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Original Article

Assessment of Liver and Kidney Profile in Broiler Chicken Exposed to Food Azo Dye Tartrazine

Farah Ashfaq[1], Sara Hayee[1*], Samia Kausar[2], Fozia Bashir[3], Amir Nadeem[4] and Tehreem Zahid[2]

[1]Department of Zoology, Government Graduate College for Women, Samanabad, Lahore, Pakistan
[2]Department of Zoology, Lahore College for Women University, Lahore, Pakistan
[3]Department of Biology, Government Associate College for Women, Manga Mandi, Lahore, Pakistan
[4]Department of Zoology, Government Islamia Graduate College, Civil Lines, Lahore, Pakistan

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***Corresponding Author:**

Sara Hayee
Department of Zoology, Government Graduate College for Women, Samanabad, Lahore, Pakistan
sarahayee33@gmail.com

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ABSTRACT

Food additives give the aesthetic appearance of the materials desired by consumers. These have been categorized into preservatives, antioxidants, colorants, emulsifiers, flavors, and filters. Tartrazine is one of the AZO dyes and is a commonly used food color that provides a lemon-yellow color. There is conflicting data available about the toxic effects of tartrazine. **Objective:** To determine the effects of tartrazine on the liver and kidney profiles of broiler chickens. **Methods:** For this purpose, forty-five broiler chickens were taken and divided into three groups, each with fifteen chickens. The two experimental chicken groups were treated with 5mg and 10 mg doses of tartrazine. The observed parameters included serum-level creatinine, urea, alanine aminotransferase (ALT) and aspartate aminotransferase (AST). **Results:** The parameters serum level urea, serum level creatinine, ALT and AST have shown significant increase in experimental group I and II as compared to control group. **Conclusions:** All the parameters observed in this study were increased compared to the control group. AST and ALT parameters increased in experimental groups showing liver damage.

INTRODUCTION

In the food industry, many food additives are used. Among these additives, it is considered that food colors are the most toxic [1]. Tartrazine is an orange -yellow colored synthetic food color originally isolated from bitumen by a German scientist, J. H. Ziegler, in 1884 [2]. Also, it is derived from coal tar and is a water-soluble compound [3]. It is considered as most commonly used food color. It has been reported to be used in the leather, textile and cosmetic industries [4]. When tartrazine enters the digestive system through food, it is mainly absorbed by the intestinal epithelium. It is metabolized by hepatic or mammalian intestinal wall azo reductase into Sulphanililc acid, which has potential carcinogenic impacts [5]. According to the World Health Organization (WHO), 7.5 mg/kg/day is the permissible dose for tartrazine. Several studies have reported its relation with health disorders [6]. It has been revealed earlier that tartrazine has some immune-toxic properties [7, 8]. It has been reported that tartrazine

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influenced organs like the liver, kidney and stomach in experimental animals [9]. Earlier studies on tartrazine revealed its effects on DNA damage, particularly in the liver and kidney [10]. This azo dye is processed in humans by azo reductase and excreted in urine [11]. European Food Safety Authority (EFSA) has reported that metabolites of tartrazine are absorbed to a larger extent than this dye itself [12]. This dye is not only dangerous in itself but also because of its byproducts [13]. The present study uses broiler chicken as an animal model to evaluate the effects of tartrazine in low and high doses on liver and kidney profiles. For kidney profiling, urea and creatinine were studied. Urea is a major end product of protein and amino acid catabolism [14]. Both urea and Creatinine tests are helpful to diagnose impaired renal function [15]. Aminotransferase (ALT) and aspartate aminotransferase (AST) tests were performed for liver profiling. These are the most common liver chemistries. The hepatocellular injury coincides with disproportionate AST and ALT levels [16].

METHODS

The study was carried out in the physiology lab of Lahore College for Women, University, Lahore in March to April, 2023. Forty-five broiler chickens of average size 300 gm were purchased from Tolinton Market, Lahore. Birds were reared in scaffolding cages of 2 m (length) × 1 m (width) × 1 m (height). The raring cages, feeding and drinking units were installed and fumigated 24 hours before introducing the chicks into the units. These were acclimatized for one week in an animal house before the start of the experiment under standard conditions. The temperature ranged from 25-30 °C. The room was well-ventilated. The chickens were fed a basic diet including wheat, soyabean and distilled water. The animals were divided into three groups. Each group had fifteen animals. The first group was the control group (CG), which was not treated with tartrazine. The second group, group 1 (G1), was a low-dose group in which animals were given 5mg/kg tartrazine. The third group, group 2 (G2), was a high-dose group with a 10mg/kg dose. Both these groups were orally administered with tartrazine for thirty days daily. No death rate was recorded during the experiment, which showed that animals remained healthy. Tartrazine is a yellow substance known as E102 or FD & yellow 5 dye (Figures 1 and 2). It was purchased from a pharmaceutical market. The 5 mg and 10 mg of tartrazine were mixed with 10 ml of distilled water to prepare low and high doses for groups 2 and 3, respectively.

Figure 1: Tartrazine. Courtesy: [17]

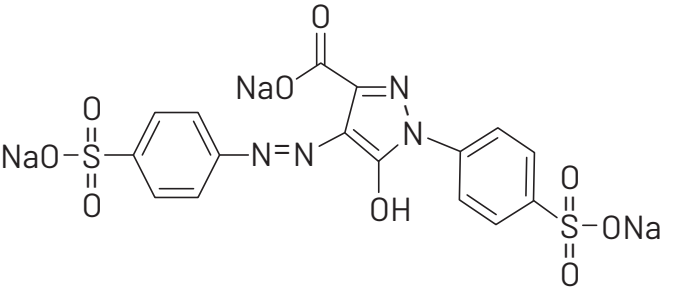

Figure 2: Chemical formula of tartrazine. Courtesy: [18]

After thirty days, the animals were sacrificed. Their blood samples were collected in sample tubes. These samples were centrifuged at 4000 rpm for 15 minutes and serum samples were stored in a freezer at -40 °C until the parameters were studied. The studied parameters include serum-level creatinine, urea, alanine aminotransferase (ALT) and aspartate aminotransferase (AST). All the parameters were determined with the help of their respective commercially available kits and chemistry analyzers. Data were represented as mean ± SEM (Standard Error Method). The comparison between the control and experimental groups was done by applying ANOVA. Bar graphs represent the comparison between the groups. All graphs were made on Origin 6.0 Professional. Data were analyzed on the SPSS version 21.0.

RESULTS

The control group contained fifteen chicks. These were untreated birds fed on a basal diet and distilled water. Their body weight remained the same when measured on the 1st and 30th day of the experiment. In this group, serum levels of creatinine and urea were 0.27± 0.01 g/L and 0.338 ± 0.041g/L respectively. The levels of ALT and AST were found to be 54 ± 5.31/ UL and 129.09 ± 2.9 /UL respectively. The Control group fed by basal diet and saline water only showed the mean ± SEM value of alanine transferase (ALT) as 54 ± 5.31/UL. The AST value was 129.09 ± 2.9/UL (Table 1, Figure 3). Group 1 (G1), a low-dose group, was treated with 5 mg tartrazine. The mean Value of Serum Creatinine Level was 0.65± 0.03g/L. This group's mean Value of Serum Urea Level was 0.398 ± 0.025g/L. The significance is ($p < 0.03$). The mean ±SEM value of ALT/UL was 67.32± 4.27 /UL. The

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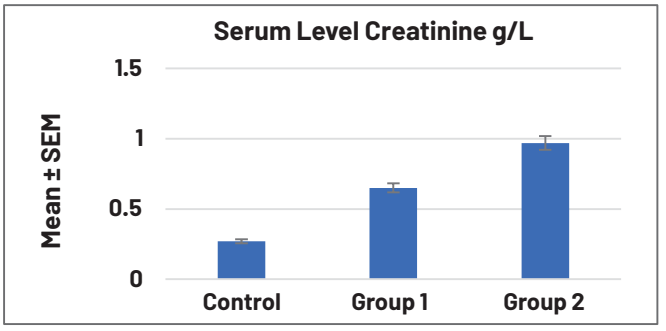
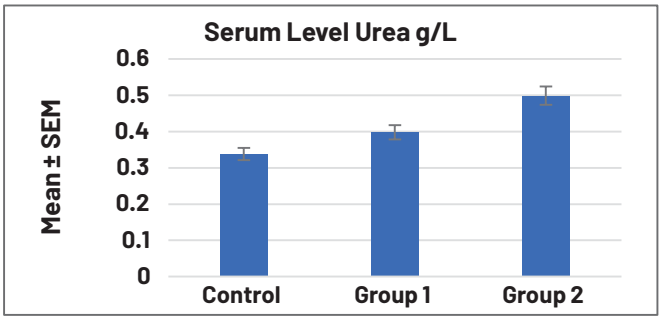
mean ± SEM value of AST/UL was 131.45 ± 4.41/UL. All the parameters increased significantly as compared to the control group (Table 1, Figure 3). This group's (G2) mean serum creatinine level was 0.97 ± 0.05 g/L. The mean value of Serum Urea level was 0.499± 0.021g/L. The significance is (p< 0.03). In this group, ALT's mean ± SEM value was 72.12± 0.091/UL. The mean ±SEM value of AST/UL was 171± 0.01/UL.All the parameters increased significantly as compared to the control group and group 1(Table1, Figure3)

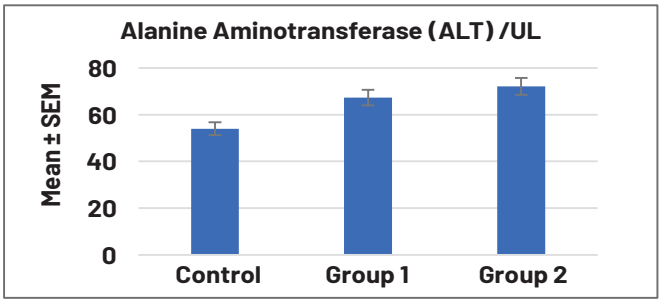
Table 1: Mean ± SEM (g/L) values of all parameters in the control group, Group 1 and Group 2

Parameters	Mean ± SEM (g/L)			ANOVA p-value
	Control (CG) n= 15	Group 1 (G1) 5 mg/kg Tartrazine n=15	Group 2 (G2) 10 mg/kg Tartrazine n=15	
Serum Urea level (g/L)	0.338± 0.041	0.398 ± 0.025	0.499± 0.021	0.03
Serum Creatinine level (g/L)	0.27± 0.01	0.65± 0.03	0.97 ± 0.05	0.02
Alanine Amino-transferase (ALT)	54 ± 5.31	67.32± 4.27	72.12± 0.091	0.02
Aspartate Amino-transferase (AST)	129.09 ± 2.9	131.45 ± 4.41	171± 0.01	0.02

p>0.01=highly significant
p>0.05 = Significant







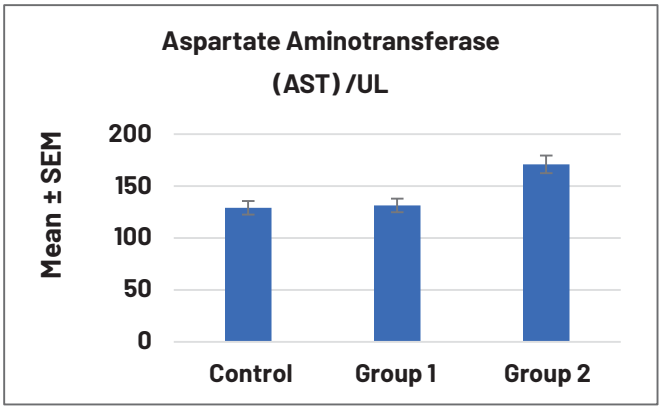


Figure 3: Mean ± SEM (g/L) values of serum level urea, serum level creatinine, AST and ALT of the control group, group 1 and group 2

DISCUSSION

The alanine aminotransferase (ALT) and aspartate aminotransferase (AST) tests are thought to be liver-specific tests. These tests help determine damage in the liver [19]. It is also called the SGOT (Serum Glutamic Oxaloacetic Transferase); its value is low in the liver, but when there is a liver injury, more enzyme is released, which shows some liver problem. Our results showed a significant increase in the AST of the liver as the broiler chicks were dosed with 10 mg/kg (high dose), but at 5mg/kg dose, there was a slight increase in the AST. Our results support some of the previous studies on this work. Chocolate brown and tartrazine were fed to the rats to depict the liver function of the rats. Results showed a considerable increase in the AST value of the liver of 108% and 106% of the control group [20]. The alanine aminotransferase (ALT) is a liver protein that helps in breakdown in the liver cell. It helps the body break down other proteins to metabolize them easily. ALT is mainly found in the liver cells but when the liver is injured or flamed, it is released in the bloodstream, which means there is some problem with the liver. The rising level of ALT indicates chronic damage in hepatocytes. In the current study, an increased level of ALT was observed. Elevations in levels of ALT and AST have been reported in similar studies carried out on rats [20, 21]. Creatinine is a chemical compound that is formed after an energy-producing process. Our healthy kidneys filter it and exit it in the urine [22]. In the present study, a rise in creatinine levels was observed. Our study gets support from similar findings [23], which discovered a remarkable rise in serum creatinine and urea levels when rats devour high dosage of tartrazine (500 mg/kg bw) or less dosage of tartrazine (15 mg/kg bw). Urea is a major nitrogenous waste product formed during amino acid catabolism. A modest quantity of urea is wiped out through perspiration and the gut; however, a large portion of urea delivered in the liver is moved in blood to the kidneys, where it is disposed of from

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the body in urine. In the present study, the serum urea level was increased by increasing the dose. A similar study reported that rodents ingested either low or high portions of tartrazine demonstrated elevated serum urea levels [24].

CONCLUSIONS

The discoveries of the present trial study show that tartrazine prompts antagonistic poisonous impacts in Chicks when directed for high doses. Biochemical examination showed that high and low dosages of tartrazine application influenced the congregation of Urea and Creatinine Levels. Moreover, high levels of AST and ALT showed liver damage in broiler chickens. Increasing rates of liver enzymes resulted in injurious pathological effects that may destroy the liver cells. This study should be conducted with a large sample size. If this experiment were done for the long term with different doses, it would give more precise and valuable data.

Authors Contribution

Conceptualization: FA
Methodology: SK, TZ
Formal analysis: SK, TZ
Writing-review and editing: SH, FB, AN
All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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