Exploration of origin and remediation of taste and odor issues associated with drinking water in Bucaramanga, Colombia.

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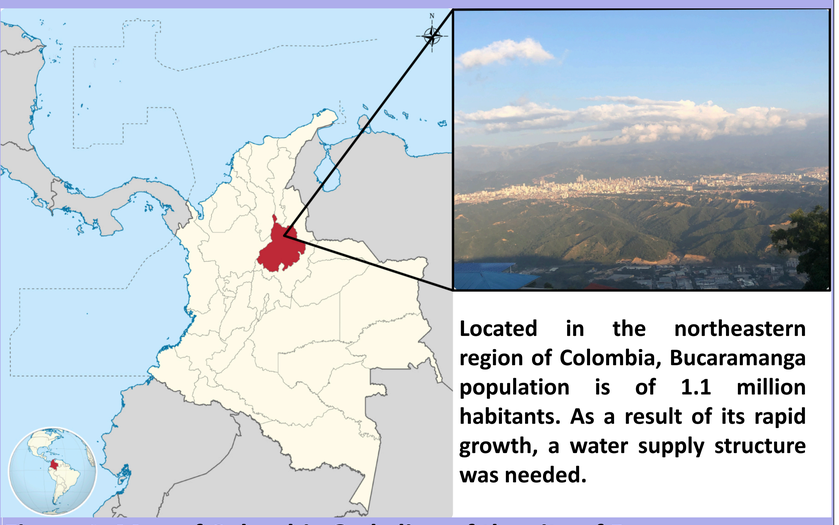
Bucaramanga, Colombia



Located in the northeastern region of Colombia, Bucaramanga population is of 1.1 million habitants. As a result of its rapid growth, a water supply structure was needed.

Figure 1. Map of Colombia & skyline of the city of Bucaramanga.

Bosconia reservoir

Figure 2. Bosconia reservoir

Bucaramanga weather

Shown by a defined weather pattern of four seasons, two dry and two wet, Bucaramanga has an average of six dry months. This dry period aligns with consumer complaints of odor and taste changes after 2015.

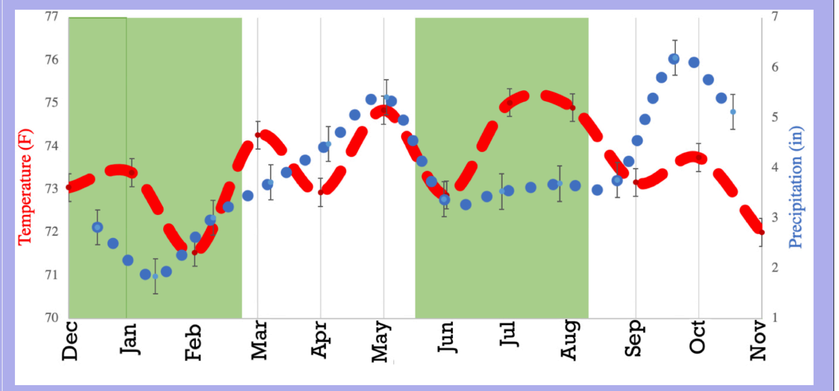


Figure 3. Bucaramanga's weather pattern over a year.

What causes the bad taste & odor?

Due to the environmental conditions caused by the dry season, the cyanobacteria are releasing organic compounds such as Geosmin and 2-MIB.

Figure 4. Formation of Geosmin and 2-MIB.

Objectives

- Establish the origin and cause for the cyanobacteria blooms.

- Determine the best remediation technique considering the cause.

Hypotheses

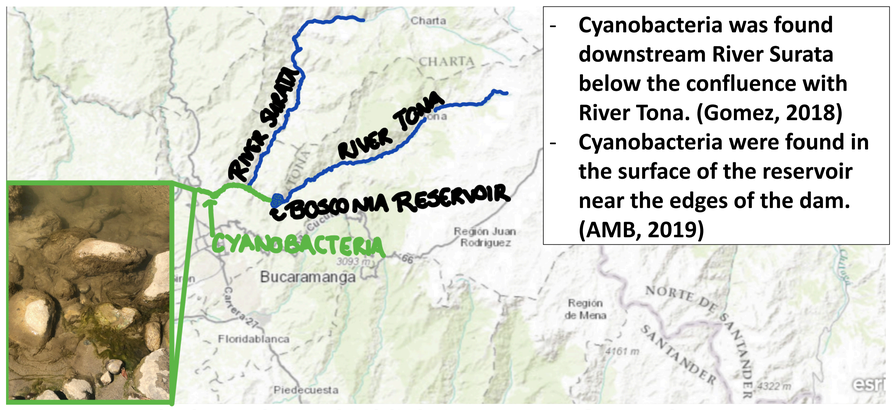
- Nutrient inputs coming from upstream of the reservoir periodically cause a 'bloom' of cyanobacteria resulting in taste and odor compounds in the water.

- Or, the cyanobacteria are always in the reservoir but produce geosmin and 2-MIB only during the dry season.

Methodology

With the collaboration of the Bucaramanga water authorities (AMB), Penn State, and UPB, this project was to gather and synthesize data. This information is critical to provide a better understanding of the source of the issue and aid AMB in applying the treatment.

Identification of Cyanobacteria



- Cyanobacteria was found downstream River Surata below the confluence with River Tona. (Gomez, 2018)
- Cyanobacteria were found in the surface of the reservoir near the edges of the dam. (AMB, 2019)

Figure 5. Hydrological map highlighting traces of cyanobacteria

POSSIBLE SOLUTIONS

Based on the cause of the problem, different approaches could be taken to resolve the issue.

If the cyanobacteria are present in the reservoir, then there are two remediation techniques that could resolve this problem.

Cyanobacteria physical disruption

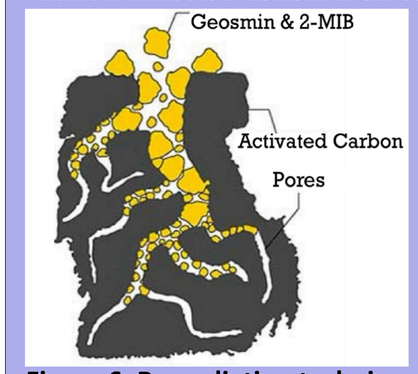
With positively charged bubbles, placed in the reservoir, the chain like structure of the cyanobacteria can be disrupted and thus inhibiting the bloom.

Chemical removal of taste and odor compounds

Powder Activated Carbon is a potential remediation technique. This process would be implemented in the treatment plant as a coagulant to remove geosmin and 2-MIB.

Upstream nutrient control

If there is a point source of nutrient intake to a river (fertilizer with nitrogen excess) governmental action must be considered to control such activities.



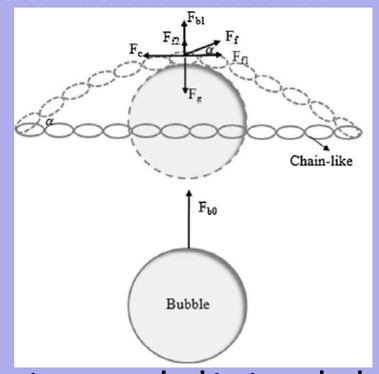


Figure 6. Remediation techniques to remove bad taste and odor.

Conclusions and Future Work

In order to conclude which remediation technique is the most efficient, there are certain studies that must be performed. 1) Nutrient intake measurements in the reservoir. 2) Further investigation of reservoir hydrobiological reports.

Acknowledgments

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References

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AMB, (2019)