

# 1 Study on The Physical Properties and *In vitro* Digestion of A

## 2 Novel Oleogel Formulation Composed of Fish Oil

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### 5 Outline

- 6 1. Introduction
- 7 2. Study on the physical properties of a novel oleogel formulation composed of oil
- 8 3. Study on the in vitro digestion of a novel oleogel formulation composed of oil
- 9 4. Conclusion

### 10 Abstract

11 Long-chain omega-3 polyunsaturated fatty acids are present in fish oil and are prone to  
12 oxidation, which can lead to rancidity and reduce the availability of beneficial components.  
13 Oleogels are formed by heating and cooling processes where a gelling agent forms a 3D  
14 network structure to solidify liquid oil into a semi-solid gel. This novel technology alters the  
15 physical properties of the oil and aims to assessing its impact on the oxidative stability of fish  
16 oil. Furthermore, the study seeks to ascertain the potential of encapsulating fish oil within  
17 oleogels to facilitate controlled release within the digestive system. Three groups of fish oil  
18 oleogel samples were prepared using different concentrations (4%, 6%, and 8%) of carnauba  
19 wax and fish oil under heating at 90°C, mixing, and subsequently cooling. Visual appearance  
20 revealed that oleogels of different concentrations successfully formed semi-solid gels at room  
21 temperature, and even at 45°C storage conditions for 3 days, higher wax concentrations  
22 maintained gel structures. As the wax concentration increased, the color of the oleogels became  
23 lighter yellow, and the texture became harder, indicating a tighter bond between the wax and  
24 fish oil. With temperature changes, higher wax concentrations exhibited increased melting  
25 points and crystallization ranges and higher viscoelastic values, attributed to the wax's ability  
26 to modify the crystalline behavior of the oil. Accelerated testing revealed that higher wax  
27 concentrations may promote oxidation due to higher levels of free fatty acids in the wax.  
28 Furthermore, simulated digestion experiments showed that oleogels prepared with higher wax  
29 concentrations delayed the digestion of fish oil in the stomach, releasing it in the intestines,  
30 thereby reducing the unpleasant fishy taste upon ingestion. Overall, this study demonstrates the  
31 stability of fish oil oleogel structures and their impact on human digestion and absorption,  
32 suggesting potential applications in the development of functional food formulations.