Lab Report: Mixture Analysis with Varied Spectrometric and Chromatographic Techniques

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Introduction

This report outlines the comprehensive analysis performed on various mixtures using a series of sophisticated analytical techniques. The primary goal was to determine specific parameters and characteristics of the mixtures, which contain combinations of common cosmetic ingredients such as Jojoba Oil, Beeswax, Vitamin E, etc. The methodologies utilized span across spectrophotometry, chromatography, nuclear magnetic resonance, and other pertinent techniques.

Experimental Procedures and Observations

A variety of instruments provided valuable data:

Table 1: Mixture Components and Analytical Instruments

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| --- | --- | --- |
| **Mixture ID** | **Main Components** | **Instrument** |
| M1 | Coconut Oil, Beeswax | UV-2600 |
| M2 | Jojoba Oil, Cetyl Alcohol, Vitamin E | NMR-500 |
| M3 | Almond Oil, Beeswax, Glycerin | GC-2010 |
| M4 | Coconut Oil, Gum, Glycerin | IC-2100 |
| M5 | Jojoba Oil, Glycerin | PCR-96 |
| M6 | Almond Oil, Cetyl Alcohol | TC-5000 |
| M7 | Coconut Oil, Cetyl Alcohol, Vitamin E | FB-1000 |
| M8 | Jojoba Oil, Beeswax, Vitamin E | VS-300 |
| M9 | Jojoba Oil, Gum, Glycerin | VS-300 |
| M10 | Almond Oil, Gum | VS-300 |

Table 2: Observed Results and Measurements

|  |  |  |  |
| --- | --- | --- | --- |
| **Mixture ID** | **Measurement Value** | **Unit** | **Technique Used** |
| M1 | 2.1 | Abs | Spectrophotometry |
| M2 | 10.5 | ppm | NMR Spectrometry |
| M3 | 250.0 | ppm | Gas Chromatography |
| M4 | 75.4 | mM | Ion Chromatography |
| M5 | 35.0 | Ct | PCR Cycle Threshold |
| M6 | 55.0 | C | Thermal Analysis |
| M7 | 0.75 | mm | Wear Scar Diameter |
| M8 | 2986.5 | cP | Viscosity |
| M9 | 1811.17 | cP | Viscosity |
| M10 | 7490.12 | cP | Viscosity |

Detailed Results

UV-Vis Spectrophotometry: Mixture M1

The UV-Vis analysis of the Coconut Oil and Beeswax mixture produced an absorption peak at 2.1 Abs, suggesting moderate interaction between the mixture components when exposed to ultraviolet light. This data invites hypotheses regarding potential energy transfer mechanisms within the oil and wax matrix.

NMR Spectrometry: Mixture M2

NMR spectrometry identified a chemical shift at 10.5 ppm for the Jojoba Oil, Cetyl Alcohol, and Vitamin E combination. Such a shift suggests unique environmental changes created within the mixture, offering insights into molecular interaction pathways, possibly due to the presence of additive systems in these ingredients.

Gas Chromatography: Mixture M3

A sharp peak was observed at 250 ppm for the Almond Oil, Beeswax, and Glycerin sample, highlighting the volatile component profile. The presence of consistent chromatogram patterns in these analyses provides key markers for mixture consistency and stability.

Ion Chromatography: Mixture M4

This analysis generated a concentration of 75.4 mM for the Coconut Oil, Gum, and Glycerin blend. The varied ionic content unveils correlations with potential emulsifying properties due to the complex interplay between the polar and nonpolar constituents.

PCR Analysis: Mixture M5

For the Jojoba Oil and Glycerin combination, a cycle threshold (Ct) of 35 was recorded. Although generally applied to nucleic acid analysis, utilized here, the PCR machine’s adaptability affirmed the cycle’s end synonymous with viscosity changes under thermal stress.

Thermocycler Examination: Mixture M6

Thermal stability testing through the Thermocycler TC-5000 demonstrated a characteristic melting point at 55°C, significant when considering the Almond Oil and Cetyl Alcohol mixture, where phase transition temperatures suggest novel formulation properties.

Four Ball Wear Test: Mixture M7

The mixture of Coconut Oil, Cetyl Alcohol, and Vitamin E showed a wear scar diameter of 0.750 mm under mechanical stress, indicating reasonable tribological performance—key for lubricant applications.

Viscosity Measurements: Mixtures M8, M9, M10

Conclusion

This series of tests provides critical insight into the physicochemical properties of the chosen mixtures. Each analytical technique offered unique information elucidating aspects such as molecular interactions, thermal properties, and mechanical performance. The data underscores the importance of selecting the appropriate analytical method tailored to the specific inquiries posed during formulation development.

Notes: