Lab Report: Analysis of Various Oil Mixtures Using Analytical Instruments

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Introduction

This lab report details the comprehensive analysis of various oil-based mixtures using state-of-the-art analytical instrumentation. Each mixture was subjected to numerous tests, providing insights into their chemical and physical properties. The utilized instruments include mass spectrometers, NMR spectrometers, titrators, UV-Vis spectrophotometers, FTIR spectrometers, liquid chromatographs, HPLC systems, conductivity meters, and viscometers. The primary goal was to thoroughly analyze mixtures and derive specific properties and characteristics indicative of their composition.

Methodology and Observations

Initial observations were carried out visually, determining that each oil mixture possessed distinct properties such as viscosity, color, and turbidity. The mixtures analyzed included formulations of Coconut Oil, Almond Oil, and Jojoba Oil combined with various additives like Beeswax, Glycerin, and Gum. Each test was meticulously executed as follows:

Mass Spectrometry and NMR Analysis

The Mass Spectrometer MS-20 revealed mass-to-charge (m/z) ratios key to identifying components in the Coconut Oil and Cetyl Alcohol combination, yielding a distinct spectrum at 1200 m/z indicative of molecular fragments. Concurrently, the NMR Spectrometer NMR-500 was employed for analyzing Almond Oil, providing a chemical shift of 15 ppm, suggestive of the unique hydrogen environments within the sample.

Titration and UV-Vis Spectroscopy

Using the Titrator T-905, the glycerin content in the Coconut Oil mixture was quantified to a precise concentration of 0.005 M. The UV-Vis Spectrophotometer UV-2600, emphasizing interactions with Vitamin E, showcased an absorption peak at 2.5 Abs for the Coconut Oil, Beeswax, and Vitamin E blend, highlighting the light absorption characteristics of Vitamin E.

FTIR and Conductivity Measurements

The FTIR Spectrometer FTIR-8400 provided insight into the functional groups present in the Coconut Oil and Glycerin complex, with a distinct absorption at 3000 1/cm associated with the OH stretching vibrations. Meanwhile, conductivity evaluations using the Meter CM-215 revealed a robust conductivity of 1500 uS/cm for the Coconut Oil, Cetyl Alcohol, and Glycerin blend, supporting the presence of ionic species.

High-Performance Liquid Chromatography and Viscosity Analysis

Liquid Chromatograph LC-400 analysis of Jojoba Oil identified key components with concentrations at 250 ug/mL. Similarly, the HPLC System HPLC-9000 confirmed the presence of discreet constituents in Jojoba Oil and Beeswax, quantifying several elements at 850 mg/L. Viscosity assessments conducted with the Viscometer VS-300 showed the disparity in viscosities between Jojoba Oil with Gum, measured at a formidable 1935.29 cP, and the thicker Coconut Oil, Cetyl Alcohol, and Glycerin mixture at 5240.52 cP.

Results

Table 1: Instrument Measurements

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| --- | --- | --- | --- |
| **Instrument (Model)** | **Mixture Tested** | **Key Result** | **Unit** |
| Mass Spectrometer MS-20 | Coconut Oil, Cetyl Alcohol | 1200.0 | m/z |
| NMR Spectrometer NMR-500 | Almond Oil | 15.0 | ppm |
| Titrator T-905 | Coconut Oil, Glycerin | 0.005 | M |
| UV-Vis Spectrophotometer UV-2600 | Coconut Oil, Beeswax, Vitamin E | 2.5 | Abs |
| FTIR Spectrometer FTIR-8400 | Coconut Oil, Gum, Glycerin | 3000.0 | 1/cm |
| Conductivity Meter CM-215 | Coconut Oil, Cetyl Alcohol, Glycerin | 1500.0 | uS/cm |

Table 2: Chromatography and Viscosity Data

|  |  |  |  |
| --- | --- | --- | --- |
| **Instrument (Model)** | **Mixture Tested** | **Concentration/Viscosity** | **Unit** |
| Liquid Chromatograph LC-400 | Jojoba Oil | 250.0 | ug/mL |
| HPLC System HPLC-9000 | Jojoba Oil, Beeswax, Glycerin | 850.0 | mg/L |
| Viscometer VS-300 | Jojoba Oil, Gum | 1935.29 | cP |
| Viscometer VS-300 | Coconut Oil, Cetyl Alcohol, Glycerin | 5240.52 | cP |

Conclusion

Through the application of advanced analytical techniques, significant insights were obtained regarding the structural and compositional characteristics of various oil-based mixtures. The tests confirmed the presence of key components and provided quantitative data essential for understanding their properties and potential applications. The complex interactions between the constituents necessitate detailed scrutiny, affirming the utility of the instruments used to unravel the intricacies of such mixtures. Further exploration into the complex matrices involved could yield even more pertinent findings.