

# Hepatic Copper Concentrations & Copper-Associated Hepatitis in Dogs – An Overview of the Clinical Research

## 1. Copper and Your Dog

- Copper is an essential trace mineral, but excess copper stored in the liver can cause **chronic liver inflammation, scarring, and liver failure** in dogs (copper-associated hepatitis, CAH).([ResearchGate](#))
- Historically, CAH was mostly a problem of a few breeds (e.g., Bedlington Terrier, Labrador, Doberman).
- This large study shows that **pathologic liver copper levels have increased over time not only in “at-risk” breeds but also in the general dog population**, making this relevant to Kangal and Anatolian Shepherd dogs even though they were not specifically studied.([ResearchGate](#))

For the purpose of this advisory, Kangal Dogs are best thought of as “non-predisposed large working dogs” (similar to many of the “NPB” [non-predisposed breed] dogs in the study), but the trend suggests we should not assume they are safe from copper issues.

**As additional research emerges in the coming years, we expect to develop a clearer understanding of the significance and predictive value of ATP7A and ATP7B copper transport gene mutations in relation to copper-associated hepatitis in the Kangal Dog.**

## 2. What the study actually did

- **Data source:** 546 archived liver samples from dogs seen at Michigan State University’s diagnostic lab between **1982 and 2015**.([ResearchGate](#))
- Dogs were divided into:
  - **Predisposed breeds (PB):** Labrador Retrievers, Doberman Pinschers, West Highland White Terriers, Dalmatians (and their mixes).
  - **Non-predisposed breeds (NPB):** all other purebred and mixed-breed dogs — this is the category where Kangal/Anatolian type dogs would logically fall.([ResearchGate](#))
- Two time windows were compared:
  - **“Historical” period:** 1982–1988
  - **“Contemporary” period:** 2009–2015
- For each sample, they:
  - Did histopathology to classify **“hepatitis” vs “no hepatitis”**.([ResearchGate](#))
  - Measured **quantitative hepatic copper concentration ([Cu]H)** using inductively coupled plasma mass spectrometry (ICP-MS).([ResearchGate](#))

**Important copper cut-offs they used** (dry weight, µg/g):([ResearchGate](#))

- **~300 µg/g:** upper end of historical “normal” and midpoint of current reference ranges.
- **~400 µg/g:** upper end of most current reference ranges.

- **≥1000 µg/g:** often associated with histologic liver injury (inflammation, necrosis). Many clinicians consider treatment when copper is **≥600–800 µg/g**, especially if there is inflammation.

### 3. Key findings that matter to Kangal / Anatolian owners

#### 3.1 Copper levels have gone up *across the board*

**Predisposed breeds (PB)** (Labradors, Dobermans, WHWT, Dalmatians):([ResearchGate](#))

- Median liver copper increased from **≈291 µg/g (1982–88)** to **≈604 µg/g (2009–15)** – more than a **2-fold increase**.
- The percentage of PB dogs with copper **>300 µg/g** rose from **48% to 71%**.
- PB dogs with **>1000 µg/g** (a level strongly associated with liver damage) increased from **≈11% to ≈31%**.

**Non-predisposed breeds (NPB)** – the group most analogous to Kangals:([ResearchGate](#))

- Median copper increased from **≈177 µg/g (1982–88)** to **≈278 µg/g (2009–15)** (about a **55% increase**).
- Dogs with copper **>300 µg/g** nearly **doubled**, from **≈28% to ≈49%**.
- The proportion with **>1000 µg/g** stayed roughly similar (≈4–6%), but many more NPB dogs now have copper above historical “normal” ranges.

#### **Take-home for our breeds:**

Even in dogs *not* traditionally considered high-risk, liver copper levels have **crept up into ranges that many internists view as potentially concerning**, especially if there is any liver inflammation.

#### 3.2 Copper is increasingly a cause of chronic hepatitis

When dogs were grouped by **presence of hepatitis (inflammation) vs no hepatitis**, the study found:([ResearchGate](#))

- In **NPB dogs (our closest comparison)**:
  - Historical (1982–88): median copper in hepatitis cases was **~181 µg/g** – close to “normal” values.
  - Recent (2009–15): median copper in hepatitis cases jumped to **~542 µg/g** – about a **3-fold increase**.
  - This suggests that **older cases of hepatitis in “non-predisposed” breeds usually weren’t due to copper**, whereas **many newer hepatitis cases now have clearly abnormal copper levels**.
- Across **all breeds**, in 2009–2015 about **44% of dogs with hepatitis had copper >1000 µg/g**, compared with only **≈17%** in the 1980s.

#### **Interpretation for Kangals/Anatolians:**

- If a Kangal has **chronic hepatitis today**, the odds are much higher than in the 1980s that **excess copper is involved**, even though our breed has not been classically labeled “copper-storage”.

### 3.3 The change likely started in the mid-late 1990s and appears linked to environment/diet

- For Labrador Retrievers (used as a “sentinel” breed), copper levels and the percentage of dogs with very high copper **increased sharply in the mid-late 1990s and remained high thereafter.** ([ResearchGate](#))
- The authors note several **environmental/dietary factors** as plausible contributors, including:
  - Greater use of **copper plumbing** (water exposure).
  - Changes in **commercial dog food copper supplementation**:
    - 1997: AAFCO recommended stopping use of poorly absorbed cupric oxide in favor of more bioavailable forms such as **copper sulfate**.
    - 2007: The maximum copper limit for adult maintenance dog food was **removed**, allowing diets to include higher copper without strict regulatory caps. ([ResearchGate](#))

Recent reviews (2025) continue to support the idea that **excess dietary copper is now a major driver of CAH**, with genetic mutations (like ATP7B) playing a smaller role in many dogs than once thought. ([Frontiers](#))

#### Implication:

Even if Kangal Dogs do not carry known “copper storage disease” mutations, **modern diets and environment may still push their liver copper up into risky ranges**, especially over years of exposure.

## 4. Practical implications specifically for Kangal / Anatolian owners

### 4.1 Risk perspective for our breed

- Kangals are large, long-lived working dogs often kept on:
  - Commercial kibble (sometimes higher fat & protein, often higher trace mineral fortification).
  - Well water or municipal water (which may run through copper plumbing).
- While **no specific study has evaluated Kangal hepatic copper**, the strong, cross-breed upward trends suggest that **“non-predisposed” breeds are no longer low-risk by default.** ([ResearchGate](#))

### 4.2 When should a Kangal’s liver copper be checked?

Based on this study and current specialist practice, the Health Committee might advise that **quantitative liver copper measurement** (on biopsy) be considered in:

#### 1. Any Kangal with evidence of liver disease

- Elevated liver enzymes (especially ALT, ALP, GGT) on bloodwork.
- Unexplained weight loss, decreased appetite, vomiting, increased drinking/urination, or jaundice.
- Abnormal liver appearance on ultrasound.

2. **Kangals with chronic unexplained hepatitis or cirrhosis**
  - If a biopsy is being done for any chronic liver disease, **request quantitative copper analysis on that sample**, not just routine histopathology. ([Frontiers](#))
3. **Possibly: breeding dogs with liver “red flags”**
  - Repeated mild liver enzyme elevations of unknown cause.
  - Strong family history of liver disease or unexplained middle-aged deaths.
  - In such dogs, a specialist may recommend biopsy and quantitative copper to inform **breeding decisions and long-term management**.

#### 4.3 How concerning is a given copper number?

Using the thresholds from the study and current internist practice: ([ResearchGate](#))

- **<300 µg/g:**
  - Often considered within/near historical normal range.
  - If no inflammation and no clinical signs, usually **no specific copper intervention** beyond routine monitoring.
- **300–400 µg/g:**
  - Above historical “normal” but still in a gray zone.
  - May warrant **closer monitoring** and re-evaluation of diet, especially in a young dog or one with mild inflammation.
- **400–600 µg/g:**
  - Generally considered **elevated**.
  - If there is any degree of hepatitis, many specialists would treat or at least **implement aggressive copper-restriction in diet**.
- **600–800 µg/g:**
  - Frequently considered **“treatment threshold”** for CAH, particularly if inflammation or fibrosis is present.
- **≥1000 µg/g:**
  - Strongly associated with histologic liver injury (inflammation, necrosis).
  - Usually triggers **active treatment (chelation and/or zinc) plus strict dietary copper limitation**, and close monitoring.

The study also notes that **some dogs show significant liver damage at more modest copper levels**, so **context (histology, enzymes, clinical signs)** always matters. ([ResearchGate](#))

#### 4.4 Diet & management considerations for Kangal owners

While the Strickland study is not a feeding trial, it reinforces concerns that **modern diets may be “over-coppered” for some dogs**. In light of these data and more recent reviews: ([ResearchGate](#))

The Health Committee could recommend the following **general guidance** (not brand-specific, and always deferring to the dog’s veterinarian):

1. **Avoid unnecessary additional copper:**
  - Be cautious with **multivitamin/mineral supplements** that add extra copper on top of complete diets.
  - Avoid multiple copper-fortified products (e.g., kibble + “performance” topper + vitamin mix).
2. **Consider copper content when choosing diets, especially for dogs with known liver issues or high-normal copper:**
  - Prefer diets that **do not dramatically exceed current minimum copper requirements**.
  - For dogs with elevated or high-normal copper, discuss **formulation or therapeutic liver diets** with a veterinary nutritionist or internist.
3. **Water source awareness:**
  - If using **well water** or older household plumbing, consider water testing, especially if multiple dogs in the household develop liver issues.
4. **Long-term monitoring in middle-aged and senior dogs:**
  - Annual or semi-annual **liver enzyme checks** for breeding dogs and older Kangals.
  - Abnormal trends should trigger more detailed evaluation (ultrasound, and if indicated, biopsy with quantitative copper).

**Primary source:** Strickland et al., “Hepatic copper concentrations in 546 dogs (1982–2015),” *J Vet Intern Med* 2018. ([ResearchGate](#))