

****Expert Answer on Ichthyopathology:****

Leonardite and upland peat are indeed valuable sources of humic acids (HA) and fulvic acids (FA). However, their effects on **blood pH** and **erythropoiesis** in trout depend on chemical composition, bioavailability of components, and mechanisms of action on the fish organism.

**1. Impact on Blood pH**

- **Leonardite:**

Rich in humic acids (HA), which have a higher molecular weight and weak acidity. When introduced into water or feed, they can partially neutralize alkalinity, lowering blood pH through modulation of metabolic processes (e.g., enhanced bicarbonate excretion). However, the effect is mild and depends on the initial environmental pH. In trout under stress or intensive growth, HA may stabilize pH, preventing alkalosis.

- **Upland Peat:**

Contains more fulvic acids (FA), which have lower molecular weight and high reactivity. FA actively participate in ion exchange, stimulate carbonic acid secretion in the blood via enhanced metabolism, leading to **moderate pH reduction**. This is particularly noticeable when peat is added to water, where FA are rapidly absorbed through the gills.

****Conclusion**:**

- **Upland peat** is more effective in reducing blood pH due to the high activity of FA.
- Leonardite provides gentle pH stabilization, especially during pathological deviations.

**2. Impact on Erythropoiesis**

- **Leonardite:**

Humic acids stimulate hematopoiesis by:

- Increasing iron bioavailability (binding Fe^{3+} into complex forms).
- Exerting antioxidant effects, protecting erythroblasts from oxidative stress.
- Activating erythropoietin receptors in the kidneys (the primary hematopoietic organ in fish).

In trout, this results in increased mature erythrocyte counts and hemoglobin levels, crucial during hypoxia or anemia.

- **Upland Peat:**

Fulvic acids enhance erythrocyte proliferation in the spleen and liver via stimulation of growth factors (e.g., G-CSF). However, excess FA may cause erythrocyte aggregation ("rouleaux formation"), reducing oxygen transport. Optimal peat dosage is critical for normal erythropoiesis.

****Conclusion**:**

- **Leonardite** is more effective for stimulating qualitative erythropoiesis (increasing functional erythrocyte counts).
- Peat is beneficial in micronutrient deficiencies but requires dosage control.

Recommendations for Trout Farming

- **For blood pH correction**:
Use upland peat (0.5–1.0 g/m³ in water or 0.1–0.3% in feed).
- **For erythropoiesis stimulation**:
Apply leonardite at 0.2–0.5 g/m³ or 0.05–0.1% in feed.
- **Combined approach**:
Alternate supplements for synergistic effects (e.g., peat for short-term pH correction and leonardite for long-term hematopoiesis stimulation).

Limitations and Risks

- High peat doses may induce hypercapnia or gill toxicity.
- Leonardite requires pre-treatment with alkali to enhance HA bioavailability.
- Monitor water parameters (hardness, temperature) and fish liver condition.

Summary:

For trout farming, **leonardite** is preferred for improving erythrocyte parameters, while **upland peat** is optimal for rapid blood pH correction. Preliminary small-scale trials are recommended before large-scale application.

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