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Growth Performance of Broiler Chickens on Dietary Supplementation of Garlic and Ginger Powder

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ABSTRACT

Feed additives are given to broiler diets to boost productivity and growth rate. Ginger and garlic have acquired popularity for increasing the health and nutritional value of poultry products. This study aims to evaluate how dietary supplementation with garlic and ginger powder, as well as their combination, affects broiler feed intake and growth performance. Arbor acres chicks, 180 days old, were randomly assigned to five treatments with three replicates (12 birds each). Treatment 1 was a diet without ginger or garlic (control). Treatments 2 and 3 included 0.25% of ginger and garlic, respectively. Treatments 4 and 5 contained 0.25% and 0.50% ginger and garlic, respectively. The feeding experiment was conducted for 42 days. During the beginning phase, birds fed a combination of 0.25% ginger and garlic showed significantly higher weekly weight gain (84.22g/bird) and daily weight gain (12.03g/bird) compared to other treatments. Birds fed with 0.25% ginger exhibited the highest feed intake throughout both the starter and finisher phases (20.84g/bird and 54.79g/bird, respectively). Birds fed 0.25% ginger and garlic exhibited considerably higher feed conversion ratios ($p<0.05$) throughout both the starter and finisher phases. Therefore, it can be inferred that ginger and garlic at the inclusion rate of 0.25% ginger, 0.25% garlic, and 0.25% garlic in combination with 0.25% ginger can improve the feed intake and weight gain of broilers.

INTRODUCTION

The poultry sector provided around 25% of Nigeria's agricultural domestic products (FAO, 2014). According to the USDA (2013), commercial poultry production in Nigeria is expected to be worth approximately $800 million. Nigeria is currently Africa's biggest egg producer, but ranks fourth in broiler output (USDA, 2013). This suggests that Nigeria still must increase its broiler bird production, as poultry industry is gaining popularity in poor nations due to its role in bridging the gap between protein malnutrition and economic empowerment. Selection for economically significant qualities has led to a rise in the number of issues encountered during production, including obesity, ascites, sudden death syndrome, and leg deformities (Mench, 2012; Tolkamp *et al.*, 2015). One of the most common issues in the broiler sector nowadays is the presence of excessive body fat deposits. Abdominal fat is closely associated with total carcass lipids and is utilized as the primary criterion for detecting excess fat deposits in broilers. Broiler chicken performance and cellular activity are determined by the availability of nutrients in feed, their use, and the distribution of absorbed nutrients into tissues and organs. Feed additives are added to broiler diets to boost productivity by boosting growth rate, feed conversion efficiency, and livability in chicken birds. (Zhang *et al.* 2009).

Herbs and spices have recently attracted more attention as references for growth promoter chemicals. There is evidence that some of these components have different active substances (Al-Kassie & Witwit, 2010), which enhance digestion by stimulating endogenous enzymes (Brugalli, 2003), increase digestive enzyme production, and improve digestion by improving liver function (Ziarlarimi *et al.*, 2011). Ginger and garlic are examples of phytogenic plants, which are natural growth boosters and can be used instead of antibiotics. Furthermore, these herbal plants are readily available locally and in sufficient quantities (Gbenga *et al.*, 2009).

Ginger is the rhizome of the plant Zingiber officinale, and it is used as a delicacy, spice, and medicine. Preliminary research suggests that nine chemicals contained in ginger may bind to serotonin receptors, potentially influencing gastrointestinal function. In vitro studies demonstrate that ginger extract may reduce the number of free radicals and lipid peroxidation while also having anti-diabetic activities (Morakinyo *et al.*, 2011). Ginger supplementation in chicken diets has been shown to improve gastric output, small intestine shape, and digestive enzyme activity (Ali *et al.* 2008; Incharoen & Yamauchi, 2009). Gingerols, gingerdiol, and gingerdione, which are ginger components, have been shown to stimulate digestive enzymes and have antibacterial activity.

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Garlic (Allium sativum) is a perennial herb with a bulb separated into segments (cloves) (Singh & Panda, 2005), belonging to the Amaryllidaceae family and the Allium genus. It has a good effect on avian digestion because of its high aromatic essential content (Demir *et al.*, 2005). These functions were attributed to bioactive chemicals found in garlic, such as alliin, diallyl sulphide, and allicin (Amagase & Milner, 1993), which have antibacterial properties (Tsao & Yin, 2001) and may be responsible for garlic's growth-promoting effect.
Many investigations demonstrated a rise in body weight and the best feed conversion ratio when utilizing herbal plants in broiler diets (Great, 2003; Iqbal *et al.*, 2001). On the other hand, research into the use of herbal combinations in bird diets has yielded conflicting results. The goal of this study was to learn more about the impact of employing different doses of garlic and ginger powder as supplements on the performance and carcass quality of broiler chicks.

LITERATURE REVIEW

When broiler chicks have free access to nutrition, they are more likely to become overweight, a condition known as hyperphagia. Feed limitation can reduce fat deposition in broilers (Nielsen *et al.*, 2013), however it also reduces growth rate. Birds may retain huge amounts of fat in their liver and adipose tissue (Hermier, 1997). Lipogenesis (the conversion of glucose to triglycerides) occurs predominantly in the liver of birds and consists of several connected, enzyme-catalyzed events such as glycolysis, the citric acid cycle, and fatty acid synthesis (Zhang *et al.*, 2009).
Poultry with a high belly fat content has a low market price. In terms of marketing, economic viability and consumer aversion to excess fatty tissue deposits drive poultry scientists to discover innovative strategies for reducing broiler body fat. Fat in a broiler, particularly during the finisher phase of production (around 43 days of age), can account for up to 10%-15% of the total carcass weight (Havenstein *et al*, 2013). According to these numbers, there is significant potential for increasing feed efficiency and improving broiler carcass quality by minimizing fat deposition. Some dietary techniques designed to lower animal production costs have the potential to reduce broiler fat formation.
The availability of feed supplies determines the development rate and survival of poultry birds in every setting (FAO, 2013). Poultry feed is extremely important in production since there is a bridging gap between the idea and the method utilized in feed preparation. Nutritional requirements and feed quantities vary according to the age, weight, and season of the poultry since poultry birds require a tangible amount of energy, protein, vitamins, minerals, and, most importantly, water, which is a significant overlooked nutrient in livestock production (NRC, 1994). Body growth and physiological condition maintenance of birds is an important function of nutrients in poultry feed. However, the delivery of nutrients to poultry birds varies depending on their age, species, and goal of production (Isiaka *et al*, 2016). Poultry requires a steady supply of energy, protein, vital amino acids, essential fatty acids, minerals, vitamins, and, most importantly, water. Poultry birds get their energy and other nutrients from the grain they eat, whereas minerals, vitamins, and important amino acids (lysine, methionine, threonine, and tryptophan) come from supplements. However, the nutrients must be delivered to the diet adequately in terms of the right quantity and the right quality, as deviation from this resulted in fat accumulation in the carcass and poor bird performance (Oluyemi & Robert, 1981).

Table 1: Nutrient Requirements of Broilers

Nutrients	Broiler Starter	Broiler Finisher
Crude protein (%)	23.00	20.00
Crude fibre (%)	5.00	5.50
Met. Energy (Kcal/kg)	3100.00	3200.00
Calcium (%)	1.00	0.90
Phosphorus (%)	0.70	0.50
Sodium (%)	0.15	0.15
Vitamin A (IU)	1500.00	1500.00
Vitamin D (IU)	200.00	200.00
Vitamin E (mg)	10.00	7.00

Source: NRC, 1994

The energy content of poultry feed is the most important factor influencing intake. Energy requirements, and hence feed intake, change significantly with environmental temperature and level of physical activity (El-Begearmi & Klasing, 2012). Changes in dietary energy level influence feed intake, and other nutrient specifications must be changed to maintain the needed consumption. As a result, the first step in developing diets for poultry should be to determine the dietary energy level. Poultry requires varying amounts of energy for metabolic functions at each growth stage, and a lack of it can have an impact on productive performance. The cost and availability of energy-rich foods determines dietary energy levels employed in feeding. Due to the high cost of maize, many developing countries advocate the adoption of low-energy diets for poultry feeding. However, inadequate calorie intake leads to a reduced carcass output and poor growth. According to Donald *et al.* (2015), birds consume consistent metabolizable energy by altering their dietary intake. According to Olomu (2018) and Fetuga (2017), the ideal energy level for broiler starters is 2800-3000kcal/kg metabolizable energy.

MATERIALS AND METHODS

The experiment was conducted in the Poultry Unit of the University of Ibadan's Teaching and Research Farm in Ibadan, Nigeria. Fresh ginger and garlic were imported from Kano State, Nigeria. The garlic bulbs were divided into cloves, which were then chipped. The chips were baked in an oven until thoroughly dry. Dried garlic chips were then crushed and stored in an airtight jar until ready to use. The ginger was likewise washed and sliced thinly, followed by sun drying on a metal pan until it was fully dried. The sliced dried ginger was crushed and stored in an airtight jar until ready to use. Five experimental diets were designed for the starter and finisher periods. Diet 1 has no ginger or garlic and serves as the control diet; Diet 2 contains 0.25% ginger; and Diet 3 contains 0.25% garlic. Diet 4 includes 0.25 percent garlic and 0.25 percent ginger. Diet 5 has 0.50% ginger and 0.50% garlic as additions.

Table 2: Gross Composition of Experimental Starter Diet

Ingredients	T1	T2	T3	T4	T5
Maize	50.00	50.00	50.00	50.00	50.00
Soya bean meal	41.00	41.00	41.00	41.00	41.00
Fish meal	1.00	1.00	1.00	1.00	1.00
Soya oil	2.00	2.00	2.00	2.00	2.00
Wheat offal	2.00	2.00	2.00	2.00	2.00
Bone meal	2.05	2.05	2.05	2.05	2.05
Limestone	1.00	1.00	1.00	1.00	1.00
Vit-min premix	0.30	0.30	0.30	0.30	0.30
DL methionine	0.25	0.25	0.25	0.25	0.25
L lysine	0.10	0.10	0.10	0.10	0.10
Table salt	0.30	0.30	0.30	0.30	0.30
Total	**100**	**100**	**100**	**100**	**100**
Calculated values					
Crude protein (%)	23.12	23.12	23.12	23.12	23.12
ME (kcal/kg)	3007.1	3007.1	3007.1	3007.1	3007.1
Crude fibre (%)	3.82	3.82	3.82	3.82	3.82
Fat (%)	4.01	4.01	4.01	4.01	4.01
Calcium (%)	1.21	1.21	1.21	1.21	1.21
Phosphorus (%)	0.71	0.71	0.71	0.71	0.71

T1: Basal diet, T2: Basal diet + 0.25% ginger, T3: Basal diet + 0.25% garlic, T4: Basal diet + 0.25% ginger & 0.25% garlic, T5: Basal diet + 0.50% ginger & 0.50% garlic.

Table 3: Gross Composition of experimental finisher diet

Ingredients	T1	T2	T3	T4	T5
Maize	55.00	55.00	55.00	55.00	55.00
Soya bean meal	34.00	34.00	34.00	34.00	34.00
Wheat offal	4.00	4.00	4.00	4.00	4.00
Soya oil	3.00	3.00	3.00	3.00	3.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Limestone	1.00	1.00	1.00	1.00	1.00
Vit-min premix	0.25	0.25	0.25	0.25	0.25
DL methionine	0.25	0.25	0.25	0.25	0.25
L-lysine	0.25	0.25	0.25	0.25	0.25
Table salt	0.25	0.25	0.25	0.25	0.25
Total	**100**	**100**	**100**	**100**	**100**

Calculate values					
Crude protein (%)	20.92	20.92	20.92	20.92	20.92
ME (kcal/kg)	3208.5	3208.5	3208.5	3208.5	3208.5
Crude fibre (%)	3.89	3.89	3.89	3.89	3.89
Fat (%)	3.90	3.90	3.90	3.90	3.90
Calcium (%)	1.15	1.15	1.15	1.15	1.15
Phosphorus (%)	0.65	0.65	0.65	0.65	0.65

T1: Basal diet, T2: Basal diet + 0.25% ginger, T3: Basal diet + 0.25% garlic, T4: Basal diet + 0.25% ginger & 0.25% garlic, T5: Basal diet + 0.50% ginger & 0.50% garlic.

One hundred and eighty-one-day-old arbor acre chicks were bought from a well-known commercial hatchery in Ibadan. In a properly randomized design, the birds were assigned at random to one of five nutritional therapy groups, each containing three replicates of twelve birds. Feed and water were freely available, and all prescriptions and management protocols were followed. Feed intake was tracked daily, but it was reported and presented weekly by weighing a predefined amount of meal supplied to the birds and measuring what remained the following day.

The birds' original weight was measured at the start of the trial. Subsequently, their weights were measured weekly, and the difference between the mean weight at the start and end of the tests was calculated to determine the birds' average weight growth. The feed conversion ratio (FCR) was calculated using the data received from feed intake and body weight gain. The feed conversion ratio is the ratio of feed consumption to body weight.

FCR = average total feed intake/average body weight gain

RESULTS AND DISCUSSION

Table 4 shows the growth performance of broiler chickens fed a ginger and garlic supplemented diet, either alone or in combination, during the beginning period. Significant variations were found in weekly weight gain (WWG). Birds fed with 0.25% ginger and garlic showed considerably greater ($p<0.05$) WWG of 84.22g/bird compared to other treatments. There were no significant variations in WWG between birds fed the basal diet (63.17g/bird), birds fed 0.25% ginger (67.56g/bird), birds fed 0.25% garlic (67.45), and birds fed a combination of 0.50% ginger and garlic (68.57). Birds fed 0.25% ginger and garlic showed a substantially higher ($p<0.05$) daily weight gain (DWG) of 12.03g/bird compared to other treatments. There were no significant variations in DWG between birds fed the basal diet (9.02g/bird), birds fed 0.25% ginger (9.65g/bird), birds fed 0.25% garlic (9.64g/bird), and birds fed a combination of 0.50% ginger and garlic (9.80).

Birds fed with 0.25% ginger had the highest daily feed intake (DFI) (20.84g/bird, $p<0.05$). There were no significant variations in DFI between birds fed the basal diet (17.95g/bird), birds fed a combination of 0.25% ginger and garlic (17.93g/bird), and birds fed a combination of 0.50% ginger and garlic (18.82g/bird). There was a significant difference in DFI between birds fed 0.25% garlic (19.58g per bird). Birds in this treatment consumed more feed than birds fed a basic diet, a combination of 0.25% ginger and garlic (17.93g/bird), or a combination of 0.50% ginger and garlic (18.82g/bird).

Birds fed with 0.25% ginger exhibited a considerably higher feed conversion ratio (FCR) of 2.16 ($p<0.05$). Feeding birds 0.25% ginger and garlic resulted in the lowest and highest FCR (1.49), respectively ($p<0.05$). Birds fed a combination of 0.50% ginger and garlic had a considerably higher FCR (1.92) than birds fed a basal diet (1.99), 0.25% garlic (2.03), or 0.25% ginger (2.16). The FCR range ranged between 1.49 and 2.16.

Table 4: Performance characteristics of broiler chickens at starter phase as influenced by the diet

Parameters	T1	T2	T3	T4	T5	SEM±
Weekly weight gain (g/bird)	63.17b	67.56b	67.45b	84.22a	68.57b	1.81
Daily weight gain (g/bird)	9.02b	9.65b	9.64b	12.03a	9.80b	0.26
Daily feed intake (g/bird)	17.95b	20.84a	19.58ab	17.93b	18.82b	0.22
Feed Conversion Ratio	1.99c	2.16a	2.03b	1.49e	1.92d	0.05

The values in the same row with different superscript are significantly different ($p<0.05$).

Table 5 shows the growth performance of broiler chickens fed ginger and garlic supplemented diets separately or in combination during the finisher period. There were no significant differences in the WWG and DWG between the treatments. However, a substantial difference was seen in the DFI. Birds fed with 0.25% ginger had considerably higher DFI (54.79g/bird) than other treatments ($p<0.05$). There was no significant difference in DFI between birds fed 0.25% ginger and garlic (49.68g/bird) and birds fed 0.50% ginger and garlic (49.26g/bird).

Birds fed a basal diet had the lowest feed intake (47.18g/bird), while birds fed 0.25% garlic had a significantly higher DFI (51.47g/bird) than birds fed a combination of 0.25% ginger and garlic (49.68g/bird) and 0.50%

ginger and garlic (49.26g/bird).

Birds fed with 0.25% ginger showed a considerably higher feed conversion ratio (FCR) of 1.41 ($p<0.05$). Birds given 0.25% ginger and garlic had the lowest ($p<0.05$) and highest (1.31) FCR. There was no significant difference in the FCR of birds fed 0.25% garlic (1.35) versus those fed 0.50% ginger plus garlic (1.35). The FCR range was between 1.31 and 1.41.

Table 5: Performance characteristics of broiler chickens at finisher phase as influenced by the diets

Parameters	T1	T2	T3	T4	T5	SEM±
Weekly weight gain (g/bird)	247.56	272.34	266.10	265.30	254.89	6.07
Daily weight gain (g/bird)	35.37	38.91	38.01	37.90	36.41	0.87
Daily feed intake (g/bird)	47.18d	54.79a	51.47b	49.68c	49.26c	0.15
Feed Conversion Ratio	1.33bc	1.41a	1.35b	1.31c	1.35b	0.05

The values in the same row with different superscript are significantly different (p<0.05).

T1: Basal diet, T2: Basal diet + 0.25% ginger, T3: Basal diet + 0.25% garlic, T4: Basal diet + 0.25% ginger & 0.25% garlic, T5: Basal diet + 0.50% ginger & 0.50% garlic.

Birds fed 0.25% ginger consumed considerably more feed throughout both the starter and finisher phases than birds in other treatments. Onyenekwe and Hashimoto (1999) ascribe this to ginger's flavoring qualities. This finding is consistent with the study of Oleforuh-Okoleh *et al.* (2015), who found that birds fed a ginger-based diet had a higher feed intake than birds fed a basal diet or a ginger-garlic combination. Furthermore, birds fed 0.25% garlic had considerably higher feed intake than birds fed a basic diet or a mix of ginger and garlic. However, this conclusion contradicts the findings of Onu (2010), who showed a numerical reduction in feed consumption in birds fed garlic based. The findings of this study revealed a substantial difference in weekly and daily weight gain among birds throughout the beginning phase, with birds fed a mixture of 0.25% ginger and garlic gaining the most weight. The mixes of ginger and garlic considerably increased the growth of the birds compared to ginger and garlic solely in the diet. This conclusion is consistent with the findings of Ademola *et al.* (2009) and Onu (2010), who found that broilers fed a ginger and garlic combo gained much more weight. However, Bamidele and Adejumo (2012) found no significant changes in the weight gain of pullets fed ginger and garlic combinations. There was no significant difference in weight growth between birds fed 0.25% ginger (T2) and 0.25% garlic (T3) during the starter and finisher periods. However, this study contradicts the findings of Karangiya *et al.* (2016), who found that birds fed 1% ginger and garlic alone gained more weight than birds fed ginger and garlic together. The weight gain of birds fed a mixture of ginger and garlic powder may be attributed to the actions of active compounds that stimulate digestive enzymes, inhibit pathogenic bacteria, improve gut environment, and improve feed digestion, all of which led to an increase in body weight gain (Cullen *et al.* 2005; Prakash & Srinivasan 2012). Birds fed a mixture of 0.25% ginger and garlic had the highest feed conversion ratio (FCR) during the starter and finisher phases. Mohamed *et al.* (2012) found that birds fed 0.1 and 0.2% ginger had higher FCR than birds fed a control diet. This study also supports the findings of Javed *et al.* (2009), who found that an aqueous extract of a plant mixture (*Zingiber officinale, Carum apticum, Withania somnifera, Trigonella Foenum-Graecum, Silybum marianum, Allium sativum,* and *Berberis lyceum*) improved broiler chick performance in terms of weight gain and Feed Conversion Ratio. Onu (2010) also found that birds given a 0.25% combination of ginger and garlic had better feed efficiency Dieumou *et al.* (2009) found no significant differences in body weight gain (BWG), feed intake, or FCR. Dieumou *et al.* (2009)'s report is inconsistent with this study. Variations in results may be related to variances in cultivar, ginger and garlic extract preparation, broiler strain, level of incorporation, and the environment in which this research was conducted.

The addition of ginger and garlic powder at 0.25% each resulted in the highest meal intake by birds. This could be related to the pleasant fragrance of ginger and garlic, which promotes greater feed intake. It could also be due to medicinal and chemical qualities that affect taste. This finding was consistent with that of (Qorbanpour *et al*, 2018), who discovered that including ginger and garlic at a level of less than 1% increases feed intake between the ages of 1 and 21 days. This discovery is also consistent with the findings of (Barash *et al*, 2013), who explained that at inclusion levels more than 1%, it reduces feed intake, most likely due to odor, which may influence respiration. However, the results of this study do not coincide with those of (Taufik & Maruddin, 2019). Although there was no significant difference ($P>0.05$) in weight gain, T4 of 0.25 ginger and garlic resulted in the highest weight gain. The maximum feed conversion ratio is achieved with a ginger inclusion level of 0.25%. As the level of ginger powder in broiler diets increased, feed intake fell dramatically when compared to the control diet. Birds fed control meals that did not contain ginger or garlic consumed considerably less food. Other research conducted by Rahimi *et al.* (2011) and Zhang *et al.* (2009) indicated that the synergistic effect of garlic and ginger powder combination increases feed intake among broiler chickens. This was also supported by Karangiya *et al.* (2016), who discovered that broiler hens fed with ginger utilized more feed than those who were not given ginger powder.

These findings are consistent with those reported by Zomrawi *et al.* (2013) and Herawati (2006), who stated that birds fed diets containing 1.5-2.0% ginger ingested less feed. Herawati (2010) produced a similar finding, reporting that broilers fed 2% dried additional red ginger meal had considerably reduced feed intake than those fed a control diet. The findings were consistent with those of Herati and Marjuki (2011), who found that increasing garlic in the ration by up to 2% resulted in lower feed intake. This contradicted the findings of Doley *et al.* (2009), who found no variation in feed consumption among broilers administered ginger extract for six weeks. For weight gain (T2), 0.25% garlic and T3 (0.25% ginger) performed best. This could be attributable to the fact that herbal plants may contain chemicals that improve digestion and absorption of certain nutrients in these diets, resulting in improved bird growth. This conclusion was consistent with the findings of Tollba, & Hassan, (2003). and Demir *et al.* (2003), who found that utilizing ginger and garlic in broiler feeds increases body weight. Some specialists claim that red ginger acts as a stimulant for feed digestion and conversion, resulting in increased body weight gain. This contradicted the findings of Garcia *et al.* (2007), Ghazaiah *et al.* (2007), and Tollba *et al.* (2007), who found no difference in body weight gain in broilers given ginger and garlic at graded levels for six weeks. Furthermore, Onimis *et al.* (2005) and Ademola *et al.* (2009) found that ginger increased body weight when consumed at a 2% level. Similarly, Al-Homidan (2005) discovered that broilers gained more weight when given 0.5% or 0.75% ginger.

The experimental diets did not significantly impact the feed conversion ratio ($P<0.05$). The feed conversion ratio improved for bird-fed diets enhanced with ginger and garlic powder as compared to the control diet. The diet with 0.25% ginger powder produced the highest feed conversion ratio. The improved feed conversion ratio can be linked to the ginger powder's antibacterial qualities, which resulted in greater nutrient absorption in the intestine, ultimately leading to an improvement in feed conversion ratio. These findings are congruent with those of Tollba (2003), Onimisi *et al.* (2005), Herawati (2006), Moorthy *et al.* (2009), and Herawati (2010). They demonstrated that birds fed diets with up to 2% ginger had a higher feed conversion ratio than those not supplemented with ginger. The positive effect of ginger powder in broiler diets on final body weight, body weight gain, and feed conversion ratio can be attributed to the fact that ginger and garlic powder contain medical and chemical properties responsible for taste, the most notable of which are allicin, ginerol, and shagaol. It contains antibacterial and anti-inflammatory properties (Zomrawi *et al.*, 2012). Because of the active components found in ginger and garlic, more stable intestinal flora was formed, and feed conversion efficiency improved because of better digestion (Tekeli, 2011).

CONCLUSION

Based on the findings and discussion above, it is possible to conclude that including ginger and garlic as additives in broiler diets at graded levels up to 0.50% ginger and 0.5% garlic, either combined or individually, had no overall effect on the birds' performance, only feed intake and body weight gain. Following this trial's conclusion, I urge further research to determine how the processing procedure for both ginger and garlic influences performance.

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