

Descriptors used in search platforms Scopus



**Table 1.** – Características dos estudos que analisaram os efeitos da exposição à metais pesados em fígado e brânquias de ciclídeos coletados no ambiente.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **References** | **Country** | **Species** | **Weight (g)/ Size (cm)** | **Number of animals** | **Groups of animals** | **Collection Period/ Station** | **|Analysis** | **Metals** | **Tissues** |
| **El-Demerdash and Elagamy, 1999** [30] | Egypt | *Tilapia nilótica**(Oreochromis nilótica)* | 200-250/ 15-20 | 20 | Test + Control | Yes/ ? | Metals in tissues and water, oxidative status, biochemical markers | Cd, Hg | Liver, Brain |
| **Rashed, 2001(a)**[31] | Egypt | *Tilapia nilótica**(Oreochromis nilótica)* | 440-1020/ ? | 50 | Tests (animal ages) |  ? | Metals in tissues, water, sediment and aquatic plant | Co, Cr, Cu, Fe, Mn, Ni, Sr, Zn | Liver, Gills, Muscle, Stomach, Intestine, Vertebral Column, Scales |
| **Rashed, 2001(b)**[18] | Egypt | *Tilapia nilótica**(Oreochromis nilótica)* | 440-1020/ ? | 50 | Tests (animal ages) + Control | ? | Metals in tissues, water, sediment and aquatic plant | Pb, Cd | Liver, Gills, Muscle, Stomach, Intestine, Vertebral Column, Scales |
| **Elghobashy *et al*, 2001**[32] | Egypt | *Oreochromis niloticus* | 150 ± 5/ ? | 30 | Tests (collection sites) + Control | Yes/ Summer | Metals in tissues, metals and physical-chemical parameters in water, oxidative status, biochemical markers | Fe, Cu, Zn, Pb, Cd | Liver, Gills, Kidney, Muscle |
| **Adham *et al*, 2001**[33] | Egypt | *Oreochromis niloticus* | 150 ± 16,0/ 14,00 ± 1,4 | 200 | Tests (collection sites) + Control | Yes/ Fall-Winter, Spring-Summer | Metals and physical-chemical parameters in water, histopathology, biochemical markers | Pb, Cu, Mn, Zn, Fe, Ni, Hg | Liver, Gills, Blood |
| **Youssef *et al*, 2004**[34] | Egypt | *Oreochromis spp/ Sarotherodon galilaues* | *O. niloticus*: 60-431/ 14,5-27 *S. galilaeus*: 3,6-37,5/ 8,0-11,5*O. oreus*: 21-151,8/ 10.5-20 | ? | Tests (animal species) | ? | Metals in tissues | Cu, Zn, Fe, Mn, Cd | Liver, Gills, Kidney, Muscle, Brain, Gonad |
| **Al-Kahtani, 2009**[35] | Arabia | *Oreochromis niloticus* | 40-60/ 12-19 | ? | Tests (collection stations) | Yes/ Fall, Winter, Spring, Summer | Metals in tissues, metals and physical-chemical parameters in water  | Fe, Zn, Cu, Pb, Mn, Cd  | Liver, Muscle |
| **Abdel-Baki *et al*, 2011**[36] | Saudi Arabia | *Tilapia nilótica**(Oreochromis nilótica)* | ?/ ? | 10 | Test | Yes/ Summer | Metals in tissues and water | Pb, Cd, Hg, Cu, Cr | Liver, Kidney, Intestine, Gills, Muscle |
| **Muisa *et al*, 2011**[37] | Zimbabwe | *Oreochromis niloticus* | ?/ ? | ? | Tests (collection periods and sites) | Yes/ 2 periods | Metals in tissues, water and sediment | Al | Liver, Gills, Muscle, Kidney |
| **Abdel-Moneim *et al*, 2012(a)**[38] | Egypt | *Oreochromis niloticus* | 85-150/ 18-25 | 108 | Tests (collection sites) + Control | Yes/ ? | Metals in water, histopathology, oxidative status | Cd, Cu, Fe, Mn, Pb, Zn, Cr, Hg, Co, Ni | Gills |
| **Abdel-Moneim *et al*, 2012(b)**[39] | Saudi Arabia | *Oreochromis niloticus* | 90-130/ 18-22 | 120 | Tests (collection sites) | Yes/ ? | Metals and physical-chemical parameters in water, histopathology | Fe, Mn, Zn, Cu, Ni, Cd, Pb, Cr, Co, Hg | Liver, Gills |
| **Cyrille *et al*, 2012**[40] | Ivory Coast | *Sarotherodon melanotheron* | Juvenile: 15,1-15,8/ ? Adult: 19,5-25,0/ ? | 15 | Tests (juvenile and adult animals) | Yes/ Dry, Rainy, Swelling | Metals in tissues, water physical-chemical parameters  | Cd | Liver, Gills, Muscle |
| **Carvalho *et al*, 2012**[41] | Brazil | *Oreochromis niloticus* | 90-200/ 15-20 | 32 | Tests (collection stations) + Control | Yes/ Fall, Winter, Spring, Summer | Metals and physical-chemical parameters in water, oxidative status, biochemical markers  | Cr, Cd, Cu, Zn, Mn, Fe | Liver, Gills, Muscle |
| **Coulibaly *et al*, 2012**[42] | Ivory Coast | *Sarotherodon melanotheron* | ?/ ? | 60 | Tests (collection stations) | Yes/ Dry, Rainy, Swelling | Metals in tissues, water and sediment  | Cd, Cu, Pb, Hg, Zn | Liver, Kidney, Muscle, Brain |
| **Abdel-Moneim *et al*, 2013a**[43] | Egypt | *Oreochromis niloticus* | 125-210/ 20-26 | 120 | Test + Control | Yes/ ? | Metals in tissues and water, oxidative status, histopathology | Cd, Cu, Fe, Pb, Zn, Mn | Liver |
| **Abdel-Moneim, 2013b**[44] | Saudi Arabia | *Oreochromis niloticus* | 75-152/ 15-21 | ? | Tests (collection sites) + Control | Yes/ ? | Metals in water, histopathology | Ni, Fe, Zn, Co, Ba, Pb, Cu, Cd | Liver |
| **Jinadasa and Edirisinghe, 2014**[45] | Sri Lanka | *Tilapia sp* | 216.6 ± 162,1/ 21,1 ± 4,0 | 80 | Tests (collection sites) | ? | Metals in tissues | Cd, Pb, Hg | Liver, Gills, Muscle |
| **Mohamed and Osman, 2014**[46] | Sudan  | *Oreochromis niloticus* | ?/ ~13 | ? | Tests (collection sites) | ? | Metals in tissues and water | Cd, Cr, Ni, Pb, Cu, Zn, Fe, Sr | Muscle, Gills |
| **Voigt *et al*, 2014**[47] | Brazil | *Geophagus brasiliensis* | Male: 59,5-278,0/ 145-250 Female: 64,6-145,4/ 150-190 | Male:38 Female:17 | Tests (gender, weight and size of animals) | Yes/ Summer | Metals in tissues, water and sediment | Cu, Mn, Zn, Fe, Co, Cd, Cr, Ag, Ni | Liver, Gills, Muscle |
| **Abdel-Khalek, 2014**[48] | Egypt | *Oreochromis niloticus* | 160-180/ 18,5-24,8 | 36 | Tests (collection sites) + Contol | Yes/ Summer | Metals in tissues and water, histopathology | Cu, Zn, Pb, Fe, Mn, Cd | Liver, Gills, Kidney, Muscle |
| **Abdel-Khalek, 2015**[49] | Egypt | *Oreochromis niloticus* | 160-180/ 18,5-24,8 | 36 | Tests (collection sites) + Control | Yes/ Summer | Metals and physical-chemical parameters in water, oxidative status | Cu, Zn, Pb, Fe, Mn, Cd | Liver, Gills, Blood |
| **Ajima *et al*, 2015**[50] | Nigeria | *Pelmatochromis guentheri/**Pelmatochromis pulcher* | 35 ± 0,05/ ? | 18 | Tests (animal species) | ? | Metals in tissues, water and sediment | Pb, Zn, Cd, Cu, Fe | Gills, Muscle, Intestine |
| **Ruelas-Inzunza *et al*, 2015**[51] | Mexico | *Oreochromis aureus* | Rainy station: 506,8 ± 100,5/ 30,9±2,4 Dry station: 563,4 ± 93,9/ 31,0±2,8 | 80 | Tests (collection stations) | Yes/ Dry,Rainy | Metals in tissues | Hg | Liver, Muscle, Kidney |
| **Kumar *et al*, 2016**[52] | India | *Oreochromis mossambicus* | ? | 54 | Tests (collection sites) | Yes/ ? | Metals in muscle, histopathology, oxidative status, biochemical markers | Cr, Mn, Co, Ni, Cu, Zn, As, Se, Cd, Hg, Pb | Liver, Gills, Kidney, Muscle, Brain, Gonad |
| **Mbewe *et al*, 2016**[53] | Zambia | *Tilapia andersonii/**T. rendalli/**Oreochromis niloticus* | *T.rendalli*: 170-250/ ? *O.niloticus*: 150-300/ ?T*.andersonii*: 390/ ? | 3/ 4/ 3 | Tests (animal species and collection sites) | Yes/ ? | Metals in tissues and sediment | Cu, Cd, Pb, Mn, Cr, Ni, Fe | Liver, Gonads, Muscle, Intestines, Head. |
| **Doria *et al*, 2017**[54] | Brazil | *Geophagus brasiliensis* | 148,8 ± 8,89/ 19,97 ± 2,87 | 55 | Tests (collection sites) | Yes/ Summer | Metals in tissues, histopathology, oxidative status, biochemical markers | Cu, Mn, Zn, Co, Cd, Cr, Ag, Pb, Ni, Al, As | Liver, Gills, Blood, Muscle, Brain |
| **Kumar e*t al*, 2017**[55] | India | *Oreochromis mossambicus* | ?/ ? | ? | Tests (collection sites) | Yes/ ? | Metals in tissues, water and sediment, oxidative status, biochemical markers | Cr, Mn, Co, Ni, Cu, Zn, As, Se, Cd, Hg, Pb | Liver, Gills, Kidney, Muscle, Brain, Gonad |
| **Muñoz-Nájera e*t al*, 2018**[56] | Mexico | *Oreochromis niloticus* | ?/ ? | 150 | Tests (collection periods) | Yes/ 5 periods | Metals in tissues, metals and physical-chemical parameters in water, biochemical markers | Cd, Cr, Cu, Pb | Liver, Muscle |
| **Pettamanna; Raghav; Nair, 2020**[57] | Índia | *Etroplus suratensis* | 65,7-83,1/11-14,5 | 15 | Test + Control | Yes/Winter | Metals and physical-chemical parameters in water, histopathology, biochemical markers | Cu, Fe | Liver |
| **Martínez-Durazo** ***et al*, 2020**[58] | Mexico | *Tilapia nilótica**(Oreochromis niloticus)**Largemouth bass**(Micropterus**salmoides)* | 461,8-619,6/26,98-34,5145,1-1.182,0/30,17-40,10 | 21-3021-30 | Tests (animal species) | Yes/Dry and Rainy | Metals in tissues. | Cr, Cu, Fe, Mn, Ni,Zn | Liver, gills, stomach, gonads and muscle |
| **Salem** ***et al*, 2021**[59] | Egypt | *Tilapia nilótica**(Oreochromis nilótica)* | 80±5/17±2 | 16 males | Tests (collection sites) | Yesyear all | Metals in tissues, metals and physical-chemical in water, quantitative, biochemical markers Real‑Time PCR. | Cd, Fe, Mn, Co e Pb | Liver |
| **Ngo *et al*, 2022**[01] | Vietname | *common Carp (Cyprinus carpio),* *silver Carp (Hypothalmic molitrix),* *Tilapia nilótica (Oreochromis niloticus)* | ? | 240/240/240 | Tests (animal species) | Yes/four seasons | Metals in tissues and wate, oxidative status, biochemical markers. | Zn, Cu, Pb, Cd | Livers, kidneys, gills |
| **Páez-Osuna *et al*, 2022**[60] | Mexico | *Oreochromis aureus* | 200-840/22.2-41.3 | 15 | Tests (collection periods) | Yes/spring | Metals in tissues, sediments, metals and physical-chemical parameters in water and risk assessment. | As, Cd, Cu, Hg, Se, Zn | Liver, muscle, and guts |
| **Vieira *et al*, 2023**[61] | Brazil | *Tucunare (Cichla* sp*).**Piraíba (Braquiplatystoma filamentosum)**Jaraqui (Semaprochilodus* sp) | ? | 10/10/10 | Tests (animal species) | ? | Metals in tissues, oxidative status, biochemical markers and bioinformatic. | Hg | Liver, muscle |
| **Martínez-Durazo** ***et al*, 2023**[6] | Mexico | *Tilapia nilótica**(Oreochromis niloticus)**Largemouth bass**(Micropterus**salmoides* | ? | 20/20/20 | Tests (animal species) + control | Yes/Dry and Rainy | Metals in tissues, histopathology. | Cr, Cu, Fe, Mn Ni, Zn, As, Hg, Se. | Liver, gills, muscle, gonads |
| **Páez‑Osuna, *et al*, 2023**[62] | Mexico | *Carpa mon**(Cyprinus carpio)**Tilápia azul**(Oreochromis aureus)**Robalo**(Micropterus**salmoides)* | *C.carpio*36,5-47/625/1.725*O. aureus*21-34/165-670*M. salmoides*24-38/170/740 | 7/22/16 | Tests (animal species) | ? | Metals in tissues, risk assessment. | As, Cd, Cu, Zn | Liver, gills, muscle, guts |

**Table 1.** Legenda: Ag: Silver; Al: aluminum; As: Arsênico; Ba: Barium; Ni Cd: Cadmium; Co: Cobalt; Cr: Chrome; Cu: Copper; Se: Selenium; Fe: Iron; Hg: Mercury; Mn: Manganese; Mo: Molybdenum; Nickel; Pb: Lead; Se: Selênio; Sr: Strontium; Zn: Zinc; ?: uninformed.

**Table 2** – Resultados primários dos estudos sobre efeitos de metais pesados na histologia e no *status* oxidativo branquial e hepática de peixes ciclídeos em ambientes contaminados.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Metais pesados** |  | **Órgãos** | **Danos histológicos** | **Estresse Oxidativo** |
| Cd |  | Fígado(n=5) | ↑necrose, esteatose, lipidose, hiperemia, hemorragia, congestão, neoplasia, diferenciação celular, vacuolização citoplasmática e nuclear, degeneração citoplasmática e nuclear, núcleo picnótico, eosinófilos e infiltrados leucocitários. | MDA:↑SOD: ↓GSH:↑GST:↑GPx: ↓CAT: ↓LPO:↑PCO: ↑ |
| Brânquia(n=3) |  ↑ hiperplasia, hipertrofia, dilatação vascular, levantamento do epitélio, fusão lamelar, desorganização lamelar, congestão, aneurisma, fusão lamelar e ruptura das células de cloreto.  | MDA: ↑SOD: ↑GSH: ↑GST: ↑GR: ↓GPx: ↓CAT: ↓LPO: ↑G6PD:↓  |
| Cu |  | Fígado(n=8) | ↑ necrose, esteatose, lipidose, hiperemia, hemorragia, congestão, neoplasia, diferenciação tecidual, vacuolização citoplasmática e nuclear, degeneração citoplasmática e nuclear, núcleo picnótico, eosinófilos e infiltrados leucocitários. | MDA:↑SOD: ↓GSH:↑GST:↑GPx: ↓CAT: ↓LPO:↑PCO: ↑ |
| Brânquia(n=5) |  ↑ Hiperplasia, hipertrofia, dilatação vascular, levantamento do epitélio, fusão lamelar, desorganização lamelar, congestão, aneurisma, fusão lamelar e ruptura das células de cloreto.  | MDA: ↑SOD: ↑GSH: ↑GST: ↑GR: ↓GPx: ↓CAT: ↓LPO: ↑G6PD:↓ |
| Pb |  | Fígado(n=6) | ↑ necrose, esteatose, lipidose, hiperemia, hemorragia, congestão, neoplasia, diferenciação tecidual, vacuolização citoplasmática e nuclear, degeneração citoplasmática e nuclear, núcleo picnótico. ↑ Eosinófilos e infiltrados leucocitários. | MDA:↑SOD: ↓GSH:↑GST:↑GPx: ↓CAT: ↓LPO:↑PCO: ↑ |
| Brânquia(n=4) |  ↑ Hiperplasia, hipertrofia, dilatação vascular, levantamento do epitélio, fusão lamelar, desorganização lamelar, congestão, aneurisma, fusão lamelar e ruptura das células de cloreto.  | MDA: ↑SOD: ↑GSH: ↑GST: ↑GR: ↓GPx: ↓CAT: ↓LPO: ↑G6PD:↓ |
| Zn |  | Fígado(n=7) | ↑ necrose, esteatose, lipidose, hiperemia, hemorragia, congestão, neoplasia, diferenciação tecidual, vacuolização citoplasmática e nuclear, degeneração citoplasmática e nuclear, núcleo picnótico. ↑ Eosinófilos e infiltrados leucocitários. | MDA:↑SOD: ↓GSH:↑GST:↑GPx: ↓CAT: ↓LPO:↑PCO: ↑ |
| Brânquia(n=5) |  ↑ Hiperplasia, hipertrofia, dilatação vascular, levantamento do epitélio, fusão lamelar, desorganização lamelar, congestão, aneurisma, fusão lamelar e ruptura das células de cloreto.  | MDA: ↑SOD: ↑GSH: ↑GST: ↓GR: ↓GPx: ↓CAT: ↓LPO: ↑G6PD:↓ |
| Mn |  | Fígado(n=7) | ↑ necrose, esteatose, lipidose, hiperemia, hemorragia, congestão, neoplasia, diferenciação tecidual, vacuolização citoplasmática e nuclear, degeneração citoplasmática e nuclear, núcleo picnótico. ↑ Eosinófilos e infiltrados leucocitários. | MDA:↑SOD: ↓GSH:↑GST:↑GPx: ↓CAT: ↓LPO:↑PCO: ↑ |
| Brânquia(n=5) |  ↑ Hiperplasia, hipertrofia, dilatação vascular, levantamento do epitélio, fusão lamelar, desorganização lamelar, congestão, aneurisma, fusão lamelar e ruptura das células de cloreto.  | MDA: ↑SOD: ↑GSH: ↑GST: ↑GR: ↓GPx: ↓CAT: ↓LPO: ↑G6PD:↓ |
| Fe |  | Fígado(n=6) | ↑ necrose, esteatose, lipidose, hiperemia, hemorragia, congestão, neoplasia, diferenciação tecidual, vacuolização citoplasmática e nuclear, degeneração citoplasmática e nuclear, núcleo picnótico. ↑ Eosinófilos e infiltrados leucocitários. | MDA:↑SOD: ↓GSH:↑GST:↑GPx: ↓CAT: ↓LPO:↑PCO: ↑ |
| Brânquia(n=3) |  ↑ Hiperplasia, hipertrofia, dilatação vascular, levantamento do epitélio, fusão lamelar, desorganização lamelar, congestão, aneurisma, fusão lamelar e ruptura das células de cloreto.  | MDA: ↑SOD: ↑GSH: ↑GST: ↑GR: ↓GPx: ↓CAT: ↓LPO: ↑G6PD:↓ |
| Cr |  | Fígado(n=5) | ↑ necrose, esteatose, lipidose, hiperemia, hemorragia, congestão, neoplasia, diferenciação tecidual, vacuolização citoplasmática e nuclear, degeneração citoplasmática e nuclear, núcleo picnótico. ↑ Eosinófilos e infiltrados leucocitários. | MDA:↑SOD: ↓GSH:↑GST:↑GPx: ↓CAT: ↓LPO:↑PCO: ↑ |
| Brânquia(n=3) |  ↑ Hiperplasia, hipertrofia, dilatação vascular, levantamento do epitélio, fusão lamelar, desorganização lamelar, congestão, aneurisma, fusão lamelar e ruptura das células de cloreto.  | MDA: ↑SOD: ↑GSH: ↑GST: ↑GR: ↓GPx: ↓CAT: ↓LPO: ↑G6PD:↓  |
| Hg |  | Fígado(n=5) | ↑ necrose, esteatose, lipidose, hiperemia, hemorragia, congestão, neoplasia, diferenciação tecidual, vacuolização citoplasmática e nuclear, degeneração citoplasmática e nuclear, núcleo picnótico. ↑ Eosinófilos e infiltrados leucocitários. | MDA:↑SOD: ↓GSH:↑GST:↑GPx: ↓CAT: ↓LPO:↑PCO: ↑ |
| Brânquia(n=3) |  ↑ Hiperplasia, hipertrofia, dilatação vascular, levantamento do epitélio, fusão lamelar, desorganização lamelar, congestão, aneurisma, fusão lamelar e ruptura das células de cloreto.  | MDA: ↑SOD: ↑GSH: ↑GST: ↑GR: ↓GPx: ↓CAT: ↓LPO: ↑G6PD:↓  |
| Ni |  | Fígado(n=6) | ↑ necrose, esteatose, lipidose, hiperemia, hemorragia, congestão, neoplasia, diferenciação tecidual, vacuolização citoplasmática e nuclear, degeneração citoplasmática e nuclear, núcleo picnótico. ↑ Eosinófilos e infiltrados leucocitários. | MDA:↑SOD: ↓GSH:↑GST:↑GPx: ↓CAT: ↓LPO:↑PCO: ↑ |
| Brânquia(n=4) |  ↑ Hiperplasia, hipertrofia, dilatação vascular, levantamento do epitélio, fusão lamelar, desorganização lamelar, congestão, aneurisma, fusão lamelar e ruptura das células de cloreto.  | MDA: ↑SOD: ↑GSH: ↑GST: ↑GR: ↓GPx: ↓CAT: ↓LPO: ↑G6PD:↓  |
| Co |  | Fígado(n=4) | ↑ necrose, esteatose, lipidose, hiperemia, hemorragia, congestão, neoplasia, diferenciação tecidual, vacuolização citoplasmática e nuclear, degeneração citoplasmática e nuclear, núcleo picnótico. ↑ Eosinófilos e infiltrados leucocitários. | MDA:↑SOD: ↓GSH:↑GST:↑GPx: ↓CAT: ↓LPO:↑PCO: ↑ |
| Brânquia(n=2) |   ↑ Hiperplasia, hipertrofia, dilatação vascular, levantamento do epitélio, fusão lamelar, desorganização lamelar, congestão, aneurisma, fusão lamelar e ruptura das células de cloreto.  | MDA: ↑SOD: ↑GSH: ↑GST: ↑GR: ↓GPx: ↓CAT: ↓LPO: ↑G6PD:↓ |
| Ag |  | Fígado(n=1) | ↑ necrose, esteatose, hemorragia, congestão, diferenciação tecidual.. | - |
| Brânquia(n=1) | ↑ Hiperplasia, fusão lamelar, aneurisma, parasita, descamação epitelial e necrose. | - |
| As |  | Fígado(n=3) | ↑ necrose, esteatose, hemorragia, congestão, diferenciação tecidual, vacuolização, núcleo picnótico, degeneração citoplasmática e hiperemia.. | SOD e CAT: ↓PCO e LPO: ↑ |
| Brânquia(n=3) | ↑ Hiperplasia, fusão lamelar, aneurisma, parasita, descamação epitelial e necrose. | - |
| Al |  | Fígado(n=1) | ↑ necrose, esteatose, hemorragia, congestão, diferenciação tecidual.. | SOD e CAT: ↓PCO e LPO: ↑ |
| Brânquia(n=1) | ↑ Hiperplasia, fusão lamelar, aneurisma, parasita, descamação epitelial e necrose. | - |
| Se |  | Fígado(n=2) | - | MDA:↑SOD: ↓GSH:↑GST:↑GPx: ↓CAT: ↓LPO:↑PCO: ↑ |
| Brânquia(n=2) | - |  |

**Table 3:** Descriptors used in search platforms Pubmed

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| **PUBMED** |
| **Heavy Metals** | **Fish** | **Liver and Gill** |
| ("metals, heavy"[MeSH Terms] OR "trace elements"[MeSH Terms] OR "water pollutants"[MeSH Terms] OR "pollutants, water"[TIAB] OR "water pollutants"[TIAB] OR "trace elements"[TIAB] OR "metals, heavy"[ TIAB] OR "metals heavy"[TIAB] OR "metal heavy"[TIAB] OR "element, trace"[TIAB] OR "elements, trace"[TIAB] OR "biometals"[TIAB] OR "biometal"[TIAB] OR "trace minerals"[TIAB] OR "trace mineral"[TIAB] OR "mineral, trace" [TIAB] OR "minerals,trace"[TIAB] OR "toxicity"[TIAB] OR "toxicity"[MeSH Terms] OR "margin of safety"[TIAB] OR "toxic potential"[TIAB] OR "toxicity tests"[MeSH Terms] OR "tests, toxicity"[TIAB] OR "test, toxicity"[TIAB] OR "toxicity test"[TIAB])  | ("cichlids"[MeSH Terms] OR "fresh water biology"[MeSH Terms] OR "osteichthyes" [TIAB] OR "Biology, Freshwater"[TIAB] OR "Fresh Water Biology"[TIAB] OR "Biology, Fresh Water"[TIAB] OR "cichlid"[TIAB] OR "cichlidae"[TIAB] OR "cichlid fish"[TIAB] OR "fish, cichlid"[TIAB] OR "Oreochromis niloticus"[TIAB] OR "Oreochromis nilotica"[TIAB] OR "nile tilapia"[TIAB] OR "tilapia nilotica"[TIAB] OR "cichlids"[TIAB] OR "[Astronotinae](https://pt.wikipedia.org/wiki/Astronotinae)"[TIAB] OR "[Cichlasomatinae](https://pt.wikipedia.org/wiki/Cichlasomatinae)"[TIAB] OR "[Cichlinae](https://pt.wikipedia.org/w/index.php?title=Cichlinae&action=edit&redlink=1)"[TIAB] OR "[Etroplinae](https://pt.wikipedia.org/w/index.php?title=Etroplinae&action=edit&redlink=1)"[TIAB] OR "[Geophaginae](https://pt.wikipedia.org/w/index.php?title=Geophaginae&action=edit&redlink=1)"[TIAB] OR "[Heterochromidinae](https://pt.wikipedia.org/w/index.php?title=Heterochromidinae&action=edit&redlink=1)"[TIAB] OR "[Paratilapiinae](https://pt.wikipedia.org/w/index.php?title=Paratilapiinae&action=edit&redlink=1)"[TIAB] OR "[Pseudocrenilabrinae](https://pt.wikipedia.org/wiki/Til%C3%A1pia)"[TIAB] OR "[Ptychochrominae](https://pt.wikipedia.org/w/index.php?title=Ptychochrominae&action=edit&redlink=1)"[TIAB] OR "Retroculinae"[TIAB] OR [Acarichthys](https://pt.wikipedia.org/wiki/Acarichthys_heckelii) [Eigenmann](https://pt.wikipedia.org/wiki/Carl_H._Eigenmann)"[TIAB] [Acaronia](https://pt.wikipedia.org/wiki/Acaronia) [Myers](https://pt.wikipedia.org/w/index.php?title=George_S._Myers&action=edit&redlink=1)"[TIAB] OR "[Aequidens](https://pt.wikipedia.org/wiki/Aequidens) [Eigenmann](https://pt.wikipedia.org/wiki/Carl_H._Eigenmann)"[TIAB] OR "[Alticorpus](https://pt.wikipedia.org/w/index.php?title=Alticorpus&action=edit&redlink=1)"[TIAB] OR "[Altolamprologus](https://pt.wikipedia.org/w/index.php?title=Altolamprologus&action=edit&redlink=1)"[TIAB] OR "[Amphilophus](https://pt.wikipedia.org/wiki/Amphilophus)"[TIAB] OR "[Anomalochromis](https://pt.wikipedia.org/w/index.php?title=Anomalochromis&action=edit&redlink=1)"[TIAB] OR "[Apistogramma](https://pt.wikipedia.org/wiki/Apistogramma)"[TIAB] OR "[Apistogrammoides](https://pt.wikipedia.org/w/index.php?title=Apistogrammoides&action=edit&redlink=1)"[TIAB] OR 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