Antibiotic overuse in animal farming and other industries has led to the alarming rise of antimicrobial resistance, threatening the health of the humans, animals and environment worldwide. This growing issue has driven scientists to search for natural and novel solutions to prevent diseases in livestock without relying on antibiotics. Among potential solutions, seaweeds have emerged as a natural promising alternative. These marine plants are rich in bioactive compounds, which are known for their anti-inflammatory, antioxidant, and antibacterial properties. Seaweeds offer thus a multifaceted approach to combat antimicrobial resistance by enhancing animal immunity and promoting gut health. Their use could reduce the need for synthetic drugs in farming systems, which in turn helps curb the spread of drug-resistant bacteria.

Thus, the MARINA-CARE project aims to investigate the bioactive potential of four brown seaweed species (*Fucus vesiculosus, Fucus serratus, Pelvetia canaliculata* and *Laminaria digitata*) along with fucoidan, a polysaccharide found in brown seaweed, as a natural alternative to synthetic antibiotics. In addition to testing the individual bioactivity of these seaweeds, researchers will explore six combinations of each brown seaweed to determine whether blending their properties results in their effectiveness through synergistic interactions. In light of this, the study aims to (i) detect their bioactive molecules, (ii) discover whether these seaweeds and fucoidan reduce inflammatory processes and have anti-inflammatory properties, (iii) evaluate their antibacterial properties and effectiveness against pathogenic microbes, and (iv) assess their antioxidant potential to mitigate cellular damage caused by oxidative stress.

Therefore, researchers will perform chemical analysis, and seaweed powders will be tested for their nutritional composition, including content of proteins, fibers, and essential bioactive compounds such as polyphenols and flavonoids. Fatty acids, pigments, and carotenoids will also be measured using advanced techniques such as spectrophotometry and chromatography. Moreover, researchers will test the anti-inflammatory effect from seaweed extracts using pig immune cells exposed to harmful substances that mimic the infection. Researchers will detect if these extracts reduce inflammation. Key markers of inflammation will be measured to evaluate the effectiveness. Further, researchers will test antioxidant activity of these seaweed extracts to measure their ability to neutralize harmful unstable molecules called free radicals, which can damage cells and lead to various diseases. Using chemical-based tests, scientists will determine how well the extracts protect cells and measure their antioxidant strength at different doses. Finally, researchers will test antibacterial activity of these seaweed extracts against harmful bacteria such as *Escherichia coli* and *Listeria monocytogenes*. Scientist will evaluate their ability to inhibit bacterial growth, kill bacteria, and prevent the formation of biofilms, which are protective layers bacteria form to resist treatment.

The expected results from the conducted research could demonstrate that brown seaweeds have the potential to become a powerful, natural alternative to antibiotics in livestock feed. By preventing disease naturally and enhancing immunity in animals, seaweeds could reduce reliance on synthetic drugs, thereby promoting healthier animals and minimizing the spread of antimicrobial resistance. Additionally, incorporating seaweeds into livestock feed could improve overall animal welfare by supporting gut health and reducing stress-related illnesses, further enhancing productivity and food quality. While further studies on animal models are needed to confirm these benefits, the findings from this research could represent a significant step toward healthier livestock and a safer, more sustainable food system. This functional approach thus offers a promising solution to the global challenge of increasing of antimicrobial resistance.