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Toxic Effect of Pottery Chemicals on Total Erythrocyte Count and Hemoglobin Concentration of *Channa punctatus* (Bloch.)

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Abstract

Khurja is a prominent industrial and commercial town in Bulandshahr district, Uttar Pradesh the two main employment and livelihood sources in Khurja are pottery and agriculture, at roughly 50% each. The pottery industry directly employs about 25,000 workers with a further 5000-7000 employed in various support services and allied activities. Other sources of employment in Khurja include trade and commerce and a very small amount of other manufacturing. Tin oxide, also known as stannic oxide, is the inorganic compound with the formula SnO_2. The mineral form of SnO_2 is called cassiterite, and this is the main ore of tin. With many other names, this oxide of tin is an important material in tin chemistry. It is a colourless, diamagnetic, amphoteric solid. Tin oxide has long been used as an opacifier and as a white colorant in ceramic glazes. Keeping these points in view, the present study is undertaken to assess impact of pottery industry chemical tin oxide on total erythrocyte count, and hemoglobin concentration of *Channa punctatus* (Bloch.). The TEC and Hb. Conc. have been found to be decreased after treatment due to hematotoxic effect of tin oxide and adverse effect on hemopoietic system of fish.

***Key words*:** *Channa punctatus* (Bloch.), Pottery industry, TEC, Hb. Conc, Erythrocyte

In India, an early study (IDS) discovered information on 100 ceramic production clusters. Many of them are tiny clusters, and data available on them is sparse. More specific data was provided for 24 clusters from fourteen different states. The Indian ceramic industry is divided into 2 primary categories: white ware pottery and red clay pottery (including terracotta), all of which are manufactured in India [1]. Red clay (building bricks, roofing tiles, utility articles such as kulhar, saucers, surahi, matka sets) and White wares are products of each of these groups (Cups, saucers, mugs, tea-sets, Stoneware kundis, jars, Pressed porcelain insulators and other LT and HT insulators, chemical porcelain items, decorative pottery items such as flower vases, toys, ash-trays, Fire bricks, saggars and other heat resisting items) [2]. The industry also consumes a lot of electricity. The majority of the energy consumed is used to fire the clay in kilns and dryers. Gas, electricity, diesel oil, kerosene, coal, wood, and cow dung are all utilized to power the kilns. Wood and cow dung are commonly utilized in smaller and rural kilns, whereas coal is likely the most prevalent fuel used by the greatest number of units. Electricity is rarely used due to high costs and irregular availability due to country shortages. In the modern oil-fired kilns, the fuel of choice is diesel oil or kerosene [3]. Due to supply difficulties in India, gas is no longer widely available. However, as additional natural gas pipelines are installed, it is extremely likely that the supply and consumption of gas will gradually grow.

The pottery and ceramic industry release toxic heavy metals during preparation and other steps which in turn go to environment and finally to aquatic ecosystem through leaching and runoff water [4]. In the view of above facts, it is mandatory to explore this non target effect of ceramic industry for aquatic ecosystem. A dye is a coloured material that chemically attaches to the substrate it is applied on. Dyes are distinguished from pigments by the fact that they do not chemically attach to the substrate they colour [5]. In most cases, the dye is administered in an aqueous solution.

MATERIALS AND METHODS

About forty adult fresh water air breathing teleost, *Channa punctatus* (bloch.), representing both sexes will be collected alive from the local fish market. They will carefully examine for injury and kept in 1 percent solution of potassium permanganate for a few minutes before transferring them into

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large aquaria measuring 75cm × 37.5cm × 37.5cm. The fishes will be collected in the season when room temperature ranged1from 30 °C to 35 °and that of the water from 25 °C to 28 °C. Dechlorinated water will be used in the aquaria, which was changed every alternate day. The fishes will feed daily two times with flour pallets and small pieces of boiled eggs albumin. Tin oxide and nickel hydrox-ycarbonate will be used as experimental compound to assess the effect of ceramic dyes. Dacie and Lewis [6] presented an enhanced Standard Neubaur haemocytometer for estimating total erythrocyte count. Wintrobe *et al*. [7] described the conventional Sahli's technique for estimating haemoglobin concentration. All the statistical calculation for data has been conducted using computer software Ky plot version 3.0.

RESULTS AND DISCUSSION

The group 5-9 treated with 1/10th of LC_{50} of Tin Oxide, revealed significant decrease (P<0.00l) in the total erythrocytic count (TEC) in the whole duration of the experiment except at 22nd day, where the fishes showed significant increase (P<0.05) of 17.78 percent in the TEC. The fishes of experimental group (5-9) showed significant decrease (P<0.00l) in TEC at 11th day (31.85 percent), at 31rd day (24.44 percent), at 44th day (11.852 percent) and at 56th day (4.07percent) as compared to control group 1-4 (Table 1, Fig 1). The fishes of group 27-31 treated with 1/10th of LC_{50} of Nickel Hydroxycarbonate (NHC), revealed significant decrease (P<0.001) in TEC in whole duration of experiment except at 11th day, where the fishes showed significant increase (P<0.05) of 14.07 percent. The experimental fishes of group 27-31 showed significant decrease in TEC both at 22nd and 33rd day (13.70 percent), at 44th day (7.41 percent) and at 56th day (25.55 percent) as compared to control which is highly significant (P<0.001), (Table 1, Fig 1).

Table 1 Effect of pottery chemicals (1/10th of LC_{50}) on total erythrocytic count (x $10^6/mm^3$) of fish- *Channa punctatus* (Bloch.)

Treatment	Exposed period in days										
(mg/lit.)	0	11	±	22	±	33	±	44	±	56	±
Tin oxide	2.71±0.02	1.83±0.0 2^c	-31.85	3. 17 ±0.0 2^a	+17.78	2.03±0.02^c	-24.445	2.38±0.03^c	-11.854	2.58 ±0.03^c	-4.075
NHC	2.71 ±0.02	3.07±0.0 2^a	+14.07	2.32±0.03^c	-13.70	2.32±0.01^c	- 13.70	2.4±0.02^c	-7.41	2.02±0.02c	-25.56

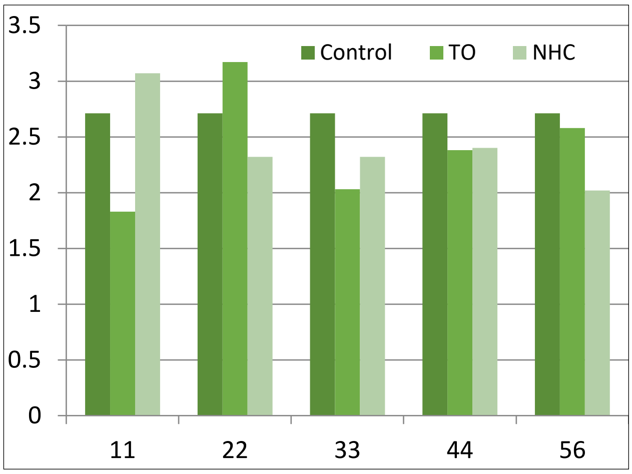

Fig 1 Effect of pottery chemicals (1/10th of LC_{50}) on TEC ($x10^6/mm^3$) of fish-*Channa punctatus* (Bloch.)

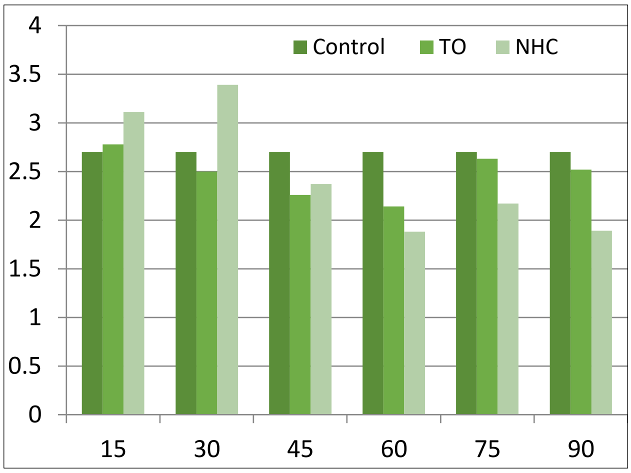

Fig 2 Effect of pottery chemicals (1/20th of LC_{50}) on TEC ($x10^6/mm^3$) of fish *Channa punctatus* (Bloch.)

The group 15-20 treated with 1/20th of LC_{50} of Tin Oxide, showed significant decrease (P<0.001) in the total erythrocytic count (TEC) in the whole duration of the experiment except at 15th day, where the fishes showed mild increase (P<0.01) of 3.33 percent in the TEC. A significant decrease in total erythrocytic count of experimental fishes was observed at 30th day (7.04 percent), at 45th day (16.67 percent), at 60th clay (20.37 percent), at 75th day (2.96 percent) and at 90th day (6.30 percent) as compared to control group (Table 2, Fig 2). The fishes of group 37-42 treated with l/20th of LC_{50} of Nickel Hydroxycarbonate (NHC) revealed significant increase (P<0.05) in TEC at 15th day (14.81 percent) and at 30th day (25. l8 percent). A significant decrease (p<0.001) was observed at 45th day (12.59 percent), at 601 h day (30.00 percent), at 75th day (19.26 per cent) and at 90th day (30.37 percent) as compared to control group 1-4 (Table 2, Fig 2).

Table 2 Effect of pottery chemicals (1/20th of LC_{50}) on total erythrocytic count (x $10^6/mm^3$) of fish-Clumna punctatus (Bloch.)

Treatment	Exposed period in days												
(mg/lit.)	0	15	±	30	±	45	±	60	±	75	±	90	±
Tin oxide	2.70±0.02	2.78±0.02^b	+3.33	2.50±0.02 ^{c}	-7.04	2.26±0.01^c	-16.67	2. 14±0.02^c	-20.37	2.63±0.01^c	-2.96	2.52±0.04^c	-6.30
NHC	2.70±0.02	3.11±0.02^a	+14.81	3.39±0.01^a	+25. 18	2.37±0.01^c	-16.67	1.88±1.90^c	-30.01	2. 17±0.02^c	-19.26	1.89±0.01^c	-30.37

"+" = Increase%
"-" = Decrease%
a = P < 0.05 significant increase
b = P < 0.01 mild increase
C = P < 0.001 significant decrease

Values represent mean ± S.E. of five fishes
TO = Tin Oxide
NHC = Nickel Hydroxycarbonate

The higher and lower doses of tin oxide poisoning produced erythrocytopenia (decreased erythrocytic count) in treated fishes. Saxena and Tripathi [8] observed decrease in total erythrocytic count of fresh water fish *Channa punctatus* under stress of hexavalent. Some other workers also observed decrease in total erythrocytic count in fishes treated with heavy metal [9-12]. The higher and lower doses of NHC poisoning also produced erythrocytopenia which indicate anaemic condition in experimental fishes. Chaudhary and Bharti [13] observed decrease in total erythrocytic count of *S. fossilis* (Bleeker) under the exposure of two different dye (Red 6BX and T_GB_{14} Green).

The fishes of group 5-9 treated with 1/10th of LC_{50} of tin oxide showed significant increase ($P<0.05$) in Hb by 5.45 percent at 22nd day. The significant decrease ($P<0.00$ 1) in Hb percent of experimental fishes were observed at 11th day (1.82 percent), at 33rd day (10.91 percent), at 44th day (l 3.64 percent) and at 56th day (5.45 percent) as compared to control group 1-4 (Table 3, Fig 3). The group 27-31 exposed with 1/10th of LC_{50} of NHC showed decrease in Hb percent in the whole duration of experiment, which decreased frequently with increased duration of exposure. The significant decrease ($P<0.001$) in Hb percent was recorded at 11th day (4.54 percent), at 22nd day (7.27 percent), at 33rd day (13.64 percent), at 44th day (15.45 percent) and at 56th day (24.54 percent) as compared to control group 1-4 (Table 3, Fig 3).

Table 3 Effect of pottery chemicals (1/10th of LC_{50}) on hemoglobin (gm%) of fish- *Channa punctatus* (Bloch.)

Treatment (mg/lit.)	Exposed period in days										
	0	11	±	22	±	33	±	44	±	56	±
Tin oxide	11.01±0.64	10.81 ± 0.06^c	-1.817	11.59 ± 0.17^a	+5.456	9.81 ± 0.06^c	-10.908	9.52 ± 0.15^c	-13.637	10.41 ± 0.10^c	-5.456
NHC	11.01±0.64	$10.51\pm0.0\ 2^a$	- 4.546	10.21 ± 0.03^c	-7.274	9.51 ± 0.31^c	-13.637	9.31 ± 0.32^c	-15.456	8.31 ± 0.38^c	-24.546

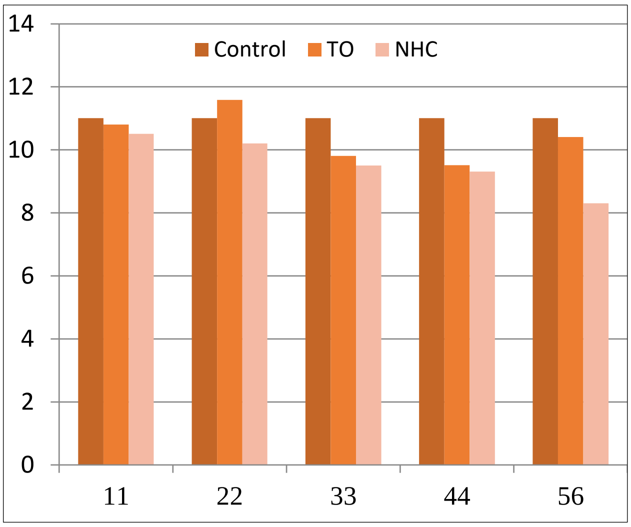

Fig 3 Effect of pottery chemical (1/10th of LC_{50}) on hemoglobin (gm%) of fish *Channa punctatus* (Bloch.)

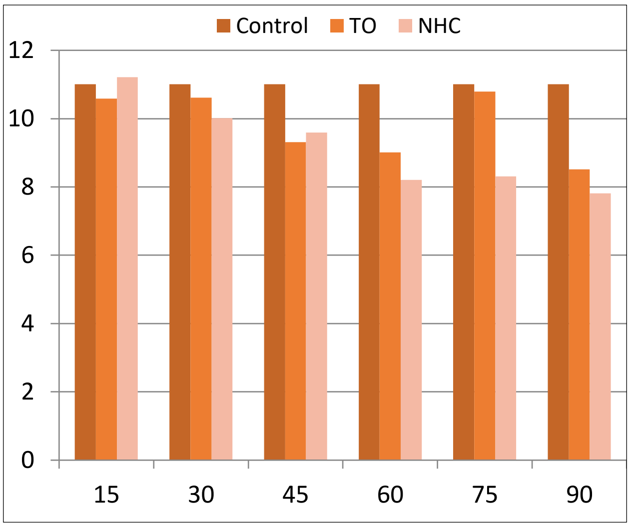

Fig 4 Effect of pottery chemical (1/20th of LC_{50}) on haemoglobin (gm%) of fish- *Channa punctatus* (Bloch.)

The chronically treated tin oxide fishes of group 15-20 (1/20th of LC_{50}) showed no change in Hb percent at 15th day along with mild significant decrease at 75th day (1.82 percent) and at 30th day (3.64 percent). The significant decrease ($P<0.00l$) in Hb percent was observed in experimental fishes at 45th day (15.45 percent), at 60th day (18.18 percent) and at 90th day (22.73 percent) as compared to control group (Table 4, Fig 4). The group 37-42 treated with 1/20th of LC_{50} of NHC revealed mild increase ($P<0.01$) in Hb per cent at 15th day (1.82 percent). A significant decrease ($P<0.001$) in Hb per cent was recorded at 30th day (9.09 percent), at 45th day (12.73 percent), at 60th day (25.45 percent), at 75th day (24.54 percent) and at 90th day (29.09 percent) as compared to control group 1-4 (Table 4, Fig 4).

Table Effect of pottery chemicals (1/20th of LC_{50}) on hemoglobin (gm%) of fish- *Channa punctatus* (Bloch.)

Treatment (mg/lit.)	Exposed period in days												
	0	15	±	30	±	45	±	60	±	75	±	90	±
Tin oxide	11.01±0.64	10.59 ± 0.66^b	0.00	10.61 ± 0.24^c	-3.637	9.31 ± 0.12^c	-15.46	9.01 ± 0.26^c	-18.18	10.79 ± 0.02^c	-1.82	8.52 ± 0.08^c	-22.73
NHC	11.01±0.64	11.21 ± 0.69^b	+1.82	10.01 ± 0.16^c	-9.10	9.59 ± 0.11^c	-12.73	8.21 ± 0.20^c	-25.46	$8.\ 31\pm0.16^c$	-24.55	7.81 ± 0.31^c	-29.09

Both tin oxide and NHC produced fall in the level of Hb in toxicated fishes at high and low level dose. The present findings confirm the findings of aforesaid authors. The higher and lower doses of tin oxide poisoning produced erythrocytopenia (decreased erythrocytic count) in treated fishes. The diminisation of haemoglobin in tin treated fishes and mammals has been observed by [14-16] and on heavy metals and dyes by [17-19].

CONCLUSION

Many chemicals are used in pottery, mostly in the form of dyes, one of which is tin oxide and the other is nickel hydroxycarbonate, both of these chemicals are used as collaring agents. The effect of both these chemicals has been observed on *Channa punctatus* fish and found that the effect of these two chemicals on hematology parameter total erythrocyte count and hemoglobin concentration has been seen at 1/10 and 1/20 percent of LC_{50}, whose above results are given in it.

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