

BLUESTAR FALSE POSITIVES STUDY REPORT April 2008

1. BLUESTAR FALSE POSITIVES

The purpose of this study was to investigate the existence of false positives of the Bluestar product. This study encompassed three kinds of products potentially present during the detection of blood traces: household products (home and cleaning products...), food products and chemicals. The analyses were not quantified and are therefore solely qualitative. Tests results are as follows:

1.1 Household products

- **CIF**: No reaction.
- **RAID** Fly/Mosquito Killer spray: No reaction.
- **Mr. CLEAN** New formula with grapefruit scent: No reaction.

The ordinary household cleaning products that were tested do not allow for the catalysis of chemiluminescence. These products had been suspected since they were thought to possibly contain chlorine derivatives. They do not seem to contain any. Furthermore, less and less products contain chlorine derivatives and are therefore rarely capable of interfering with blood traces nowadays.

- **CARREFOUR Glycerophtalic paint**: persistent blue to white chemiluminescence (< 30 sec.).
- **VERALINE Alkyd varnish** containing:
 - Bis(1,2,2,6,6-pentamethy-4-piperidyl) sebacate
 - Bisphenol-A-epichlorhydrine
 - Epoxydic resins
 - 2-butanone-oxime
 - Cobalt Carboxylate
 - Methyl sebacate
 - 1,2,2,6,6-pentamethy-4-piperidylePersistent blue chemiluminescence.

- **CARREFOUR Liquid neoprene Glue**: no reaction.
- **CARREFOUR Cyanoacrylate glue** (Super Glue kind): no reaction.

Paint and varnishes are proven Bluestar false positives. In the case of the tested varnish, the chemiluminescence could be due to the presence of Cobalt carboxylate, as many metals such as Cobalt are suspected to be false positives. Both tested kinds of glue did not react at all with Bluestar.

1.2 Food products

- **Oil** (sunflower, rapeseed, grape seed, olive): no reaction.
- **Turnip**
 - **Skin**: white chemiluminescence that appears slowly (in fact the chemiluminescence is due to the flesh that comes into contact with Bluestar later on) => no reaction due to the skin.
 - **Flesh**: highly persistent white to blue chemiluminescence (> 30 sec.); still some chemiluminescence brightness after half an hour.
 - **Juice**: intense chemiluminescence (less than flesh)
- **Untreated orange**: no reaction, either with peel or with pulp.
- **Banana** (washed in water)
 - **Peel**: no reaction
 - **Pulp**: intense white chemiluminescence (less than turnip), and persistent (about 30 sec).
- **Non-GMO canned sweet corn** (rinsed under water): no reaction.
- **Plain dark chocolate** (contains magnesium that could provoke chemiluminescence): no reaction.

- **Apple** (rinsed under water): no reaction, either with peel or with pulp.

These first tests have pointed out a strong reactivity of foods containing fibers. Thus I took the initiative to test more fiber products than initially planned.

- **Radish**
 - **Flesh:** persistent white to blue chemiluminescence
 - **Skin:** no reaction
- **Leek:** chemiluminescent reaction inside fibers (inside the fibers but not in-between)
- **Black winter radish**
 - **Skin:** no reaction
 - **Flesh:** persistent blue reaction (particularly just under the peel).
- **Green bean:** weak and non-lasting white chemiluminescence, on the fibers.
- **Ginger**
 - **Skin:** no reaction
 - **Flesh:** weak white chemiluminescence.
- **Carrot:** weak but slightly long-lasting blue reaction.
- **Sweet potato:** no reaction.

Many fiber vegetables and fruits as well as radish-like vegetables are chemiluminescent in the presence of Bluestar.

1.3 Chemical products

All the solid chemicals were first dissolved into distilled water at a 0.1 mol/L concentration. Liquid chemicals were diluted to obtain this same concentration.

- **MnSO₄ (Manganese sulfate):** bright, short-lasting white chemiluminescence; build-up of a brown precipitate.
- **CuSO₄ (Copper sulfate):** non-lasting blue chemiluminescence; build-up of a brown precipitate.
- **FeSO₄ (Iron sulfate):** non-lasting blue chemiluminescence; build-up of a brown precipitate.
- **MgSO₄ (Magnesium sulfate):** no reaction.

The Cu²⁺, Mn²⁺, and Fe²⁺ ions (the last one being similar to the ion present inside the hemoglobin molecule and seemingly responsible for the blood luminescence) allow for the catalysis of the chemiluminescence reaction and therefore are Bluestar false positives. Notice that the SO₄²⁻ sulfate ions do not catalyze the reaction since the last test with MgSO₄ did not yield any reaction.

- **NaBO₃ (Sodium perborate):** no reaction.
- **NaCO₃ (Sodium carbonate):** no reaction.

None of the ions present in these two solutions is a Bluestar false positive.

- **KMnO₃ (Potassium permanganate):** short-lasting blue chemiluminescence.
- **KI (Potassium iodide):** no reaction.

The chemiluminescence of first solution is due to manganese, already proven as a false positive (see above).

1.4 Conclusion on Bluestar false positives

First, the tested products show that fiber foods are obviously Bluestar false positives. The reaction may vary from white to blue and can sometimes be very long-lasting (as with blood).

As far as household products are concerned, the tested paints and varnishes all react but the substance responsible for the reaction has not been clearly identified.

Finally, among the chemical products, the Bluestar false positives appear to be certain metallic ions such as Manganese, Copper and Iron (potentially present in the above Bluestar false positives).

2. LUMINOL FALSE POSITIVES

The purpose of this second trial series was to compare the luminol false positives to those of the Bluestar reagent. This study encompassed the same products as previously. The analyses were not quantified and are therefore solely qualitative. Qualitative comparison of luminol and Bluestar chemiluminescence is difficult because the luminol concentration is not identical in each product. Tests results are as follows:

2.1 Household products

- **CIF:** No reaction.
- **RAID Flying Insect Killer spray:** No reaction.
- **Mr. CLEAN** New formula with grapefruit scent: No reaction.

The ordinary household cleaning products that were tested do not allow for the catalysis of the chemiluminescence. These products were suspected since they were thought to possibly contain chlorine derivatives. They do not seem to contain any. Furthermore, less and less products contain chlorine derivatives and are therefore rarely capable of interfering with blood traces.

- **CARREFOUR Glycerophtalic paint:** persistent blue to white chemiluminescence.
 - **VERALINE Alkyd varnish:** Persistent blue chemiluminescence.
- **CARREFOUR Liquid neoprene Glue:** no reaction.
- **CARREFOUR Cyanoacrylate glue** (Super Glue kind): no reaction.

Results are consistent with those obtained with Bluestar. Paint and varnishes are known Luminol false positives. In the case of the tested varnish, the chemiluminescence could be due to the presence of Cobalt carboxylate. Indeed many metals such as Cobalt are suspected to be false positives. The two tested kinds of glue did not react at all with Luminol.

2.2 Food products

- **Oil** (sunflower, rapeseed, grape seed, olive): no reaction.
- **Turnip**
 - **Skin:** no reaction due to the skin.
 - **Flesh:** highly persistent white to blue chemiluminescence; still some chemiluminescence brightness after several minutes.
 - **Juice:** intense chemiluminescence (less than flesh) => reaction is brighter than with banana.
- Untreated **orange:** chemiluminescence appears on pulp, but not on peel.
- **Banana** (washed in water)
 - **Peel:** no reaction
 - **Pulp:** white chemiluminescence identical to Bluestar.
- Non-GMO canned **sweet corn** (rinsed under water): weak reaction.
- **Plain dark chocolate** (contains magnesium that could provoke chemiluminescence): no reaction.
- **Apple** (rinsed under water): no reaction, either on peel or on pulp.
- **Radish**
 - **Flesh:** persistent white to blue chemiluminescence
 - **Skin:** no reaction
- **Leek:** chemiluminescent reaction inside fibers (inside the fibers but not in between)
- **Black winter radish**
 - **Skin:** no reaction
 - **Flesh:** persistent very blue reaction
- **Green bean:** weak white and non-lasting chemiluminescence, very localized on the fibers and quickly disappearing.

- **Ginger**
 - **Skin:** no reaction
 - **Flesh:** weak white chemiluminescence.
- **Carrot:** weak blue reaction.
- **Sweet potato:** no reaction.

Many fiber vegetables and fruits as well as radish-like vegetables are chemiluminescent in the presence of luminol (as with Bluestar).

2.3 Chemical products

All the solid chemicals were first dissolved into distilled water at a 0.1 mol/L concentration. Liquid chemicals were diluted to obtain the same concentration

- **MnSO₄ (Manganese sulfate):** no reaction but build-up of a brown precipitate. => This result is difficult to explain.
- **CuSO₄ (Copper sulfate):** non-lasting blue chemiluminescence; build-up of a green precipitate.
- **FeSO₄ (Iron sulfate):** non-lasting blue chemiluminescence; build-up of a brown precipitate.
- **MgSO₄ (Magnesium sulfate):** no reaction.

The Cu²⁺ and Fe²⁺ ions allow for the catalysis of the chemiluminescence reaction and therefore are luminol false positives. Notice that the SO₄²⁻ sulfate ions do not catalyze the reaction since the last test with MgSO₄ did not yield any reaction.

- **NaBO₃ (Sodium perborate):** no reaction.
- **NaCO₃ (Sodium carbonate):** no reaction.

None of the ions present in these two solutions is a luminol false positive.

- **KMnO₃ (Potassium permanganate):** short-lasting blue chemiluminescence.
- **KI (Potassium iodide):** no reaction.

The chemiluminescence of first solution is due to manganese.

2.4 Conclusion on luminol false positives

The tested products show firstly that fiber foods are obviously luminol false positives. The reaction may vary from white to blue and can sometimes be very long-lasting (as with blood).

As far as household products are concerned, the tested paints and varnishes all react but the substance responsible for the reaction has not been clearly identified.

2.5 Conclusion on luminol / Bluestar false positives

The results obtained seem consistent with those yielded during the first testing serial on Bluestar. Differences reside in the reactivity of orange and corn with luminol.

3. Test results synopsis : Bluestar and luminol tested false positives

Is there a reaction with ...

| BLUESTAR | LUMINOL |
|----------|---------|
|----------|---------|

?

Household products

| | | |
|---------------------------------|-----|-----|
| CIF | no | no |
| RAID | no | no |
| Mr CLEAN | no | no |
| Oil-based paint | yes | yes |
| Alkyd varnish | yes | yes |
| Liquid neoprene glue | no | no |
| Cyanoacrylate glue (Super Glue) | no | no |

Food products

| | | |
|----------------------|-----|-----|
| Oil | no | no |
| Turnip | yes | yes |
| Orange | no | yes |
| Banana | yes | yes |
| Sweet corn | no | yes |
| Plain/dark chocolate | no | no |
| Apple | no | no |
| Radish | yes | yes |
| Leek | yes | yes |
| Black winter radish | yes | yes |
| Green bean | yes | yes |
| Ginger | yes | yes |
| Carrot | yes | yes |

Chemical products

| | | |
|--|-----|-----|
| MnSO ₄ (Manganese sulfate) | yes | no |
| CuSO ₄ (Copper sulfate) | yes | yes |
| FeSO ₄ (Iron sulfate) | yes | yes |
| MgSO ₄ (Magnesium sulfate) | no | no |
| NaBO ₃ (Sodium perborate) | no | no |
| NaCO ₃ (Sodium carbonate) | no | no |
| KMnO ₃ (Potassium permanganate) | yes | yes |
| KI (Potassium iodide) | no | no |