

Performance of broiler birds on feeding natural anti stressors in summer during heat stress

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Abstract

This study was planned to assess the effectiveness of natural anti heat stressors on the broilers during hot climate. Three hundred one day old broiler birds were divided into four treatments groups, yoghurt, garlic powder and mint and a control group. After two weeks of rearing, data were recorded for growth performance, carcass and visceral organ yield and immune response against Newcastle Disease. Statistical analysis revealed that growth performance (weight gain, carcass weight and cumulative feed conversion ratio (FCR) was significantly improved with garlic powder, but feed intake remained non-significant. Dressing% and breast% were also significantly higher in garlic fed birds and similar effect was observed for intestinal length. Among visceral organs, liver% was improved upon garlic supplemented broiler but heart and gizzard were not influenced by dietary treatments. Additionally, garlic powder in feed also resulted in significantly higher antibody titer against Newcastle disease. It was concluded that garlic as natural anti-heat stressor has significant positive influence on the performance of heat stressed broilers.

Keywords: Broiler birds, Heat stress, Garlic, Mint, Yogurt

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Introduction

In commercial broilers farming, bird have been reared in optimal condition to improved meat yield, better growth performance and for better feed conversion ratio. With the passage of time great improvement in genetic potential and nutritional manipulation of boiler has been observed; however, that genetic potential of

broilers cannot be achieved until optimum environmental conditions are not provided (Saeeda and Neeraj, 2014).

This experiment was designed, keeping in view the housing conditions and heat stress during summer season in Pakistan which has profound effects on broiler production. Due to global warming the length and intensity of summer season is increasing gradually



and temperature during extreme summer is becoming difficult to control even in environment controlled houses. In the body of birds homeostasis mechanism maintains internal temperature and keeps their functions to a normal level. When the body temperature exceeds the upper level, bird feels heat stresses (Khan et al., 2011). The bird tries to maintain a stable body temperature under normal conditions but when the body temperature of the bird increases with internal heat from metabolic processes and external heat gain from the surrounding environment the bird feel stress and difficulties to cope this condition (Ozkan et al., 2003). The tropical and sub-tropical areas of the world have high temperature and high humidity and identified as areas having problems like low performance and decreased growth rates (Ahmad et al., 2008).

In poultry industry various feed additive are being used to reduce the negative effects of heat and to get better immunity. Various synthetic anti-stressors like Vitamin C, and Vitamin E are commonly use in poultry feed (Bhatti et al., 2016), but are expensive, less efficient and too much use can damage liver. Now it is the time to develop and work on medicinal products from herbs to be used as additives in poultry feed. These natural anti-heat stressors are less toxic, cost effective, residue free and are ideal for poultry feed (Ali et al., 2014). Among different naturally occurring products; garlic, mint and yogurt are getting popularity to be used during stressful conditions.

Mint (*Mentha longifolia*) is considered as natural anti stressor that has a significant impact on overall performance of broilers (Chopra et al., 1992). It is mostly used as herbal medicine because it has strong antiseptic, antibacterial and antioxidant activities (Mimica-Dukic et al., 2003 and 1999). This has also beneficial effect on digestion process (Foster and Duke, 1999). Garlic is another herbal product which improves Feed conversion Ratio (FCR) and body weight increase, as it has antioxidant and different therapeutic protecting effects (Adibmoradi et al., 2006, Al-Shwilly, 2017 and Liao et al., 2022). Yogurt is also offered to the birds during summer because it has beneficial bacteria like lactobacillus (*L. bulgaricus*, *L. animalis*, *L. casei* and *L. acidophilus*), Bifidobacterium and *Streptococcus thermophilus*. But, the exact consequences of these natural anti-heat stressors have never been exploited. Current study was planned to explore the effect of yoghurt, garlic powder and mint on growth performance, meat quality and immune response against Newcastle Disease (ND) in

broilers during heat stress.

Material and Methods

This experiment was completed at the University of Veterinary and Animal Sciences, Poultry Research and Training (PRTC) Centre, Ravi Campus, Pattoki. The length of the study was 05 weeks during hot-humid season of July and August 2021. A 300 commercial day old broiler chicks (Ross-308) were procured from a local hatchery. All the birds were divided into 4 groups for Garlic, Mint and Yogurt with 6 replicates in each treatment having 10 birds each. Group 5 was kept as control. During first two weeks (1st & 2nd) of rearing, the experimental chicks were reared under favorable environmental temperature, relative humidity and were given commercial broiler ration without any supplementation. In the last three weeks (3rd, 4th and 5th) the broilers were subjected to “Cyclic Heat Stress” of $35\pm 1^{\circ}\text{C}$ and $75\pm 5\%$ relative humidity for 8 hours (9:am to 5pm) per day. To neutralize the effect of this heat stresses following treatments were compared with a Control group without any anti-stressor.

1. Garlic powder (*Allium sativum*) (National[®] Ltd.) @ 2 g/kg
2. Mint powder (*Mentha longifolia*) @ 2 g/kg
3. Yogurt @ 10 g/kg

The experimental birds were placed on litter floor at stocking density of 0.5 ft² per bird with 24 hours light duration. The broilers were offered with commercial mash feed *ad-libitum* feed and fresh water. The broilers were vaccinated according to vaccination schedule suggested by Poultry Research Institute (PRI) Rawalpindi.

At the ends of experiment (on 35th day), 12 birds from each group were separated and kept off-feed for four hours prior slaughtering. The birds were slaughtered and blood was collected for the determination of serum ND antibodies titers. After complete bleeding, birds were de-feathered, eviscerated and their carcass values were calculated.

Parameters studied

Growth performance

Initial and weekly body weights of the individual bird were measured and growth performance of each group was estimated through FCR and Feed Efficiency (FE) by the following formulae:



$$FCR = \frac{\text{Total Feed Consumed (g)}}{\text{Total weight gain (g)}} \quad FE = \frac{\text{Total weight gain (g)}}{\text{Total feed intake (g)}}$$

Death of birds were also recorded to calculate mortality (%) in each group.

The dressing (%) was calculated as eviscerated carcass with neck and without skin and giblets as follows:

$$\text{Dressing \%} = \frac{\text{Carcass weight (g)}}{\text{Live Weight(g)}} \times 100$$

The weight of organ% (heart, liver, gizzard and intestine) and cut-up parts% (breast, leg and fat) were recorded as following:

$$\text{organ/part weight \%} = \frac{\text{organ/part weight (g)}}{\text{Live body weight (g)}} \times 100$$

Antibody titers

On 35th days of experiment, 12 birds from each treatment group were separated and their geometric mean antibodies titers (GMT) against New Castle disease (ND) was analyzed (Hussain et al., 1988)

Statistical analysis

The data collected were analyzed through one-way Analysis of Variance (ANOVA) technique with the help of SAS 9.4. The means were compared through Duncan's Multiple Range (DMR) test (Steel et al., 1997 and Duncan, 1955).

Results

Growth performance

The influences of natural herbal anti stressor on growth performances are shown in Table 1.

Feed intake: Non-significant differences among all treatment groups were observed for total feed intake. It might be possible that the similar nutrient profile of feed had played a role to maintain overall feed intake in all groups. In weekly trends, significant differences were noted for feed intake only in 2nd, 3rd and 5th week of ages.

Body weight: Statistical analysis showed significant differences in body weights among various treated groups. All the natural products resulted in improvement in body weight of the birds. Broilers reared on feed with garlic powder anti-heat stressor

had maximum Final Body Weight (FBW) at 35th day of age but the minimum FBW was recorded in control group.

Carcass values

Carcass values of broilers fed different natural anti-heat stressors are shown in Table 2.

Breast%: Results showed that breast% was significantly affected by natural anti-heat stressors. Highest breast% (22.68±0.36) was noted in the birds receiving garlic powder while lowest value was observed in control group (18.96±0.40). However control group was non-significantly different with Mint fed groups (20.26±0.19). Yoghurt had resulted in comparable to breast% with all garlic powder fed groups.

Leg%: It is clear that natural anti-heat stressors had no influence on leg yield in broilers showing non-significant differences among the groups fed control, Yoghurt, Garlic and Mint supplemented diets.

Abdominal fat%: There are non significant differences among the groups fed control, Yoghurt, Garlic and Mint supplemented diets.

Intestinal weight (%): Mean values of intestinal weight (%) showed non significant differences among the groups fed control, Yoghurt, Garlic and Mint supplemented diets.

Intestinal length (cm): Significant differences were observed for intestinal length in broilers fed with or without different natural anti-heat stressors in diet. Highest length of complete intestine was observed in Garlic fed broilers (181.08±4.48) while lowest was noted in the birds fed control diet (154.42±3.80).

Table 1. Growth performance of broilers fed different natural anti-heat stressors

| Treatment | Cum. Feed intake (g/bird) | Final Body Weight (g/bird) | Cum. Body Weight (g/bird) | Cum. Feed Conversion Rate/bird |
|-----------|---------------------------|----------------------------|----------------------------|--------------------------------|
| Control | 3247.69±15.05 | 1872.50±8.35 ^b | 1859.99±8.52 ^b | 1.73±0.03 ^a |
| Yogurt | 3216.70±12.19 | 1999.67±13.74 ^a | 1960.17±13.88 ^a | 1.64±0.06 ^{bc} |
| Garlic | 3142.35±18.55 | 2033.50±34.01 ^a | 1995.00±34.01 ^a | 1.58±0.04 ^c |
| Mint | 3091.49±15.86 | 1963.33±28.90 ^a | 1925.33±28.84 ^a | 1.60±0.02 ^b |

Alphabets ^{a-c} in column show significant differences



Table-2. Carcass values of broilers fed different natural anti-heat stressors

| Treatment | Dressing% | Breast% | Leg and Thighs% | Abdominal fat% | Intestine% | Intestinal length (cm) |
|-----------|-------------------------|--------------------------|-----------------|----------------|------------|---------------------------|
| Control | 72.09±0.67 ^b | 23.04±1.34 ^b | 18.35±1.59 | 1.70±0.15 | 3.85±0.28 | 154.42±3.80 ^b |
| Yogurt | 77.37±0.70 ^a | 24.88±1.57 ^{ab} | 19.34±0.85 | 1.58±0.16 | 3.45±0.16 | 164.75±8.43 ^{ab} |
| Garlic | 78.42±0.96 ^a | 25.26±0.73 ^a | 20.07±0.79 | 1.49±0.13 | 3.85±0.20 | 181.08±4.48 ^a |
| Mint | 74.18±0.78 ^a | 23.18±1.19 ^b | 19.15±1.50 | 1.56±0.12 | 3.81±0.15 | 167.17±4.49 ^{ab} |

Alphabets ^{a-c} in columns show significant differences,

Visceral organ percentage

Visceral organ percentages are shown in Table 3.

The liver% was significantly ($P \leq 0.05$) affected by natural anti-heat stressors the diet. The birds fed the garlic diet had significantly higher liver% (3.10 ± 0.16) than control group (2.57 ± 0.13). There was no difference between control, yoghurt and Mint fed birds. There were no effect of natural anti-heat stressors supplementation on the heart weight% and gizzard % as a percent of total body weight among the birds that received the supplements of natural anti-heat stressors and those that did not. Similarly it was noted that, dietary treatments of natural anti-heat stressors had no impact on keel and shank length of broilers.

Immune status: In our findings, Garlic powder fed birds showed highest level of protection against N.D followed by Mint while control group had lowest N.D titer (Table 3).

Table-3. Visceral organs% and immune response of broilers fed different natural anti-heat stressors

| Treatment | Liver% | Heart% | Gizzard% | N.D titer |
|-----------|-------------------------|-----------|-----------|-------------------------|
| Control | 2.57±0.13 ^b | 0.75±0.08 | 1.55±0.08 | 2.08±0.48 ^c |
| Yogurt | 3.06±0.11 ^a | 0.67±0.03 | 1.63±0.08 | 4.75±0.37 ^{ab} |
| Garlic | 3.10±0.16 ^a | 0.57±0.03 | 1.59±0.10 | 5.33±0.33 ^a |
| Mint | 2.71±0.18 ^{ab} | 0.67±0.04 | 1.63±0.08 | 3.83±0.41 ^b |

Alphabets ^{a-c} in columns show significant differences

Discussion

Growth performance

Feed intake: Non-significant differences among all treatment groups were observed for total feed intake. It might be possible that the similar nutrient profile of feed had played a role to maintain overall feed intake in all groups. In weekly trends, significant differences were noted for feed intake only in 2nd, 3rd and 5th week of ages as shown in Table 1. This might be due to, use of garlic meal and other anti- stressor in daily feed intake given to the birds, The same results were shown ,when the birds were fed diets with 0.125 and 0.25%

garlic, meal had a significantly higher daily feed intake than the bird fed 0.5% dietary garlic meal (Javandel et al., 2008) .

Body weight: Statistical analysis showed significant differences in body weights among various treated groups. All the natural products resulted in improvement in body weight of the birds. Broilers reared on feed with garlic powder anti-heat stressor had maximum Final Body Weight (FBW) at 35th day of age but the minimum FBW was recorded in control group. The similar results were also reported in improvement of body weight gain when chickens were fed herbal products (Elagib et al., 2013) and under normal temperature (24°C) and high temperature (38°C for 3 hrs) by adding black cumin 1% and garlic 1% in broiler diets also increases the weight gain (Onibi et al., 2009). These results can be endorsed to product digestibility and presence of anti-oxidant compounds in herbal products. The positive influence of garlic powder supplementation might be due to enhancement of pancreatic enzymes activity which provides an environment for better absorption of nutrients.

Feed conversion ratio (FCR): Our results showed significant differences among improvement in Cumulative FCR of the birds. Broilers reared on garlic as natural anti-heat stressor had better Cumulative FCR (Tollba and Hassan, 2003). The poor Cumulative FCR was recorded in control group. Other studies also confirmed the same positive results on FCR with supplementation of black cumin 1% or garlic 1% in broiler feed under normal temperature (24°C) or on high temperature (38°C for 3 hrs) (Onibi et al., 2009 and Ramakrishna et al., 2003).

Carcass characters: The results of mean values of carcass qualities are shown in Table 2. Statistical analysis showed significant differences among the treatment groups on dressing%, breast% and length of intestine. Dressing% was significantly higher in the



birds given garlic in feed than that to Mint and Yoghurt. Reducing heat stress by adding anti heat stressor either from natural or synthetic source had also been reported to improve amino acid and protein digestibility in birds (Khan et al., 2012). Highest breast% was noted in the birds receiving garlic powder. A chemical Betaine present in the garlic enhances the absorption of nutrients and improved dressing percentage due to its help in liver function, cellular reproduction, and in making carnitine. Al-Shwilly (2017) also observed significant physiological and immunological benefits after supplementation of garlic in broiler feed. Similarly Liao et al. (2022) reported that addition of garlic straw powder improve meat quality and antioxidant capacity of yellow-feathered broilers. Garlic also helps the body in metabolizing homocysteine amino acid. Another effect of garlic may be on the osmo-regulation system, which increased water retention and increased the muscle mass (Esteve-Garcia and Mack, 2000). Birds in this group exhibited more body weight and improve the dressing percentage in during heat stress condition with reduced fat pad. Betaine in garlic also increased the thigh, breast meat yield and breast width of heat stressed broilers when fed with an anti-heat stressor (Khan et al., 2012). However control group was non-significantly different with Mint fed groups. The Mean values of leg proportion (%) are shown in Table 2. It is obvious that natural anti-heat stressors had no influence on leg yield in broilers showing non-significant ($P>0.05$) differences among the groups fed control, Yoghurt, Garlic and Mint supplemented diets. Previously, non-significant difference in the thigh percentage weight was also reported in broilers fed garlic and control diets (Ashayerizadeh et al., 2009). There were non-significant differences upon fat% among the groups' supplemented diets with Yoghurt, Garlic and Mint (Singh, 2015). In another study significantly higher abdominal fat% in Ross 308 broiler supplemented with 1% garlic powder were reported (Ashayerizadeh et al., 2009). In this study significant differences were noted in intestinal length on natural anti-heat stressors in diet. The highest length of complete intestine was observed in Garlic fed broilers while lowest was noted in the birds fed control diet. This shows more development of digestive system of the birds when offered garlic in diet. The increase in length of intestine might be due to increased internal structures of intestines. This is due to increase in histological structure of small

intestine in broiler chickens and increased villus height linearly in duodenum, jejunum and ileum (Saeid et al., 2013). These results are helpful in terms of more nutrient absorption in gut of the birds and hence can be good alternatives to antibiotics without affecting the growth rate of bird. Mean values of liver % are shown in Table 3. The liver% was significantly affected by natural anti-heat stressors the diet. The birds fed the garlic diet had significantly higher liver % (3.10 ± 0.16) than control group (2.57 ± 0.13). This showed the potential of garlic powder for lipid metabolism. As the liver is the primary site of lipogenesis as fatty acids are transferred from the liver to the body for usage in maintaining the body metabolism resulting in lower lipids in the liver. Garlic possesses antioxidant capabilities that have been found to put off lipid oxidation of muscle (Kirkpinar et al., 2014). However, there was no difference between control, yoghurt and Mint fed birds. Mean values of heart% are shown in Table 3. There was no effect of natural anti-heat stressors supplementation on the heart weight as a percent of total body weight. There was also no difference in gizzard weights as a percent of total body weight among the birds that received the supplements of natural anti-heat stressors and control group.

Immune status: In our findings, dietary anti-heat stressors had significant effect on the N.D titer ($P\leq0.05$). Garlic powder fed birds showed highest level of protection against N.D followed by Mint while control group had lowest N.D titer (Table 3). This might be due to Garlic components e.g. allicin which boosts the immune stimulation by mitogenic activation and modulatory effects of garlic powder in broilers. However, the results of Yoghurt were comparable with those of Garlic and Mint.

Conclusions

Based on the findings of current study, it can be concluded that natural anti-heat stressors are helpful to reduce severe consequences of heat stress and Garlic powder has most significant positive results on growth, carcass traits and immune response in broiler.

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Conflict of Interest: None

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Contribution of Authors

Ajmal AS: Conceived idea, designed and performed the experiments & collected data
Hussain Z, Jalees MM & Manzoor S: Analyzed and interpreted data and wrote the manuscript
Shafi J & Haq AU: Performed the experiments & collected data