

SUPPLEMENTARY MATERIALS (APPENDICES)

Tables 4 to 7 are supplementary materials used in calculating and estimating Tables 2 and 3. Tables 4-7 are summarized in Tables 2 and 3 as presented in the main document.

Table 4: 28 day Single Exposure of *Clarias gariepinus* to nano and bulk metals.

Score	Histological Alteration	nano SiO	bulk SiO	nano CuO	bulk CuO	nano Al ₂ O ₃	bulk Al ₂ O ₃
0	No lesion or any alteration (NT)						
2.0	Mild thickening of Gill lamella (GL1) Epithelial Hyperplasia (EH) Hypertrophy (HPT)		**			**	
4.0	Moderate thickening of Gill lamella (GL2) Oedema (OD)	**	**	**			
6.0	Eroded outer operculum (ERO) Epithelial lifting (EPL) Partial Fusion of secondary lamellae (FSGL1) Erosion of Gill lamellae (EGL) Shortening of secondary lamellae (SSGL) Stunted Gill lamellae (SGL) Blunt secondary lamellae (BSGL) Uncontrolled proliferation of epithelial cells (PEC)	**		**			**
8.0	Severe thickening of Gill lamella (GL3) Complete Fusion of secondary lamellae (FSGL1) Aneurysm (ANS)				**		
10.0	Necrosis (N) Total damage to the lamellae (TDL)				**		

Table 5: 28 day Joint Exposure of *Clarias gariepinus* to nano and bulk metals at the Equal ratio.

Score	Histological Alteration	Ratio 1 to 1					
		nano SiO+CuO	bulk SiO+CuO	nano SiO+Al ₂ O ₃	bulk SiO+Al ₂ O ₃	nano Al ₂ O ₃ +CuO	bulk Al ₂ O ₃ +CuO
0	No lesion or any alteration (NT)						
2.0	Mild thickening of Gill lamella (GL1) Epithelial Hyperplasia (EH) Hypertrophy (HPT)		**	**			
4.0	Moderate thickening of Gill lamella (GL2) Oedema (OD)					**	**
6.0	Eroded outer operculum (ERO) Epithelial lifting (EPL) Partial Fusion of secondary lamellae (FSGL1) Erosion of Gill lamellae (EGL) Shortening of secondary lamellae (SSGL) Stunted Gill lamellae (SGL) Blunt secondary lamellae (BSGL) Uncontrolled proliferation of epithelial cells (PEC)	**	**		**		
8.0	Severe thickening of Gill lamella (GL3) Complete Fusion of secondary lamellae (FSGL1) Aneurysm (ANS)					**	**
10.0	Necrosis (N) Total damage to the lamellae (TDL)						**

Table 6: 28 day Joint Exposure of *Clarias gariepinus* to nano and bulk metals at Unequal ratio.

Score	Histological Alteration	Ratio 1 to 2				Ratio 2 to 1			
		nano SiO+CuO	bulk SiO+CuO	nano SiO+Al ₂ O ₃	bulk SiO+Al ₂ O ₃	nano SiO+Al ₂ O ₃	bulk SiO+Al ₂ O ₃	nano Al ₂ O ₃ +CuO	bulk Al ₂ O ₃ +CuO
0	No lesion or any alteration (NT)								
2.0	Mild thickening of Gill lamella (GL1) Epithelial Hyperplasia (EH) Hypertrophy (HPT)		** **			**	** **	**	**
4.0	Moderate thickening of Gill lamella (GL2) Oedema (OD)							**	**
6.0	Eroded outer operculum (ERO) Epithelial lifting (EPL) Partial Fusion of secondary lamellae (FSGL1) Erosion of Gill lamellae (EGL) Shortening of secondary lamellae (SSGL) Stunted Gill lamellae (SGL) Blunt secondary lamellae (BSGL) Uncontrolled proliferation of epithelial cells (PEC)	**		**		**			
8.0	Severe thickening of Gill lamella (GL3) Complete Fusion of secondary lamellae (FSGL1) Aneurysm (ANS)								
10.0	Necrosis (N) Total damage to the lamellae (TDL)		**	**	**				

Table 7: 28 day Joint Exposure of *Clarias gariepinus* to nano and bulk metals at Equal ratio.

Score	Histological Alteration	Ratio 1 to 1 to 1	
		nano SiO+CuO+Al ₂ O ₃	bulk SiO+CuO+Al ₂ O ₃
0	No lesion or any alteration (NT)		
2.0	Mild thickening of Gill lamella (GL1) Epithelial Hyperplasia (EH) Hypertrophy (HPT)		
4.0	Moderate thickening of Gill lamella (GL2) Oedema (OD)		
6.0	Eroded outer operculum (ERO) Epithelial lifting (EPL) Partial Fusion of secondary lamellae (FSGL1) Erosion of Gill lamellae (EGL) Shortening of secondary lamellae (SSGL) Stunted Gill lamellae (SGL) Blunt secondary lamellae (BSGL) Uncontrolled proliferation of epithelial cells (PEC)	**	** **
8.0	Severe thickening of Gill lamella (GL3) Complete Fusion of secondary lamellae (FSGL1) Aneurysm (ANS)		
10.0	Necrosis (N) Total damage to the lamellae (TDL)		

