level of inconsistencies with these reports, some authors (Hossain *et al*., (2016), Hadj Ayed *et al*., (2018) and Meseret *et al.,* (2018)) reported positive effects, others (Aderemi *et al.,* (2013), Abdulaziz *et al*., (2016) and Adebiyi *et al.,* (2017)) observed negative effects.

The result also indicated that garlic fortified water treatment did not affect the internal quality of eggs and the weight of the birds significantly (Table 4). Haught unit value for all the treatments are above 80%, none of the treatments recorded values lower than the minimum 75% Haugh unit required for excellent quality eggs (Babangida and Ubosi, 2006). The Haugh unit (HU) is an objective measure of egg quality based on the logarithmic function of albumen height and egg weight. HU values were almost similar for all treatments. The internal egg quality parameters evaluated such as albumen weight, albumen height, yolk weight, yolk width, yolk height, yolk index and Haugh unit measured also showed no significant ($P<0.05$) differences across the dietary treatments. Similar inconsistencies are also observed with other authors, some reporting positive effects and others negative. Nha and Thuy (2023) noted that garlic type, method of preparation and administration, level of inclusion, species of laying hen are responsible for these inconsistencies.

Intestinal Parasites of Japanese Quail Treated with Garlic Fortified Drinking Water

Tables 5 and 6 show the effects of garlic fortified drinking water and dewormer (Bactro-Expeller) on intestinal parasites of Japanese quails. Birds subjected to garlic fortified drinking water had intestinal parasite of *Capillaria spp* with 93.75% occurrence , while birds without treatment (the control) recorded presence of *Ascaridia spp with* 6.25% occurrence, birds treated with dewormer (Bactro-Expeller) had no observation of intestinal parasite. This finding did not corroborate the findings of other researchers and the indigenous belief of quail farmers who use garlic as alternative dewormer. Khanmohammadi and Rasi-Bonab (2018) reported that garlic is tested in vivo and in vitro for its anthelmintic activity against cestodes (*Hymenolepis diminuta*, *H. microstoma,* and *Taenia taeniaeformis*) and trematodes (*Fasciola hepatica*, *Echinostoma caproni*). According to them, in all in vitro tests, the target parasites died indicating that garlic, by helping to create antioxidants, reduces the number of parasite eggs resulting in the low birth rate of new worms in the living organism. Dardona *et al*., (2024) also reported that garlic is helpful in treating human intestinal parasitic infection caused by *Entamoeba histolytica* and *Giardia lamblia* (chronic giardiasis). Though, *Capillaria species* of worms that resisted garlic treatment in this study is scarce in literature. Velkers (2010) experiment on whether allicin (active anti-microbial, anti-parasite factor in garlic) treatment could potentially substitute for flubendazole in the treatment of the worm Ascaridiae *galli* nfections in organic chicken farming reported that allicin liquid at the doses examined cannot be used as a replacement for flubendazole treatment. The result of this study may be due to lower level of garlic inclusion, a higher level of inclusion is therefore recommended.

CONCLUSION

From the results of the study,, it was therefore concluded that garlic powder improved external egg qualities, but cannot be compared with synthetic deworming drug (Bactro- expeller) in control of intestinal parasites.

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