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**MONITORAMENTO DA ÁGUA DE UM LAGO PARA CAPTAÇÃO: ESTUDO
DO LAGO DOURADO, SANTA CRUZ DO SUL, BRASIL**

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**MONITORAMENTO DA ÁGUA DE UM LAGO PARA CAPTAÇÃO: ESTUDO
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Dissertação apresentada ao Programa de Pós-Graduação em Tecnologia Ambiental – Mestrado e Doutorado, Área de Concentração em Gestão e Tecnologia Ambiental, Linha de Pesquisa em Gestão e Manejo de Recursos Naturais, Universidade de Santa Cruz do Sul – UNISC, como requisito parcial para o título de Mestre em Tecnologia Ambiental.

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1 INTRODUÇÃO

Os recursos hídricos tornam-se cada vez mais escassos e o seu uso só tende a aumentar, o que significa que a crise de falta de água potável será uma realidade num futuro próximo. Desta forma, o reconhecimento do valor da água pode auxiliar na maneira como a água é gerenciada e precificada (Gleick, 2014; Momeni *et al.*, 2019).

Grande parte da água disponível mundialmente não pode ser utilizada. Então, para suprir a demanda, são construídos reservatórios em pequena ou grande escala, podendo limitar o uso para consumo humano em função de diversos fatores relacionados a sua qualidade principalmente atrelados a eutrofização e proliferação de cianobactérias (Shiklomanov and Rodda, 2004; Dejenie *et al.*, 2008; De O. Vieira and Sandoval-Solis, 2018).

A população mundial cresceu de maneira muito acelerada, o que acarretou no aumento da produção de alimentos, maiores atividades industriais e aumento na geração de águas residuais. Com isto há uma grande complexidade e desafios quanto à gestão das águas junto com a falta de investimentos em infraestrutura e esgotamento de recursos naturais (Van Der Bruggen *et al.*, 2010; Zeng, X. *et al.*, 2019).

A qualidade da água é influenciada por vários fatores naturais das bacias hidrográficas, podendo variar de acordo com a sazonalidade das condições climáticas, volume de escoamento e os níveis da água. Além disso, a influência humana acelera os processos de alteração de qualidade, a partir da descarga de esgoto sanitário, efluente industrial, despejos urbanos, uso de fertilizantes e agrotóxicos em áreas agrícolas, drenagem pluvial, entre outros (Codd, 2000).

Os lagos desempenham um papel importante na vida humana urbana, pois são reservatórios que auxiliam no abastecimento de água, controle de enchentes e geração de energia (Méthot *et al.*, 2015; Wang, G. *et al.*, 2019). No Lago Dourado, reservatório para abastecimento de água de Santa Cruz do Sul (RS, Brasil), há uma sequência de ações para garantir a qualidade da água de abastecimento público sob a responsabilidade da Companhia de Abastecimento do Estado e do Poder Municipal. No entanto, o conhecimento de parâmetros que possam estar ligados a floração das

algas, conhecido internacionalmente como *Harmful algal bloom* (HAB) em determinados períodos do ano, necessita maiores estudos.

Associado a presença de HABs em reservatórios de água, está o sabor e o odor da água potável. As características organolépticas são frequentemente os principais critérios de qualidade da água usados pelos consumidores. Dois dos compostos mais comuns de sabor e odor são 2-metilisoborneol (MIB) e geosmina, metabólitos produzidos por uma variedade de cianobactérias. Ambos são não-tóxicos, mas deixam odor e sabor em um limiar extremamente baixo. Comumente, ocorrem regularmente em águas superficiais durante os meses quentes de verão, especialmente para condições sub / tropicais

Remover sabor e odor é um desafio, somado ao tratamento convencional da água (coagulação, floculação, sedimentação e filtração), as estações de tratamento de água costumam usar carvão ativado em pó nos períodos de episódios de HABs para reduzir geosmina e 2-MIB da água destinada aos consumidores (Doederer *et al.*, 2019). Neste sentido, devido a potencialidade de eutrofização das águas do Lago Dourado, é necessário o monitoramento destas moléculas, para garantir ações público-privadas visando minimizar o impacto para a qualidade da água.

Além de ganhos para o consumidor da água tratada e para o equilíbrio trófico da do ambiente aquático, entender a ocorrência de alterações na qualidade da água no Lago Dourado, significa redução nos custos de tratamento de água no município. Episódios de HABs provocam aumento no custo do tratamento da água de abastecimento, pois há necessidade de lavar filtros das estações mais vezes, um grande consumo de carvão ativado em pó e um número maior de análises para garantir uma água dentro dos padrões de potabilidade exigidos pela legislação vigente (Xuwei *et al.*, 2019).

Ademais, a água de superfície é encontrada extremamente variável em sua composição química devido a sazonalidade nas contribuições relativas do solo, fontes de água e de superfície. A análise de condições complexas como esta, pode ser realizada com o uso de técnicas quimiométricas. Por exemplo, determinação do índice de qualidade da água (Gharibi *et al.*, 2012; Sahoo *et al.*, 2015; Mangadze *et al.*, 2019; Unda-Calvo *et al.*, 2020) de sistemas de tratamento (El Hawary and Shaban, 2018; Brunner *et al.*, 2020), interpretação do monitoramento de parâmetros (Carrasco *et al.*, 2019; El Najjar *et al.*, 2019) e de sistemas biológicos de monitoramento (Mangadze *et al.*, 2019; Sotomayor *et al.*, 2020) entre outras aplicações. As ferramentas

quimiométricas que podem ser utilizadas são muitas e permitem uma avaliação mais completa e eu considere a complexidade do sistema.

Quando há multivariadas formas de correlação entre vários parâmetros de qualidade da água em diversos padrões de uso, o PCA é um método mais conveniente a ser explorado para extrair as informações subjacentes e alcançar algumas inferências concebíveis usando conjuntos de dados complexos (Kim *et al.*, 2019). Já a Análise Hierárquica de Agrupamentos (HCA) é uma abordagem muito significativa para reconhecer a semelhança instintiva entre variáveis usando conjuntos de dados inteiros e os resultados são exibidos como uma árvore diagramática denominada dendrograma (Özdemir, 2016).

Portanto, neste contexto a análise do Lago Dourado de Santa Cruz do Sul - Brasil, pode ser explorada considerando a complexidade do monitoramento de vários parâmetros que são importantes para reconhecer o enquadramento junto a legislação ambiental, determinação do índice trófico e toxicidade da água.

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