The Pharma Innovation Journal 2023; SP-12(12): 1284-1289

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; SP-12(12): 1284-1289

www.thepharmajournal.com
Received: 24-09-2023
Accepted: 28-10-2023

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Impact of silymarin and chromium picolinate supplementation on growth performance of broiler chicken

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Abstract
The experiment was undertaken to assess the impact of silymarin and chromium picolinate on growth performance of broiler chicken.180-day-old broiler chicks (Cobb-400) were randomly divided into four groups (n = 45) with three replications, 15 chicks in each. Group I acted as control without any supplementation of silymarin and chromium picolinate. However, groups II, III, and IV were supplemented with silymarin @ 500 mg/kg feed as milk thistle extract, chromium @ 400 µg/kg feed as chromium picolinate and a combination of silymarin (500 mg/kg feed) and chromium picolinate (400 µg/kg feed) respectively, from day old to 42 days age. The body weight, body weight gain, feed intake, feed conversion ratio was recorded at weekly intervals. The body weight, body weight gain, feed intake and feed conversion ratio was improved significantly (p<0.05) in the groups that received silymarin and chromium picolinate either alone or in combination as compared to the control group. The present study showed that the supplementation of silymarin and chromium picolinate in broiler chicks improved the growth performance of broiler chicken.

Keywords: Silymarin, chromium picolinate, broiler, body weight, body weight gain, feed intake, feed conversion ratio, group, milligram, microgram

Introduction
Silymarin (*Silybum marianum*) is an extract of 'milk thistle' plant which belong to Asteraceae family. Its seed contain the highest concentration of the active compound, silymarin (Lee *et al*., 2003) [14]. Silymarin is a primary dried extract of milk thistle plant. There are numerous flavonolignans in silymarin that have been shown to have antioxidant, anti-inflammatory, anti-fibrotic, anti-lipid per oxidative, immune-stimulating and hepatic cell stabilizing properties (Negi *et al*., 2008) [18]. In the poultry production system, silymarin has been used to promote growth in broilers and to increase egg production and quality in layers (El-Ghany, 2022) [7]. Silymarin has a variety of beneficial features, including the ability to decrease lipid peroxidation, be a potential supplemental treatment for diabetes, have hepatoprotective effects, reduce inflammation, and fight cancer.
In the broiler industry, chromium is typically not regarded as a trace mineral that is necessary (Amata, 2013) [3]. Chromium, however, was found to improve food digestion, feed conversion ratio, lean muscle growth and, as well as boost weight gain and high density lipoprotein (Sahin and Kucuk, 2003; Al-Bandr *et al*., 2010) [19, 2]. As a vital part of the GTF (glucose tolerance factor), chromium helps in the regulation of hunger, hypoglycemia & protein uptake as well as acting as a preventative measure for diabetes and heart disease (Mertz, 1993) [15]. The addition of natural Cr to broiler diets increased final BW and BWG (Mohammed *et al*., 2014) [16]. Broilers diets supplemented with 800 ppb CrPic had lower triglycerides, free fatty acids and blood levels of glucose (Kim *et al*., 1996) [12]. Huang *et al*. (2016) [9] proposed that the inclusion of 400 or 2000 µg/kg CrPic in the diet of birds could enhance the average daily gain of broilers and improve their carcass traits and meat quality, especially in conditions characterized by heat stress.

Materials and Methods
All the procedures followed in this study were sanctioned by the Institutional Animal Ethics committee, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut. 180-day-old broiler chicks (Cobb-400) were purchased (Venkey's Hatcheries Pvt. Ltd. Dehradun) and reared at Poultry Research and Training Centre, Sardar Vallabhbhai Patel University of

Agriculture and Technology, Meerut. Chicks were randomly divided into four groups (n = 45) and each group was divided into three replications, 15 chicks in each. Group I acted as the control without any supplementation of silymarin and chromium picolinate, However, groups II, III and IV were supplemented with silymarin at a dose of 500 mg/kg feed as milk thistle extract (purity 80%, World of Nature, Pune, Maharashtra. India), chromium at dose 400 µg/kg feed as chromium picolinate (purity 96%, Hi Media Laboratories Pvt. Ltd, Mumbai, India) and a combination of silymarin (500 mg/kg feed) and chromium (400 µg/kg feed), respectively from one day old to 6 weeks of the experiment. Throughout the 42-day study period, the birds were provided with non-pelleted diets and unrestricted access to water. The diets were formulated as per the nutrient requirements according to NRC (1994). The chicks were raised in well-ventilated pens using a deep litter system. Prior to spreading the dry rice husk as bedding material, the floor was meticulously cleaned, disinfected, and dried. The husk of rice was evenly spread in 4-6 cm thickness. Electric bulbs 15-watt in the pan was fitted at appropriate heights to provide uniform lighting. The chicks received ample amounts of feed from 0 to 6 weeks of age. Initially, for the first three days of brooding, feed was placed on newspaper spread on the floor. Subsequently, linear chick feeders were utilized up to 14 days, with periodic weighing at weekly intervals. Starting from the 20th day, finisher rations were introduced during the finishing phase. Fresh and clean drinking water was made available to the birds every morning and evening throughout the experimental period. The chicks were given a starter diet from days 1 to 21 and transitioned to a finisher diet from days 22 to 42. Starter and finisher rations both were purchased from the local market of Meerut City.

Data recording

Body weight (BW) and feed consumption (FC) were measured at weekly intervals using a digital electronic balance. FC was determined by subtracting the residual feed from the offered feed per day, recorded at weekly intervals. Body weight gain (BWG) was calculated at fortnightly intervals using the formula: BWG = BW of the current week - BW of the previous week. The feed conversion ratio (FCR) were calculated as: FCR = FC (g) / BWG (g)

Statistical Analysis

The data were analyzed using a one-way analysis of variance (ANOVA) procedure with the statistical software package SPSS version 20 (SPSS for Windows, V 20.0; SPSS, Inc., Chicago, IL, USA). The model was utilized for estimating the impact of silymarin and chromium picolinate on the growth profile. The application of the model proceeded as follows.

$$Yij = \mu + Ti + eij$$

Where, Yij = dependent variable
µ = overall mean of a population Ti = effect of the treatment (silymarin and chromium picolinate) (i = 1….4); eij=random error.

Result

Body weight

The impact of supplementing silymarin and chromium picolinate on the body weight of broiler chickens is illustrated in Table 1.1 and Figure 1.1. Throughout the experiment, it was noted that body weight exhibited a significant increase in the T_4 group, which received 500 mg of silymarin and 400 µg of chromium picolinate per kg of dry matter (DM), in comparison to T_2 (500 mg silymarin/kg DM), T_3 (400 µg chromium picolinate/kg DM), and the control groups (not supplemented) over the course of the experimental period. Nonetheless, there was a statistically significant variation in the mean body weight among the groups, with the T_4 group registering the highest mean body weight compared to all other groups.

Table 1: Effect of silymarin and chromium picolinate on body weight (g) of broiler

Week	T_1	T_2	T_3	T_4	SEM
0	42.97	44.13	45.00	45.13	0.33
1	171.34	171.56	171.77	171.91	0.43
2	427.52	441.80	454.40	481.96	0.60
3	702.16	750.32	764.17	851.53	1.35
4	1014.00	1135.67	1160.80	1273.20	1.18
5	1363.21	1553.80	1572.87	1784.67	0.79
6	1790.33	2093.40	2158.47	2392.47	1.09
Mean	787.36[a]	884.38[b]	903.93[c]	1000.12[d]	0.82

T_1, Control; T_2, silymarin supplemented group (500 mg/kg feed); T_3, chromium picolinate supplemented group (400 µg/kg feed); T_4, silymarin + chromium picolinate supplemented group (500 mg +400 µg/kg feed); SEM, standard error mean
Mean with different superscripts (a, b, c, and d) in a row varied statistically at $p<0.05$.

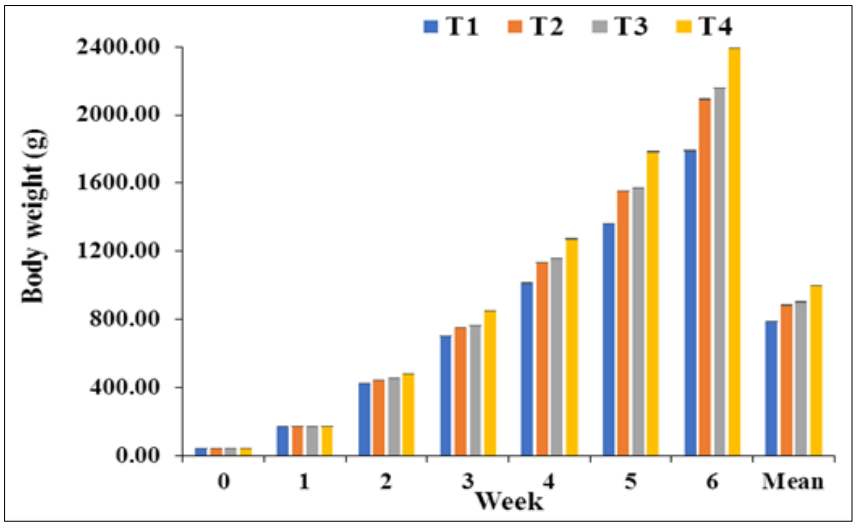

Fig 1: Weekly changes in the body weight of different group of broilers chicks

Body weight gain

The body weight gain (BWG) of the broilers that were supplemented with silymarin and chromium picolinate has been revealed in Table 1.2 and Figure 1.2. The body weight gain (BWG) on day seven of the experimental period was detailed as 128.77, 127.42, 126.77 and 126.77 g in control, silymarin, chromium picolinate, and silymarin + chromium picolinate supplemented groups, respectively. However, the corresponding BWG was 425.44, 539.60, 585.60 and 607.80 g on 42 days of the trial. The mean BWG was 293.45, 341.54, 352.24 and 391.22 g in the control, silymarin, chromium picolinate, and silymarin + chromium picolinate fed groups, respectively. There was a statistically significant difference (p<0.05) in the mean value of body weight gain (BWG) among the groups. Specifically, the group that received both supplemental silymarin and chromium picolinate showed a significantly higher (p<0.05) BWG compared to all other groups.

Table 2: Effect of silymarin and chromium picolinate on body weight gain (g) of broiler chicks

Week	T_1	T_2	T_3	T_4	SEM
1	128.77	127.42	126.77	126.77	0.53
2	259.09	270.24	282.63	310.05	1.11
3	281.59	308.52	309.77	369.57	2.52
4	310.13	385.34	396.63	421.67	1.83
5	355.71	418.13	412.07	511.47	1.85
6	425.44	539.60	585.60	607.80	1.81
Mean	293.45[a]	341.54[b]	352.24[c]	391.22[d]	1.61

T_1, Control; T_2, silymarin supplemented group (500 mg/kg feed); T_3, chromium picolinate supplemented group (400 µg/kg feed); T_4, silymarin + chromium picolinate supplemented group (500 mg +400 µg/kg feed); SEM, standard error mean.

Mean with different superscripts (a, b, c, and d) in a row varied statistically at p<0.05

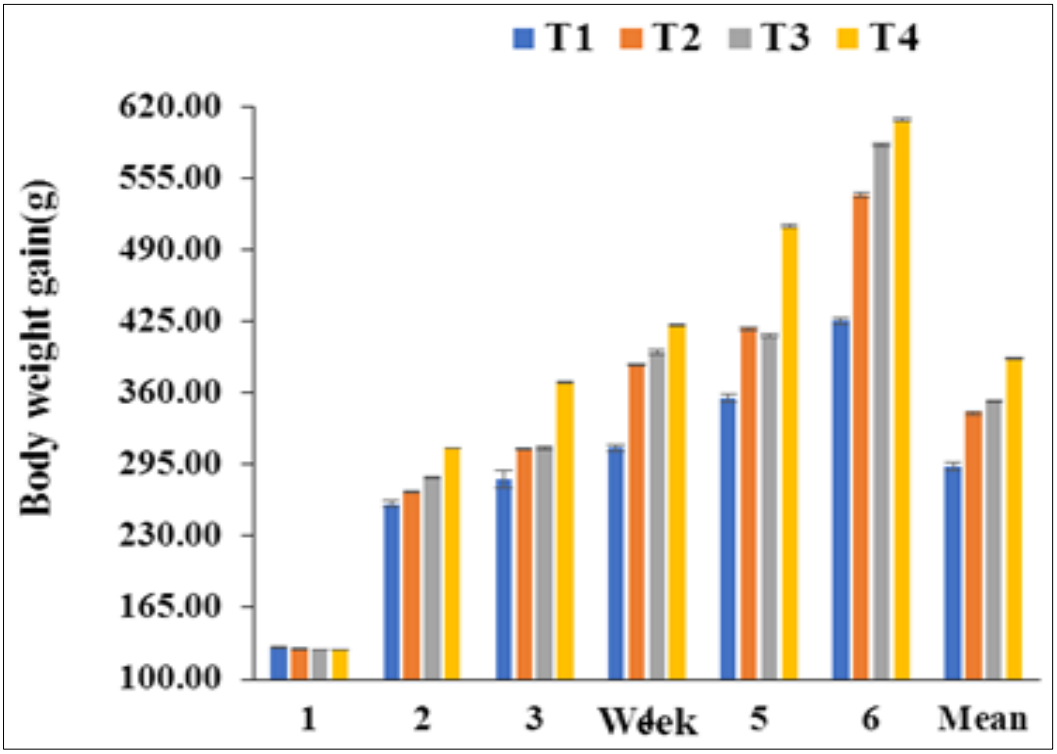

Fig 2: Weekly changes in the body weight gain of different group of broilers chick

Feed consumption

The feed consumption of broiler chickens throughout the study period is presented in Table 1.3 and Figure 1.3. The mean feed consumption was 621.96 g in the control group (T_1), 640.17 g in the silymarin group (T_2), 663.07 g in the chromium picolinate group (T_3), and 702.56 in the silymarin + chromium picolinate group (T_4). Notably, there were statistically significant differences in the mean feed consumption among the groups. The chromium picolinate-supplemented group (T_3) exhibited the lowest mean feed consumption, followed by the silymarin + chromium picolinate group (T_4), the silymarin group (T_2), and finally, the control group (T_1).

Table 3: Effect of silymarin and chromium picolinate on feed intake (g) of broiler chicks

Week	T_1	T_2	T_3	T_4	SEM
1	161.07	162.13	162.07	162.00	0.66
2	342.67	366.73	377.67	409.67	1.46
3	484.67	497.13	509.67	554.67	1.09
4	692.67	702.67	719.67	769.67	1.20
5	849.67	892.67	899.67	969.67	1.26
6	1201.00	1219.67	1309.67	1349.67	1.28
Mean	621.96	640.17	663.07	702.56	1.16

T_1, Control; T_2, silymarin supplemented group (500 mg/kg feed); T_3, chromium picolinate supplemented group (400 µg/kg feed); T_4, silymarin + chromium picolinate supplemented group (500 mg +400 µg/kg feed); SEM, standard error mean.

Mean with different superscripts (a, b, c, and d) in a row varied statistically at p<0.05

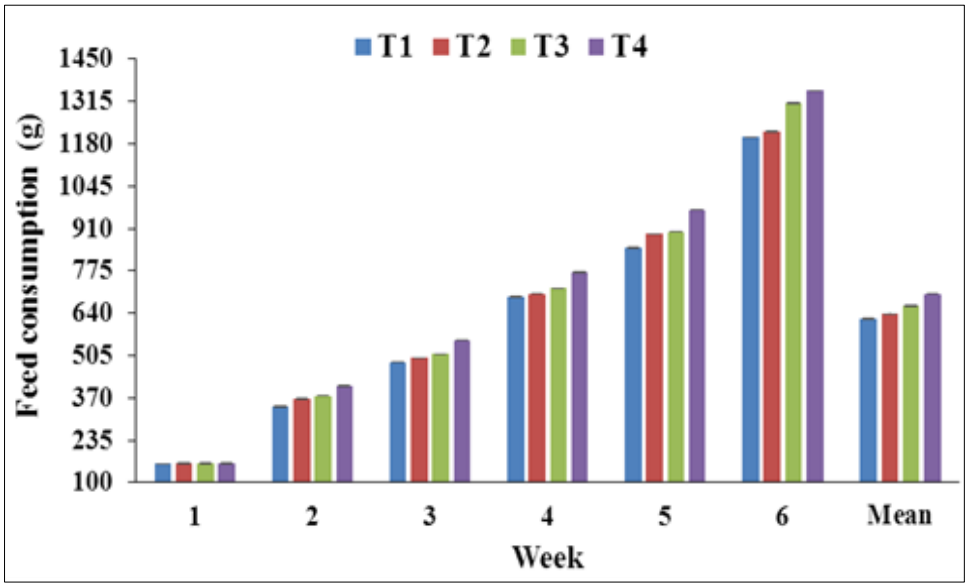

Fig 3: Weekly changes in the feed intake of different group of broilers chick

Feed conversion ratio (FCR)

The feed conversion ratio (FCR) for the experimental broiler chickens is displayed in Table 1.4 and Figure 1.4 The mean FCR values were 1.96 for group T_1, 1.74 for group T_2, 1.75 for group T_3, and 1.67 for group T_4. The statistical analysis indicated that group T_4 exhibited a significantly lower mean FCR compared to groups T_2, T_3, and the control group (T_1).

Table 4: Effect of silymarin and chromium picolinate on feed conversion ratio of broiler chicks

Week	T_1	T_2	T_3	T_4	SEM
1	1.25	1.27	1.28	1.28	0.01
2	1.32	1.36	1.34	1.32	0.01
3	1.72	1.61	1.65	1.50	0.01
4	2.23	1.82	1.81	1.83	0.01
5	2.39	2.13	2.18	1.90	0.01
6	2.82	2.26	2.24	2.22	0.01
Mean	1.96	1.74	1.75	1.67	0.01

T_1, Control; T_2, silymarin supplemented group (500 mg/kg feed); T_3, chromium picolinate supplemented group (400 µg/kg feed); T_4, silymarin + chromium picolinate supplemented group (500 mg +400 µg/kg feed); SEM, standard error mean.
Mean with different superscripts (a, b, c, and d) in a row varied statistically at $p<0.05$

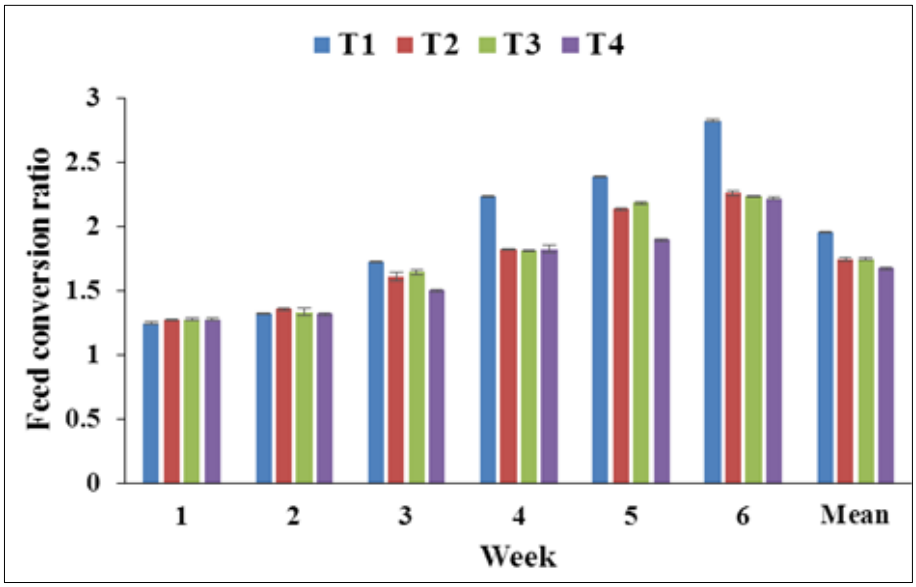

Fig 4: Weekly changes in the feed conversion ratio of different group of broilers chick

Discussion

BW was improved with supplementation of silymarin and chromium picolinate alone or in combination. In agreement with our finding Belvins *et al*. (2010) [4], reported that administering silymarin at a dosage of 1000 mg/kg resulted in an enhancement of BW and FC in broiler chickens. Broiler

chickens who consumed silymarin (160 mg/kg diet) at the stages of rearing starter, grower, and finisher showed an improvement in their BWG and FCR (Mousa and Osman 2016) [17]. Ebrahimi *et al*. (2014) [6] found that the growth performance of broilers improved when they were exposed to lead-induced oxidative stress and administered different levels of silymarin (0 mg/kg, 100 mg/kg, and 200 mg/kg). Tedesco *et al*. (2004) [21] documented that broiler chicks, which were fed a diet containing 0.8 mg/kg of aflatoxin and treated with 600 mg/kg of silymarin, showed improved feed intake and enhanced feed conversion rates. In the study conducted by Jahanian *et al*. (2017) [10], chicks were given silymarin supplements at doses of 0, 500, and 1000 ppm. The inclusion of silymarin in the diet resulted in a notable enhancement in body weight gain. Khan *et al*. (2014) [11] observed that the enhanced growth efficiency, particularly with chromium picolinate (CrPic) supplementation, can be attributed to the positive biological effects of chromium (Cr) supplementation. The discovery of enhanced growth performance in broilers aligns with prior research conducted by Toghyani *et al*. in 2006 [22] and Sahin *et al*. in 2002 [20]. Sahin *et al*. (2002) [20] documented that the inclusion of chromium in the diet resulted in significant improvements in body weight, feed intake, and enhanced feed efficiency. The chicks received chromium supplements at doses of 0, 200, 400, 800, and 1200 µg/kg, respectively. Kroliczewska *et al*. (2005) [13] similarly observed that chickens supplemented with chromium at a level of 500 µg/kg exhibited increased body weight, body weight gain, and improved feed efficiency.Similar to our findings, Toghyani *et al*. (2006) [22] reported a significant increase in the body weight, body weight gain, and feed intake of broilers with the supplementation of 500, 1000, and 1500 ppb chromium in the form of chromium picolinate, as compared to the control groups. Ghanbari *et al*. (2012) [8] found that chromium picolinate supplementation @ 0 (control), 400, 800, 1200, 1600 and 2000 µg Cr per kg of basal diet showed no significant changes in FCR. Akbari and Torki (2014) [1] observed that average daily feed intake (ADFI), average daily gain (ADG), and body weight (BW) were not significantly influenced by dietary CrPic and P. mint.

Conclusion

The supplementation of silymarin and chromium picolinate demonstrated improvements in body weight, body weight gain, feed intake, and feed conversion ratio in broilers, whether supplemented individually or in combination. There were statistically significant variations (p<0.05) BW, BWG, feed intake and FCR among the groups, with the highest values reported in the T4 group.

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