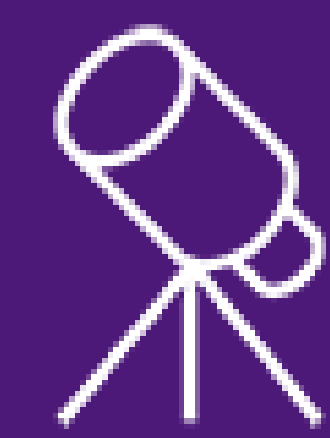


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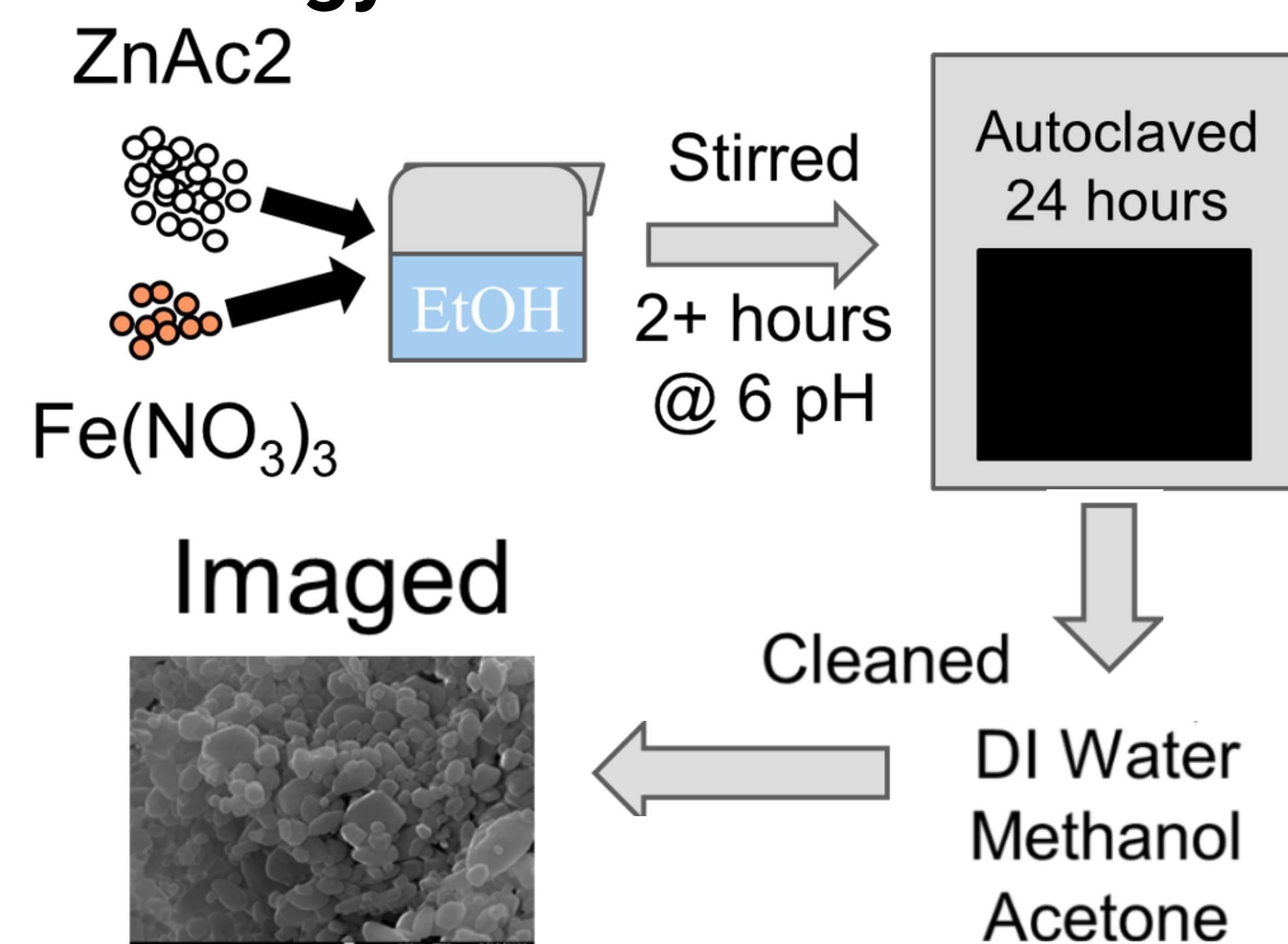
## Abstract

Zinc oxide (ZnO) is a versatile semiconductor with potent antibacterial properties driven by oxidative stress and Zn<sup>2+</sup> ion release. While particle morphology is known to influence antimicrobial efficacy, the role of pH in ethanol-based solvothermal synthesis remains underexplored. This study investigates the influence of pH (6.2–10.0) on the lattice structure and morphology of ZnO crystals. Our results indicate that near-neutral pH (7.0–7.2) promotes the growth of high-aspect-ratio cylindrical structures, whereas highly basic conditions (pH 10.0) lead to the formation of large, irregular micro-crystals.

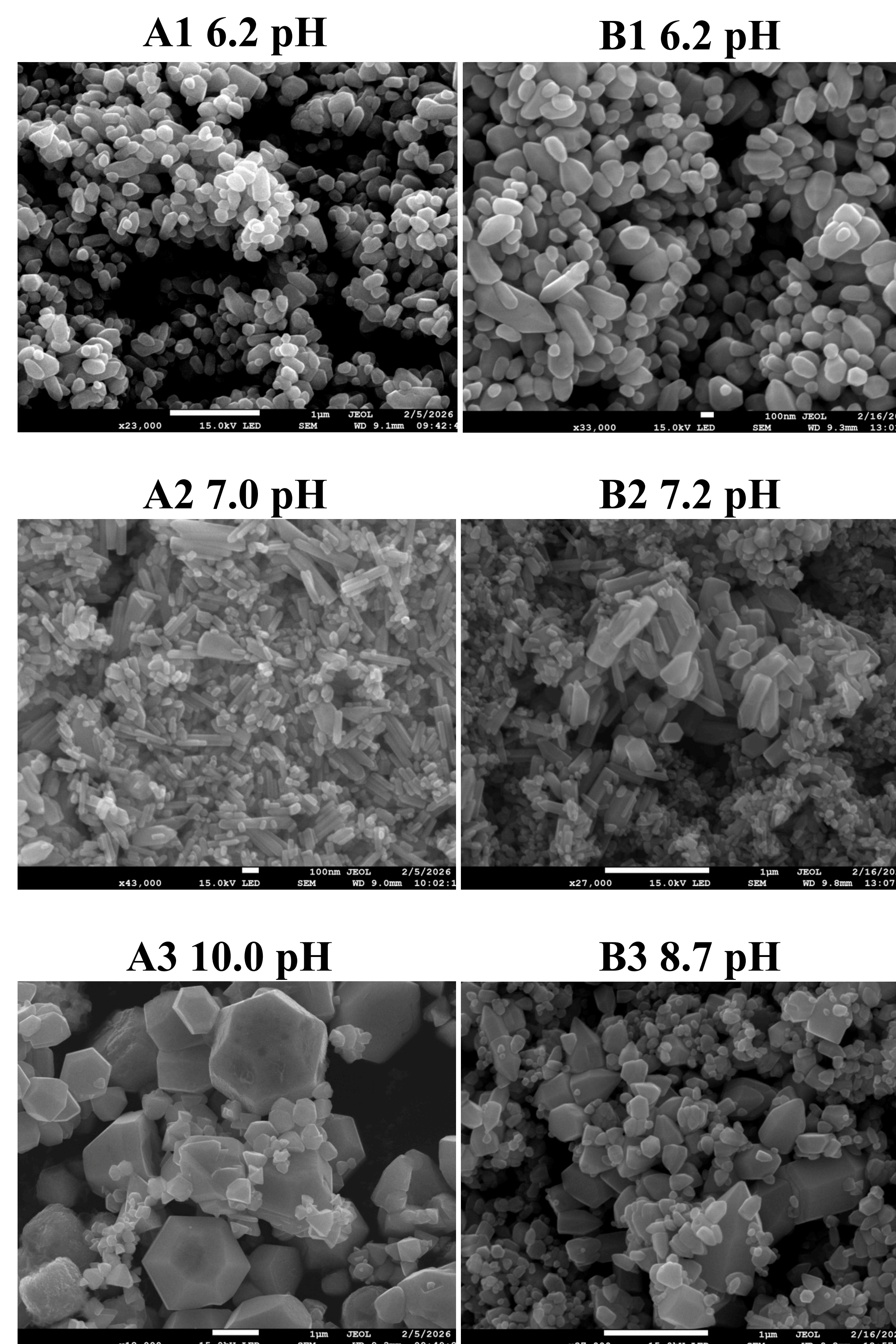
## Introduction

- Background: Rising antibiotic resistance requires biocompatible, cost-effective alternatives like ZnO.
- Mechanisms: microscale ZnO induces oxidative stress (ROS), deteriorates cell walls, and releases Zn<sup>2+</sup> ions to disrupt bacterial function.
- Objective: This study evaluates how pH variation (6.2–10.0) in ethanol-based solvothermal synthesis affects particle morphology and size.
  - Morphology has been linked to effectiveness of antibacterial activity
  - OH groups (linked with alkaline conditions) has been cited to be a crucial aspect of the ZnO reaction

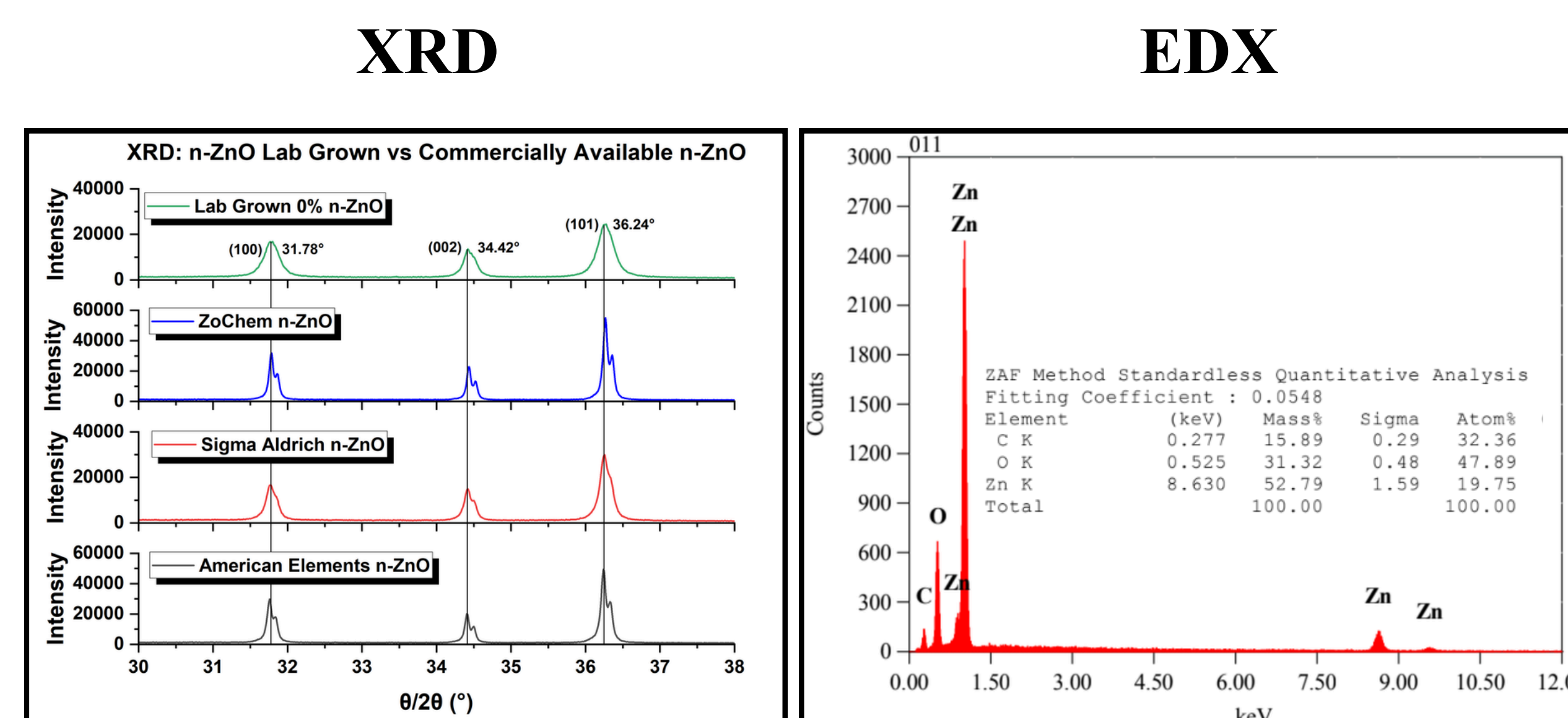
## Methodology



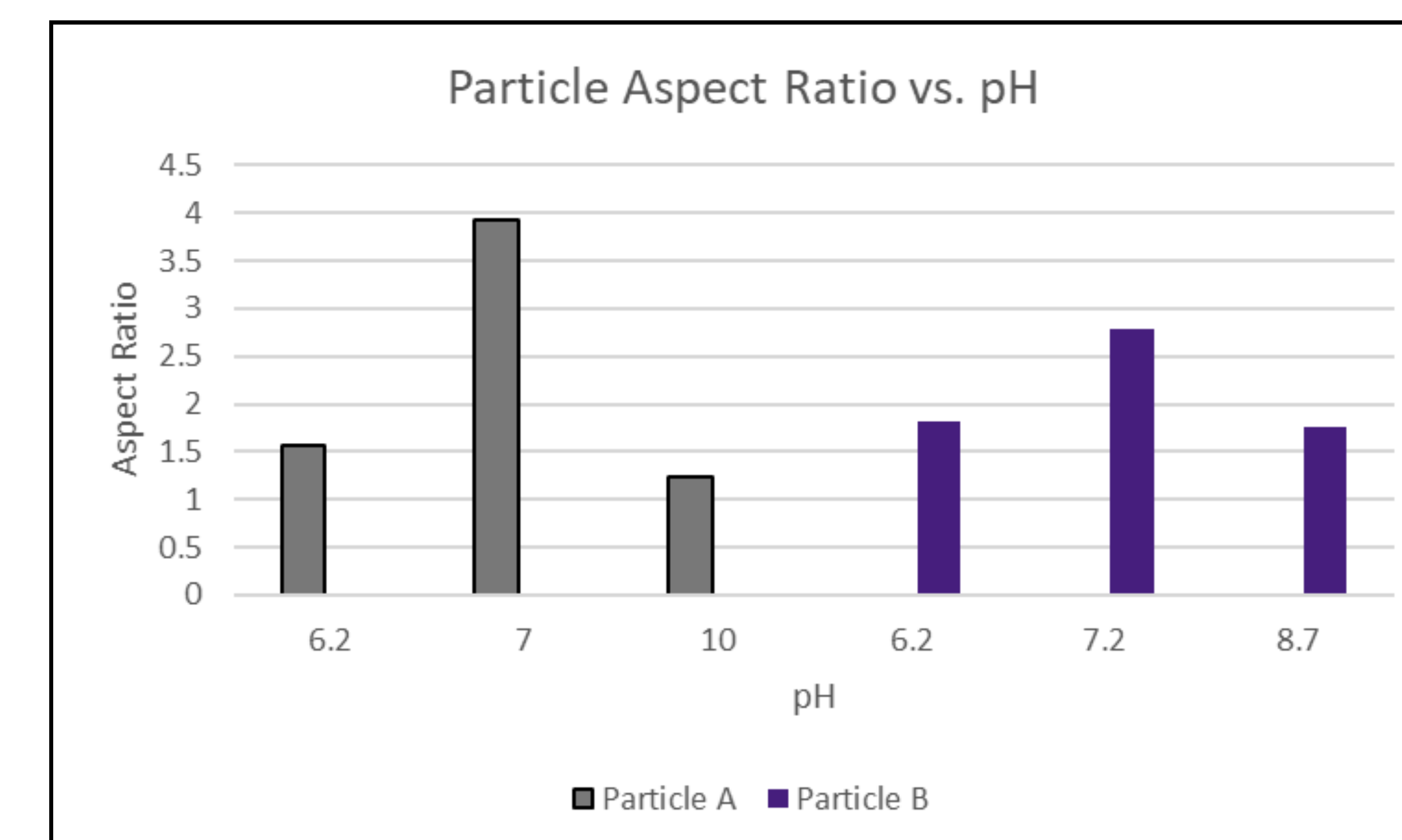
## Results: Morphological Analysis (SEM)



## Results: Structural and Elemental Analysis (XRD and EDX)



## Results: Aspect-ratios (SEM)



## Discussion

- Aspect ratio peaked at 3.92 (Particle A) and 2.79 (Particle B) at neutral pH, corresponding to the highest surface area morphologies for antibacterial activity.
- At pH 10.0, excessive OH<sup>-</sup> caused rapid, non-uniform precipitation and agglomeration, producing large (>700 nm), irregular micro-crystals with high size variance.
- XRD confirmed phase-pure wurtzite ZnO across all samples; EDX detected only Zn, O, and C with no contaminant elements.

## Conclusion

Neutral pH (7.0–7.2) produces uniform, high-aspect-ratio ZnO rods optimal for antibacterial application. Acidic conditions yielded less-structured ellipsoids, while highly basic conditions produced irregular, erratic crystals. XRD and EDX confirm that morphological differences are pH-driven, rather than resulting from compositional or structural variations.

## Future Work

- Test antibacterial activity across pH conditions to link morphology to bacterial inhibition.
- Look into surface defect concentrations for differing pH conditions for further in-depth understanding.
- Test in more acidic environments as this may hinder the production of ZnO in general, but allow for more consistency and a lesser standard deviation in sizing.