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Full Length Research Paper

Histopathological changes observed in the heart and gizzard of quail chicks *Coturnix coturnix japonica* administrated by the different levels of chrome shaving

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The present study showed the effects of different levels of tannery wastes or chrome shaving on quail chicks up to 9 months. The chrome shaving was given at 2.5 and 5% levels in replacement of animal proteins in chicks feed commercially available. Heart and gizzard were selected for the histopathological studies and effects of different levels were studied in these tissues. Histopathological changes like splitting of muscle, vacuolation, necrosis, pyknosis, and loss of striation and degeneration in heart and gizzard of quail chicks were observed and more pronounced at 5% chrome shaving levels compared to 2.5% level in last 3 weeks. These changes were time and dose dependent.

Key words: Histopathology, Chrome shavings, Quail chicks.

Introduction

The use of animal skin by man is as old as the history of mankind on the earth. The leather industry is very important, as it is the second most export oriented in Pakistan. Tanning industry uses water and some chemicals and so creates environmental problems, depending basically and the principal sources, hide and water. Tanning process produces a very obnoxious and smelly waste, which contains chromium, sulphides, ammonia, chloride and other salts, in addition to a large quantity of organic components. These industries in Pakistan are one of the most seriously pollution sources. A sample of tannery effluent contained 0.30 copper mg/l, 0.15 cadmium mg/l, 7 zinc mg 1.14mg/l nickel and 1.8 mg/l of lead. These levels were almost all well above the suggested standard for toxic substance concentrations in effluent (ATSDR, 2002).

Clinical and experimental research data show that chromium supplementation within the recommended safe and adequate intake levels are relatively non-toxic. However, there is a potential for side effects. Renal failure has been reported in a patient consuming high amount of chromium picolinate per day for weight loss, but renal function returned to normal upon discontinuation of the supplement. A potential consequence of chromium intakes above 200 µg/day is displacement of iron from transferrin. At high levels chromium may compete with iron for transferrin binding and deplete iron levels (Feed international, 1993; WHO, 1988).

El-Shahawi and Al-Yousuf (1998) showed the presence of heavy metal (Ni, Co, Cr and Pb) contamination in liver and skin tissues of *Lethrinus lentjan* fish family. Metal levels found in liver and skin fish organs followed the sequence: Cr > Pb > Ni > Co. The observation positively indicated that the tested fish from the Arabian Gulf have metal concentrations well below the permissible levels reported by WHO (1988). Swiergosz and Kowalska (2000) showed the cadmium accumulation and its effects in growing pheasants *Phasianus colchicus* (L.). The aim of their study was to determine Cd accumulation and to assess its effects on tissue structure, levels of Fe in the tissues, and levels of hematocrit and hemoglobin (Hb) in growing pheasants. Accumulation of Cd in the tissues was proportional to the dose and duration of exposure.

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The highest Cd concentration was found in the kidneys of pheasants fed. The lowest Cd concentrations were found in muscle. The mean levels of Cd in the blood of pheasants fed low and high doses of Cd were observed. The Cd accumulation in the tissues caused decreasing Fe and Hb levels in the tissues. The Fe decrease stimulated hematopoiesis in the liver. Despite this, Hb levels were not kept at normal values. Pathological changes from Cd exposure were found in the liver and testes, but the most severe damage was in the kidney. The growth of the pheasants was also slightly retarded. It may be concluded that accumulation of Cd at these levels, which also occurs in the tissues of wild birds from contaminated areas, may cause the same pathological changes and physiological dysfunction.

Ritchie (1990) observed that fibrosis begins and develops into macronodular cirrhosis, necrosis and degeneration in liver, kidney, gizzard and muscle tissues of broiler chicks after exposure of copper sulphate. Todd (1969) reported degeneration of epithehial cells of chicks after copper intoxication in sheep. Riaz (2000) observed histopathological changes in kidney and spleen of grass carp as manifested by chromium intoxication. Khan in 2003 showed the different pathological changes in gizzard of the chicks and other birds. These were necrosis, splitting of muscularis and longitudinal muscular layers. These changes were produced after administration of different chemicals, bacteria and fungi.

Quail was selected as animal tool because a lot of interest has been shown by the farmers during the last few years in raising Japanese quail (*Coturnix coturnix japonica*) in Pakistan. The information available concerning the nutritive requirements of the quail is somewhat limited as very little work has been done in Pakistan on quails (Feed Internatrional, 2000). Different levels of chrome shavings were used to evaluate the effects of different aspects on growth performance of Quails.

MATERIALS AND METHODS

Five Hundred, one day old Japanese quail specie chicks were purchased from the local hatchery and randomly divided into 3 groups of 100 birds each. These groups were randomly assigned to two experimental rations in such a way that ultimately there were two groups under each treatment. The experimental rations were fed *ad libitum* for a period of 9 weeks. Five experimental ratios were prepared containing two levels of chrome shaving partially replaced by animal proteins i.e. 0, 2.5 and 5% and were designated as A, B and C, respectively. The composition of the experimental rations and the assumed chemical composition of the rations have been given in Table 1. Assumed chemical composition of the feed ingredients were taken from N.R.C. USA (1969) prepared by P.C.S.I.R. Laboratories. After drawing blood, visceral organs of quails were exposed and heart and gizzard were dissected out for further analysis. Kidney, heart, gizzard and liver after being removed from the fish were rinsed in 0.85% saline solution for three times to remove any blood or debris attached on the external surface. Then the tissues were cut into small pieces of approximately 2–4 mm. Routine steps of histopathological processing was used (An atlas of avian pathology, 2003).

Table 1. Composition of experimental feeds.

Maize (g)	25	25	25	25	25
Wheat (g)	20	20	20	20	20
Rice broken (g)	5	5	5	5	5
Rice polish (g)	8	8	8	8	8
Cotton seed meal (g)	3	3	3	3	3
Rapeseed meal (g)	7	7	7	7	7
Soyabean meal (g)	10	10	10	10	10
Fish meal (g)	16	12	8	4	--
Hydrolysed tannery shaving (g)	--	2.5	5.0	7.5	10
Limestone (g)	1	1	1	1	1
Molasses (g)	3	3	3	3	3
D.C.P. (g)	1	1	1	1	1
Vitamin/minerals (g)	1	1	1	1	1
Total	**100**	**100**	**100**	**100**	**100**

RESULTS AND DISCUSSION

Histological studies were carried out on the heart and gizzard of quail chicks from 1st week to 9th week. Normal histology of avian heart has its axis in the median plane of the body. Its ventricles are nearly surrounded by the lobes of the liver. Like the mammalian heart, it is four-chambered and the circulation of blood through these chambers is similar in the two classes of vertebrates: (1) Relative to body weight, it is heavier in birds than in mammals or reptiles, (2) neither a ductus arteriosus nor a ligamentum arteriosum is present in chickens but both structures have been reported for other species of birds, (3) a distinguishable fossa ovalis fails to persist, (4) plaques of cartilage are normally present in the aorta at the level of the semilunar valves and sometimes in the wall of the adjacent common pulmonary artery, (5) most commonly there are 2 coronary arteries, but 3, 4, and even 5 are frequently present, (6) there are extensive anastomoses between branches of the major coronary arteries, and (7) the minimae, bessi and sinusoids are abundant in the right ventricle, particularly in the septum. The pericardium is closely applied to the atria and major vessels of the heart but posteriorly around the ventricles and be 5 transverse rows of palatine papillae in the roof of the mouth, the last row of which is the largest. In addition, numerous smaller hard tubercles are present between the rows. At the anterior end and along the margins of the mouth are a medial and a pair of longitudinal ridges.

Pathological changes observed in different groups of chick's heart were different. In group A (untreated group), the structure of heart was normal, showing normal arrangement of cardiac muscles and nuclei. Endocardium, myocardium and epicardium were normal (Figure 1). In group B and C, (2.5 and 5% levels of chromium,

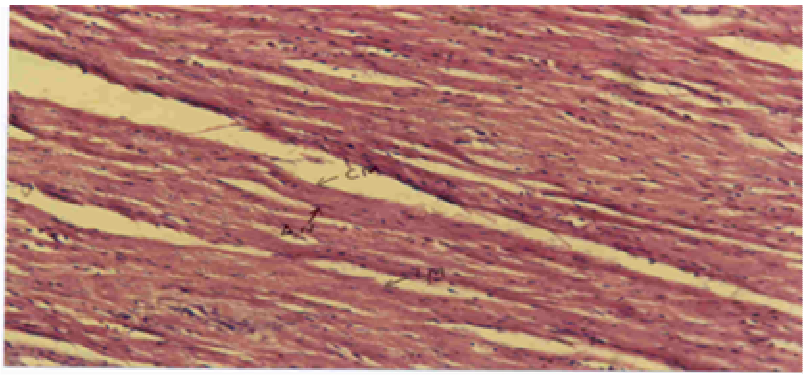

Figure 1. Section of heart of control group of quail showing normal arrangement of longitudinal muscles (LM), normal nucleus (N) and other cardiac muscular layers (CM). 100x magnification with H+E stain.

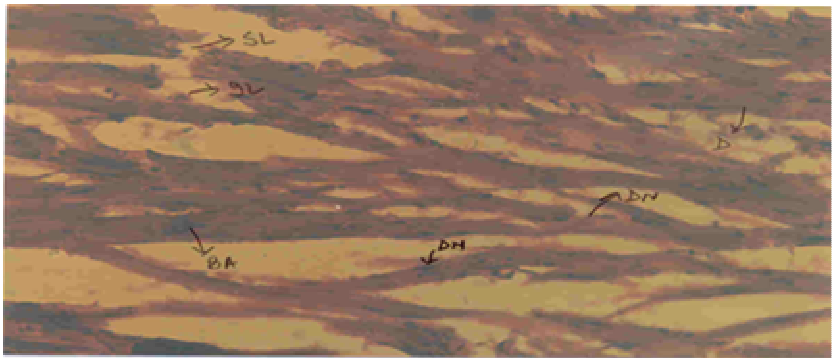

Figure 2. Section of heart of quail showing degeneration (D),dislocation of nucleus (DN), brown atrophy (BA), splitting of muscles (SL) and infiltration (IL) after exposure to 2.5% level of chrome shaving in 8th week. 400x magnification.

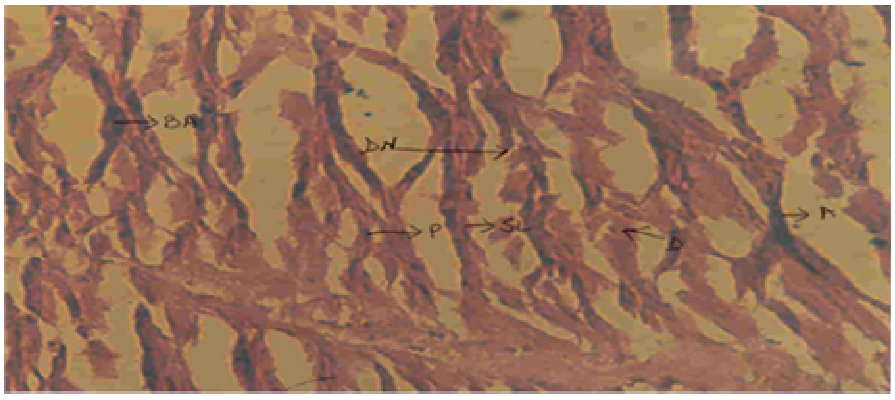

Figure 3. Section of heart of quail showing infiltration (I), brown atrophy (BA), pyknosis (P), dislocation of nucleus (DN), degeneration (D) and splitting of longitudinal muscles (SL) after exposure to 5% level of chrome shaving in 9th week. 400x magnifications.

respectively), the quails chicks showed some significant histopathological results which were more significant in the last three weeks and at 5% level of chromium. These changes were splitting of muscles, dislocation of nuclei; brown Atrophy, (pigmentation accumulation), destruction, loss of striation, splitting of longitudinal tissues and necrosis (Figures 2 and 3.).

In galliform birds the gizzard is particularly well developed. The normal structure shows that translocation of the pyloric adjacent to the isthmus of the stomach produ-

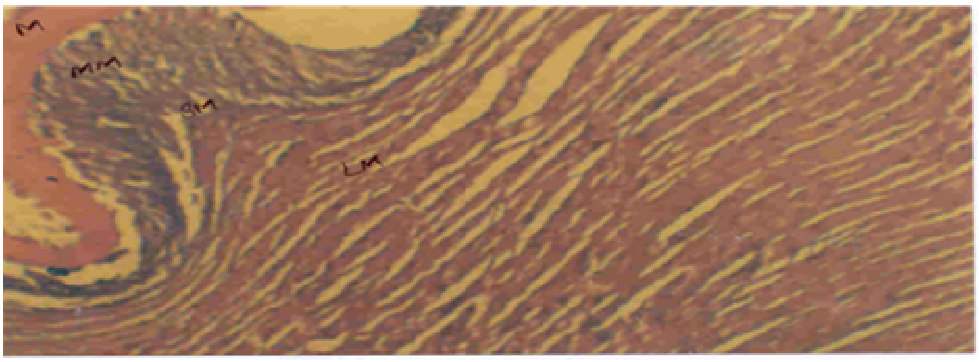

Figure 4. Section of gizzard of quail showing normal arrangement of muscular (M), muscularis (MM), serious muscular (SM) and longitudinal muscles (LM) of different muscular layers. 100x magnification with H+E staining.

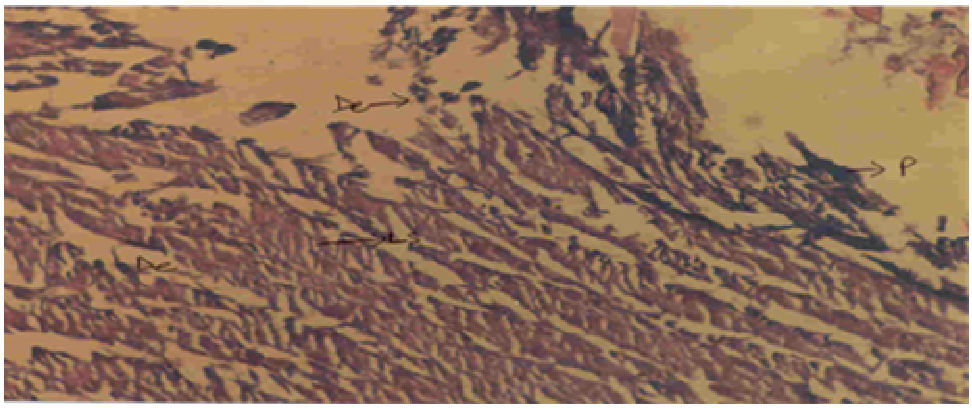

Figure 5. Section of gizzard of quail after exposure to2.5% level of chrome shaving at the 8th week showing degeneration (De), loss of striation (LS) and pigmentation (P). 400x magnification.

ces a short lesser curvature in the chicken and the entire periphery of the muscular stomach becomes the greater curvature. The mantle of muscles on the two faces of the gizzard has a radial arrangement. These lateral muscles (mm, laterals) are united in the center to the central tendon, and along the dorsal and ventral edges of the greater curvature are the semi-annular faces. The muscles form two layers, an inner layer and an outer layer. Caudal to the isthmus is an intermediate part and at the opposite pole is a thin-walled, caudal sac. The walls of both these are supported by intermediate muscles. In the chicken, there is no distinct end-piece at the exit from the gizzard as in many birds, nor a constriction between end-piece and duodenum called the pylorus. Histopathological changes in quail gizzard were different in different groups like in control group A, which was kept untreated showed normal arrangement of different muscular layers in the gizzard as described earlier (Figure 4). In group B (2.5% level of chrome shaving), there was some significant changes in gizzard. Some type of vacuolation, necrosis and loss of striation in muscle tissues were seen during in the 8th and 9th weeks. In group C (5% level of chrome shaving), there were highly significant histopathological changes observed which were more pronounced in 7th, 8th and 9th weeks. These were more splitting of muscles, necrosis, pyknosis and extensive degeneration (Figures 5 and 6.)

In Pakistan, quail farming was introduced in 1974 and people are earning a reasonable income through this enterprise. Since then this business has created a lot of interest among the people. From studies spanning more than 30 years, researchers recognize that chromium is essential for carbohydrates and lipid metabolism in mammals and birds. Today, evidence continues to amount that dietary chromium play a critical role in poultry metabolism. Moreover, recent research suggests that supplemental chromium may have a useful role in commercial broiler chicken rations. Although many researchers have suggested that chromium should become a key ingredient in nutritional supplements, official bodies such as the USA's National Research Council animal nutrition sub-committees have not yet made final recommendations on minimum dietary chromium requirements for any species (Anderson and

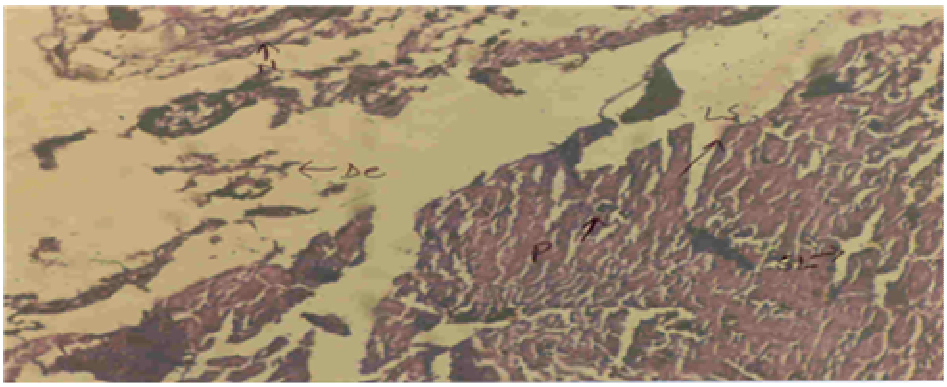

Figure 6. Section of gizzard of quail consuming 5% level of chrome shaving at the 9th week showing severe degeneration (De), splitting of longitudinal muscles (SL), pigmentation (P) and necrosis (N). 400x magnification.

Kozlonskey, 1985). Chromium also causes toxicological effects on animals. So it is necessary to know about the toxic values of chromium hence current experiment was designed to study the histopathological changes in different organs of quail chicks (WHO, 1988).

The resent work reveals some significant and highly significant histopathological changes in the heart and gizzard due to chromium shaving. These changes are degeneration of cardiac muscles, splitting of longitudinal muscles, dislocation of nucleus, necrosis, pyknosis, brown atrophy, splitting of striated muscles, pigmentation and severe degeneration in muscles of heart and gizzard.

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