Dietary fortification of crushed seeds of Bonium persicum on growth performance, apparent ileal digestibility and blood metabolites in broiler chicks during the starter phase

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The aim of the present study was to find the effect of crushed wild Cumin (Bonium persicum) seeds as a feed additive in broiler diet during the starter phase on growth performance, nutrient digestibility and blood metabolites in broilers. For this purpose, 360 day old chicks were randomly divided into four groups. One group was the control while other experimental groups were supplemented with crushed wild Cumin (WC) seeds in the feed at the rate of 0.5 (WC1), 1 (WC2) and 1.5 g/kg (WC3). Results indicated that feed intake was significantly lower \( (p < .05) \) in WC1 and WC2 compared to WC3 and the control. Body weight was significantly \( (p < .05) \) higher in WC1 compared to the WC2. Feed conversion ratio was significantly \( (p < .05) \) lower in WC1 compared to the control. Percentage of crude fat, protein and calcium digestibility was significantly \( (p < .05) \) higher in WC1 compared to the control. Similarly, low density lipoprotein, total cholesterol and triglycerides concentration was significantly \( (p < .05) \) lower in WC1 and high density lipoprotein (HDL) cholesterol was significantly \( (p < .05) \) improved. On the overall basis, wild Cumin seeds at the rate of 0.5 g/kg were comparatively better to improve the growth, gut digestibility of the nutrients and blood cholesterol profile in broiler during the starter phase.

Introduction

Previous research findings indicate that medicinal plants have wide range positive effects on poultry health and production (Alhidary et al. 2017; Khan et al. 2012; Hafeez et al. 2020a). The inclusion of different medicinal plants have also shown comparatively superior effects as growth promoters in broiler (Abudabos et al. 2016; Hafeez et al. 2020b). The exact mechanism of the herbal plants are not known, however, it is speculated that their beneficial effects are associated with their antimicrobial, appetite stimulating and carminative effects in addition to many others (Attia et al. 2017; Abudabos et al. 2018).

Wild Cumin (Bonium persicum) is a botanical plant, which belongs to an aromatic class and bears light brown seeds. It is native plant of Middle East, India and Pakistan (Gachkar et al. 2007). Different research trials indicated that many beneficial compounds such as sesquiterpenes, mono-terpenes, flavonoids, phenolic acid and aldehyde have been isolated from this plant which have wide range therapeutic and functional properties (Hassanzadazar et al. 2018; Keykhosravy et al. 2020). Wild cumin has superiorly stomachic and carminative functions (Sofi et al. 2009; Hassanzadazar et al. 2018). It also exhibited anti-inflammatory, antioxidant, antimicrobial and anti-parasitic effects (Mandegary et al. 2012; Agah et al. 2013).

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published literature, few reports have cited the effects of wild Cumin seeds on the performance of broiler. Hasan et al. (2007) reported higher feed efficiency and weight gain in birds fed with 1% wild Cumin seeds. Khajeali et al. (2012) also reported improved findings in broiler fed with 1.5% level of wild Cumin seeds in broiler chickens. Recently, Shafiee et al. (2020) reported that wild Cumin powder had no positive effect on growth, blood metabolites, apparent digestibility of some nutrients and immune response in broiler.

To our knowledge, little information is available on *Bonium persicum* on the performance, apparent ileal digestibility of nutrients and blood profile in broiler during the starter phase. The aim of the present study was to find the effect of wild Cumin seeds on the growth, apparent ileal digestibility and blood profile of broiler during the starter phase.

**Materials and methods**

**Animal management**

A total of 360 day old broilers (Hubbard strain, male) were divided into four groups (5 replicates) in a completely randomised design. For the first week of the experiment, chicks were kept at 35 °C and the temperature was gradually brought to 25 °C in the following weeks. Birds were fed a starter diet as per recommendation of NRC (1994) as given in Table 1. Water was provided *ad libitum* and light for 23 h throughout the experiment.

**Preparation of wild Cumin seeds doses**

Seeds of wild Cumin (WC) were identified on the basis of their taxonomic features for the specific structures. After drying in a hot air oven, the seeds were milled in a metallic jar and mixed in the ration at the rate of 0.5 g (WC1), 1 (WC2) and 1.5 g/kg (WC3).

**Diets and groups**

The dietary groups were control (CONT), basal diet + WC1, basal diet + WC2, basal diet + WC3. Apparent ileal digestibility was determined by mixing titanium dioxide (Sigma Aldrich) in the feed 5% as an inert marker.

**Measurement of growth traits**

Feed intake, body weight and feed conversion ratio (FCR) of birds were measured per pen per week basis.

**Table 1. Feed composition (fed basis) and chemical analysis.**

| Ingredients (%) | Starter diet |
|-----------------|--------------|
| Maize           | 66.5         |
| Cotton seed cake| 5.00         |
| Fish meal       | 9.00         |
| Wheat bran      | 15.8         |
| Methionine      | 0.10         |
| Lysine          | 0.60         |
| Soya bean Oil   | 2.20         |
| Salt            | 0.40         |
| Lime stone      | 0.40         |
| Calculated (%)  | 92.2         |
| ME (Kcal/kg)    | 2801         |
| Ash             | 8.40         |
| Crude fibre     | 14.3         |
| Crude protein   | 21.2         |
| Ether extract   | 4.72         |
| Methionine      | 0.43         |
| Lysine          | 1.00         |
| Calcium         | 1.00         |
| Available p     | 0.46         |

Vitamin and mineral mix supplied the following per kilogram of diet: vitamin A, 10,000 U; cholecalciferol, 2000 U; vitamin E, 19 U; vitamin K, 2.2 mg; thiamine, 1.5 mg; riboflavin, 6.8 mg; niacin, 60 mg; vitamin B12, 0.013 mg; Ca pantothenate, 12 mg; folic acid, 1.0 mg; biotin, 0.2 mg; dl-methionine, 1200 mg; Fe, 90 mg; Cu, 10 mg; Zn, 80 mg; Mn, 120 mg; I, 1.2 mg; Co, 0.7 mg; Se, 0.33 mg.

**Determination of apparent ileal nutrient digestibility**

At the end of the experiment (day 14), three birds per replicate were randomly selected, slaughtered and ileal digesta were collected. The ileal digesta samples were analysed for nitrogen free extract, crude protein, ash, dry matter and crude fat by the method described by Shuib et al. (2020). Phosphorus and calcium concentration were determined using spectrophotometer and atomic absorption respectively.

**Determination of blood metabolites**

Three mL of blood samples were collected from the three slaughtered birds per replicate at day 14 to measure triglycerides, low-density lipoprotein (LDL) cholesterol, high-density lipoprotein (HDL) cholesterol, total cholesterol, glucose and protein by spectrophotometer using commercial kits (Biocheck, Inc USA).

**Statistical analysis**

Data was analysed through analysis of variance (ANOVA) under general linear model using randomised design with the help of statistical software SPSS 21.0 (SPSS Inc., Chicago, IL). Means were separated for significant difference using Tukey test. Pen was considered as an experimental unit. *p* value less than .05 was considered as statistically significant.
Results

The results of feed intake of the control and treatment groups are presented in Table 2. Results showed that feed intake during 1st week was significantly higher (p < .05) for WC3 followed by WC2 and the control. Birds in WC1 consumed the least amount of feed intake during the week 1. During 3rd week, feed intake was significantly improved (p < .05) in the control group followed by WC2, WC3 and WC1. For overall starter phase, feed intake was significantly higher for the control followed by WC3, WC2 and WC1 (p < .05) due to supplementation of wild Cumin seeds.

The findings for body weight of the control and treatment groups are shown in Table 3. Result of body weight during 1st week was significantly (p < .05) higher in WC1 compared to the rest of the treatments and the control groups. In the following week, body weight was significantly (p < .05) higher in the control group compared to the treatment groups. In the 3rd week, body weight of birds in WC3 was significantly (p < .05) higher in WC3 compared to the control. Interestingly overall body weight was significantly (p < .05) higher in WC1 compared to the control and the rest of the treatments. The results for the FCR are shown in Table 4. The FCR was significantly (p < .05) lower in WC1 during the first three weeks and on the overall basis.

The results of apparent ileal digestibility of the control and treatment groups are shown in Table 5. Results indicated that dry matter was significantly (p < .05) higher in WC1 and WC3 compared to the control. Crude protein and crude fat concentration was significantly (p < .05) higher in WC1 compared to the control and the rest of the treatments.

The findings of blood metabolites of the control and treatment groups are given in Table 6. Triglyceride concentration was significantly (p < .05) higher in WC3 compared to the control and the other groups. High density lipoprotein concentration was significantly (p < .05) higher in WC1 and WC3 compared to the control. The LDL, total cholesterol and triglycerides concentration was significantly (p < .05) lower in WC1 compared to the control. Other blood metabolites did not vary among the control and the treatment groups.

Table 2. Mean ± SEM of feed intake (g) in the control and wild Cumin supplemented broiler during the starter phase.

| Weeks | CONT | WC1 | WC2 | WC3 | SEM | p-Value |
|-------|------|-----|-----|-----|-----|--------|
| 1     | 117.0<sup>b</sup> | 114.0<sup>c</sup> | 116.0<sup>c</sup> | 134.0<sup>a</sup> | 11.2 | .02   |
| 2     | 310.0 | 303.2 | 284.7 | 395.3 | 14.3 | .61   |
| 3     | 543.0<sup>a</sup> | 481.0<sup>c</sup> | 500.0<sup>c</sup> | 510.0<sup>b</sup> | 10.3 | .001  |
| Overall mean | 969.0<sup>a</sup> | 898.0<sup>c</sup> | 900.0<sup>c</sup> | 918.3<sup>b</sup> | 9.4 | .03   |

Mean values with a row bearing different superscripts differ significantly (p < .05).

CONT: Control; WC1: wild cumin at the rate of 0.5 g/kg; WC2: wild cumin at the rate of 1.0 g/kg; WC3: wild cumin at the rate of 1.4 g/kg.

Table 3. Mean ± SEM of body weight (g) in the control and wild Cumin supplemented broiler during the starter phase.

| Weeks | CONT | WC1 | WC2 | WC3 | SEM | p-Value |
|-------|------|-----|-----|-----|-----|--------|
| 1     | 101.0<sup>c</sup> | 109.0<sup>a</sup> | 100.2<sup>c</sup> | 104.0<sup>b</sup> | 5.43 | .040   |
| 2     | 279.9<sup>c</sup> | 253.0<sup>b</sup> | 243.0<sup>b</sup> | 229.0<sup>c</sup> | 12.24 | .020   |
| 3     | 330.0<sup>c</sup> | 360.0<sup>a</sup> | 355.2<sup>b</sup> | 370.0<sup>c</sup> | 11.55 | .030   |
| Overall mean | 710.0<sup>b</sup> | 722.0<sup>c</sup> | 678.0<sup>c</sup> | 703.0<sup>b</sup> | 10.98 | .010   |

Mean values with a row bearing different superscripts differ significantly (p < .05).

CONT: Control; WC1: wild cumin at the rate of 0.5 g/kg; WC2: wild cumin at the rate of 1.0 g/kg; WC3: wild cumin at the rate of 1.4 g/kg.

Table 4. Mean ± SEM of feed conversion ratio (FCR) in the control and wild cumin supplemented broiler during the starter phase.

| Weeks | CONT | WC1 | WC2 | WC3 | SEM | p-Value |
|-------|------|-----|-----|-----|-----|--------|
| 1     | 1.2<sup>b</sup> | 1.05<sup>a</sup> | 1.2<sup>b</sup> | 1.3<sup>a</sup> | 0.11 | .030   |
| 2     | 1.1 | 1.2 | 1.1 | 1.7 | 0.12 | .405   |
| 3     | 1.3<sup>a</sup> | 1.3<sup>b</sup> | 1.5<sup>b</sup> | 1.4<sup>b</sup> | 0.13 | .020   |
| Overall mean | 1.4<sup>a</sup> | 1.2<sup>c</sup> | 1.3<sup>b</sup> | 1.3<sup>b</sup> | 0.12 | <.03   |

Mean values with a row bearing different superscripts differ significantly (p < .05).

CONT: Control; WC1: wild cumin at the rate of 0.5 g/kg; WC2: wild cumin at the rate of 1.0 g/kg; WC3: wild cumin at the rate of 1.4 g/kg.

Table 5. Mean ± SEM of the apparent ileal digestibility (%) of the control and wild cumin treated broiler during the starter phase.

| Parameters (%) | CONT | WC1 | WC2 | WC3 | SEM | p-Value |
|----------------|------|-----|-----|-----|-----|--------|
| Dry Matter     | 74.0<sup>c</sup> | 76.0<sup>b</sup> | 74.1<sup>ab</sup> | 76.3<sup>a</sup> | 1.23 | .02    |
| Crude Protein  | 65.0<sup>b</sup> | 70.0<sup>c</sup> | 65.0<sup>b</sup> | 67.0<sup>b</sup> | 1.34 | <.01   |
| Crude Fat      | 79.0<sup>b</sup> | 79.0<sup>c</sup> | 76.0<sup>b</sup> | 79.0<sup>b</sup> | 2.31 | .04    |
| Nitrogen Free Extract | 83.4 | 86.1 | 84.2 | 86.0 | 1.89 | .11    |
| Calcium        | 26.1<sup>b</sup> | 29.0<sup>c</sup> | 26.0<sup>b</sup> | 28.0<sup>b</sup> | 1.26 | <.01   |
| Phosphorus     | 28.3 | 26.0 | 26.0 | 26.0 | 2.11 | .06    |

Mean values with a row bearing different superscripts differ significantly (p < .05).

CONT: Control; WC1: wild cumin at the rate of 0.5 g/kg; WC2: wild cumin at the rate of 1.0 g/kg; WC3: wild cumin at the rate of 1.4 g/kg.

Table 6. Mean ± SEM of the blood metabolites of the control and wild cumin treated broiler during the starter phase.

| Parameters (mg/dL) | CONT | WC1 | WC2 | WC3 | SEM | p-Value |
|--------------------|------|-----|-----|-----|-----|--------|
| Triglycerides      | 44.0<sup>b</sup> | 44.0<sup>b</sup> | 44.2<sup>b</sup> | 48.0<sup>a</sup> | 2.31 | <.01   |
| Total Cholesterol  | 117.4<sup>ab</sup> | 112.2<sup>b</sup> | 13.0<sup>a</sup> | 122.4<sup>a</sup> | 2.34 | <.01   |
| LDL (mg/dL)        | 48.0<sup>a</sup> | 39.0<sup>b</sup> | 45.0<sup>b</sup> | 43.0<sup>b</sup> | 1.45 | <.01   |
| HDL (mg/dL)        | 55.0<sup>b</sup> | 60.1<sup>a</sup> | 56.0<sup>b</sup> | 57.0<sup>b</sup> | 1.28 | .01    |
| Glucose (mg/dL)    | 12.0 | 12.0 | 12.0 | 12.0 | 0.12 | .68    |
| Protein (g/dL)     | 4.2  | 4.3  | 4.0  | 4.0  | 0.11 | .22    |

Mean values with a row bearing different superscripts differ significantly (p < .05).

CONT: Control; WC1: wild cumin at the rate of 0.5 g/kg; WC2: wild cumin at the rate of 1.0 g/kg; WC3: wild cumin at the rate of 1.4 g/kg.
Discussion

In the current study, feed intake was significantly higher in the control group compared to the treatment groups. Also the body weight and FCR were significantly higher in WC1 compared to the control. Interestingly, weight gain was higher in WC1 though the feed intake was less compared to the other groups. It seems that the higher growth in this group is due to the right dose of WC at which it suits the best for optimum growth in birds. Little information is available in the published literature to compare the effect of *Bonium persicum* on the performance in broiler chickens. Shafiee et al. (2020) did not report significant effect on the feed intake in broiler dosed with 0.25 and 0.75% WC seeds, which could be due to the lower doses of the WC as compared to the results in our study. The reduced feed intake in the present study may be due to anti-nutritional factors such as p-cymenene and y-terpinene in *Bonium persicum* (Foroumadi et al. 2002). Wild Cumin seeds have a number of compounds such as polyphenol, estragol, anethole, limonene, carvone, carvacrol, linalool, and monoterpenes. The improved weight gain and feed efficiency of birds fed with WC seeds may be due to the presence of these compounds which have antibacterial and antioxidant effects (Thippeswamy et al. 2013; Abdalaziz et al. 2017). Additionally, we found that the apparent ileal digestibility of the nutrients was comparatively better improved in WC1. It seems that the improved growth and feed efficiency in birds in this group is due to the higher digestibility indices in this group.

The result of the present study indicated that dry matter, calcium, crude protein and crude fat were significantly higher in birds in WC1. The higher dry matter could be the result of greater feed intake in the treatment groups. Also the higher calcium availability could be due to the enhanced digestibility potential of WC. The higher weight gain and lower FCR resulted from the supplementation of WC seeds in the present study can be attributed to higher apparent ileal digestibility of nutrients. The literature suggests that *Bonium persicum* has a high nutritive profile (Hassanzadazar et al. 2018). Moreover, herbal plants activate pancreatic secretion which increases the digestion and absorption of amino acids from the bird digestive tract. The literature also suggests that increased flow of bile juices, and more release of enzymes responsible for digestion could be one of the most important mechanism which lead to improved digestibility of nutrients in broilers (Khan et al. 2012). Moreover, antimicrobial impact is produced due to supplementation of feed with herbal products which may result in increased appetite and enhanced digestion in broilers. Another reason could be increased bile secretion and positive effects on release of digestive enzymes (Attia et al. 2017). Anti-fungal and anti microbial effects exerted by herbs could also end up in enhanced digestibility of nutrients (Saleh et al. 2014). Growth of intestinal mucosa and improved morphology of gut may have resulted in enhanced digestibility of nutrients in response to WC seeds. The higher doses of WC in the current study were less effective on the most of the parameters of the apparent digestibility which may be due to the anti-histaminic activity that may negatively influence the intestinal secretions (Shafiee et al. 2020).

In the present study, triglyceride was significantly low in WC1 and HDL cholesterol was significantly higher in the same group. Blood profile in broilers receiving diet supplemented with WC may be affected due to various possible reasons. Wild Cumin seeds have anti-oxidant properties which are responsible for decreased lipids peroxidation resulting in improved blood profile (Al-Mamary 2002). Moreover, WC may have hypo-lipidemic and hypo-cholesterolaeic properties. In addition, the Acetyl CoA synthetase enzyme may be inhibited by WC, which is responsible for biosynthesis of fatty acids. In the current study, the growth performance and blood biochemical were improved parallel in birds supplemented with 0.5 WC. It seems that the growth performance is heavily dependant on the digestability indices and blood biochemical profile in broiler. Why the higher doses of WC seeds have negative impact on the growth and health of birds is still to be researched, however, we speculate that the higher doses increase the stint smell and decrease the palatability of diet especially during the starter phase.

Conclusions

Overall feed intake was significantly lower in 0.5 g/kg, however, weight gain and feed efficiency were superior in this group. Digestibility of dry matter was significantly higher in all the treatment groups. Blood triglycerides were decreased in 0.5 and 1.0 g/kg, however, total cholesterol and LDL decreased significantly in 0.5 g/kg while HDL cholesterol increased in the same group. On overall basis, the dose of 0.5 g/kg wild Cumin seeds was superior to the other treatments in improving the growth, digestibility indices and blood cholesterol in broiler during the starter phase.
Disclosure statement
No potential conflict of interest was reported by the author(s).

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