

Medicine detection with Low Frequency Electromagnetic Signals

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Abstract: - This paper presents a new, non-invasive method to detect molecular structures inside materials. There have been different methods to detect molecular structures such as Chromatography, Spectroscopy and Nuclear Magnet Resonance. A brief description of these methods is presented and how they are used. Then the new method is presented using an apparatus emitting low frequency electromagnetic signals. This paper presents how the frequencies are found, that are used to detect molecular structures. The method was applied for finding the frequencies of four pain-reliever medication. Discussion follows on the results. Conclusions are drawn and further work is proposed.

Keywords: - Detection with Low Frequency Signals, Pain-Relief Medication Detection, Molecular Structure Detection, Non-Invasive Detection

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1 Introduction

The aim of this research is on the detection of chemical substances inside materials using low frequency electromagnetic signals. More specifically the research involves the scanning of chemical substances and the development of a non-invasive method, that will find the frequencies that each material responds. Application on the detection of materials will be depicted and examples will be presented. This method has already successfully been used for the detection of molecular structures, such as pain-relievers medication. It could also be applied for the detection of other chemical structures that reside inside materials.

Until now, methods such as Chromatography, Ultraviolet-Visible spectroscopy, Nuclear Magnetic Resonance (NMR), were used to analyze presence of chemical structures inside different substances.

2 Background

To identify various chemical structures inside a material, there are different techniques used, such as Chromatography, Ultraviolet-Visible Spectroscopy and Nuclear Magnetic Resonance. They are briefly described below:

2.1 Chromatography

Chromatography is a technique to detect the constituents of a mixture. The mixture is dissolved in a fluid called the mobile phase, which carries it through a structure holding another material called the stationary phase. The various constituents of the mixture travel at different speeds, causing them to separate. The separation is based on differential

partitioning between the mobile and stationary phases. Subtle differences in a compound's partition result in different retention on the stationary phase and thus affect the separation.

Chromatography may be preparative or analytical. The purpose of preparative chromatography is to separate the components of a mixture for later use, and is thus a form of purification. Analytical chromatography is done normally with smaller amounts of material and is for establishing the presence or measuring the relative proportions of analytes in a mixture. [1]

2.2 Ultraviolet-Visible Spectroscopy (UV-Vis)

Ultraviolet-visible spectroscopy or ultraviolet-visible spectrophotometry (UV-Vis or UV/Vis) refers to absorption spectroscopy or reflectance spectroscopy in part of the ultraviolet and the visible and adjacent spectral regions. The absorption or reflectance in the visible range directly affects the perceived color of the chemicals involved. In this region of the electromagnetic spectrum, atoms and molecules undergo electronic transitions. Absorption spectroscopy is complementary to fluorescence spectroscopy, in that fluorescence deals with transitions from the excited state to the ground state, while absorption measures transitions from the ground state to the excited state.

The instrument used in ultraviolet-visible spectroscopy is called a UV/Vis spectrophotometer. It measures the intensity of light after passing through a sample and compares it to the intensity of light before it passes through the sample. [2]

2.3 Nuclear Magnetic Resonance (N. M. R.)

Nuclear magnetic resonance spectroscopy is a spectroscopic technique to observe local magnetic fields around atomic nuclei. The sample is placed in a magnetic field and the NMR signal is produced by excitation of the nuclei sample with radio waves into nuclear magnetic resonance, which is detected with sensitive radio receivers. The intramolecular magnetic field around an atom in a molecule changes the resonance frequency, thus giving access to details of the electronic structure of a molecule and its individual functional groups. These fields are unique and highly characteristic to individual compounds. The NMR spectroscopy is the definitive method to identify monomolecular organic compounds. Similarly, biochemists use NMR to identify proteins and other complex molecules. Besides identification, NMR spectroscopy provides detailed information about the structure, dynamics, reaction state, and chemical environment of molecules. The most common types of NMR are proton and carbon-13 NMR spectroscopy and it is applicable to any kind of sample that contains nuclei possessing spin. [3][8]

3 Detector System Apparatus and Method

An apparatus is shown that uses low frequencies on a rotating antenna. The antenna is on an inclined free circular motion.

3.1 Detector System Apparatus

The apparatus used and its operation is briefly presented and is shown on figure 1. The apparatus consists of a flat base with an inclined pole and a rectangle box with a signal generator circuitry and an antenna. The rectangle box with the antenna can rotate on the pole. The antenna is emitting a low frequency signal, and is in an inclined circular motion. It has been observed that under some circumstances a force is exerted on the rotating antenna in the presence of a material. The force appears when a material is pointed by the antenna while the antenna is emitting a specific signal for that material. The presence of the force can be used for the detection of materials.



Fig. 1 Detector Apparatus

The antenna is emitting appropriate signal for the specific material. The method how the appropriate signals are found for each specific material or family of materials is presented. Some parameters that affect the force will be analysed.

The presence of the Force designates a response from the material. When the material is removed, then the Force disappears. When the material is moved to another position, then the Force appears when the antenna is pointing to the new position.

The system has a rest position when the antenna is pointing downwards. This position is 180 degrees from the highest position located exactly opposite. The highest position is defined to be at 0 degrees. The system is brought to an initial position/angle at φ_i (i.e at 30 degrees) and released. The system does a specific movement. It rotates until it reaches its final position/angle φ_f (i.e. at 320 degrees). The characteristics of the movement are noted, such as the position of the antenna in time. If during a rotation, a delay is experienced in the movement, this designates the presence of material and in this case the antenna's final position φ_f will not reach the final position of the movement φ_f . The position/angle φ_d of the antenna, when the delay is experienced designates the detection of material and its direction is φ_d .

There are different parameters that affect the Force exerted on the antenna. The force F , exerted on the antenna of the system, opposing to the movement, is a function (f) of: the quantity M of the molecular structure and the distance D from the material.

$$F = f(M, D)$$

The larger the quantity of the material M , the larger is the force F . Material is counted to be only the weight of the pure active material.

The smaller the distance D between the material and the antenna, the larger is the force F .

The frequencies that will be used are in the low frequency range.

3.2 Method Finding the Detection Frequencies of Materials

To find the frequencies that respond to a material requires a specific method and it is very laborious, and has the following steps in 2 phases A, B. During this process the parameters that affect the force exerted on the antenna, M and D , must be kept constant. Response to frequencies from 2300-2500 Hz will be tested using the method.

A. Finding the frequencies that respond

1. The material is placed on specific angle φ_p .

- The signal generator on the apparatus is emitting an initial frequency f_i .
- Then antenna is brought to the initial angle φ_i and is released. If the final angle of this movement φ_f reaches the final angle φ_F , then there is not detection.
- Then the frequency emitted by the generator is increased by 1Hz, the antenna is brought to the initial angle, released and checked if φ_f reached the final angle φ_F .
- The previous step 4, is repeated until the antenna does not reach the final angle φ_F . The detected frequency f_d is recorded.

B. Centering the responding frequencies found in A

- The detected frequencies f_d found in A, are checked again, one at a time, for confirmation. The antenna is brought to the initial angle φ_i and is released. The final angle φ_f is recorded for each one of them.
- From the detected frequencies f_d , from step 1 above, that are consecutive, the one that has the smaller φ_f is kept. The others are discarded.

4 Frequency response of some Pain-Reliever Medications

The apparatus and method presented in section 3 of this paper was used to find the frequencies that some mild pain-reliever medicine respond. Discussion on the detected frequency response follows.

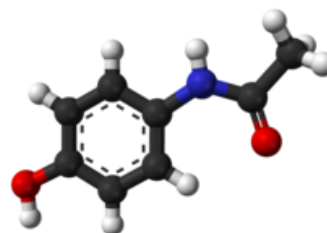
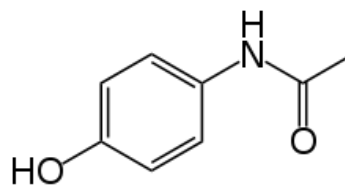
4.1 Testing mild pain-relievers

Four common mild pain-reliever medications were used with the apparatus and the method was applied. These medications are Depon, Aspirin, Nurofen and Ponstan. The characteristics of these four medications as well as their molecular structures are presented below.

4.1.1 Paracetamol (Depon)

Paracetamol, also known as acetaminophen, is a medication used to treat pain and fever. It is typically used for mild to moderate pain relief. Paracetamol, brand names: Depon, Panadol, etc. [4]

Chemical formula: $C_8H_9NO_2$
Molar mass: $151.165 \text{ g}\cdot\text{mol}^{-1}$



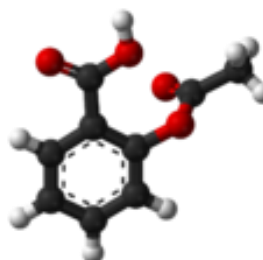
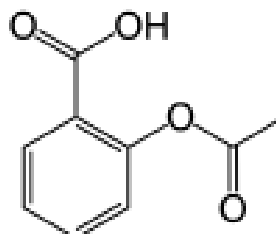
4.1.2 Acetylsalicylic acid (Aspirin)

Acetylsalicylic acid (ASA), is a medication used to reduce pain, fever, or inflammation. Specific inflammatory conditions which aspirin is used to treat include Kawasaki disease, pericarditis, and rheumatic fever.

Acetylsalicylic acid, brand names: Aspirin, etc.[5]

Chemical Formula: $C_9H_8O_4$

Molar mass: $180.159 \text{ g}\cdot\text{mol}^{-1}$

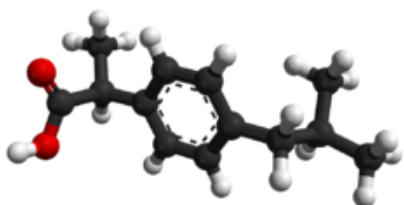
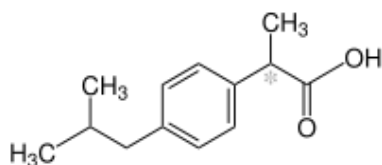


4.1.3 Ibuprofen (Nurofen)

Ibuprofen is a medication in the nonsteroidal anti-inflammatory drug (NSAID) class that is used for treating pain, fever, and inflammation. This includes painful menstrual periods, migraines, and rheumatoid arthritis.

Ibuprofen brand names: Algofren, Seractil, Nurofen, etc. [6]

Chemical Formula: C₁₃H₁₈O₂
Molar mass: 206.285 g·mol⁻¹



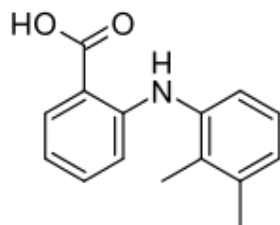
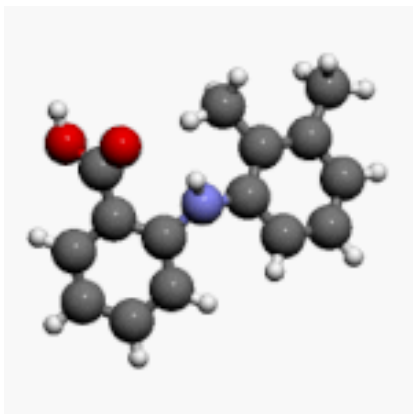
4.1.4 Mefenamic Acid (Ponstan)

Mefenamic acid is a member of the anthranilic acid derivatives (or fenamate) class of nonsteroidal anti-inflammatory drugs (NSAIDs), and is used to treat mild to moderate pain.

Mefenamic Acid brand names: Ponstan, etc.[7]

Chemical Formula: C₁₅H₁₅NO₂

Molar mass: 241.290 g·mol⁻¹



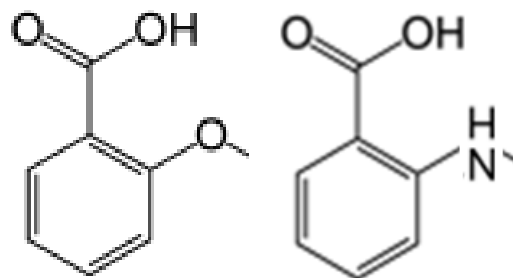
Below is the table showing the detected frequencies.
Table 1: Frequency Table: Depon, Aspirin, Nurofen and Ponstan

Depon (Paracetamol) 2300-2500 Hz	Aspirin (Acetylsalicylic Acid) 2300-2500 Hz	Nurofen (Ibuprofen) 2300- 2500 Hz	Ponstan (Mefenam ic Acid) 2300-2500 Hz
2381	2346	2395	2391
2386	2429	2467	2429
2391	2483	2491	2453
	2494	2497	2486

4.2 Analysis and Discussion

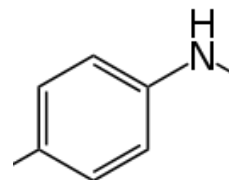
It is worth to notice that using this apparatus and the described method, we get response from materials in the range of low frequencies. Looking at the frequencies that these four medications respond, it can be observed that:

a. Aspirin and Ponstan both respond to 2429Hz. Also Ponstan frequency 2486Hz is close to Aspirin frequency of 2483Hz. Ponstan is also responding at 2383Hz, during frequency finding phase A, but during phase B was centered 2386Hz. Below it is seen the common part between Aspirin (left) and Ponstan (right).



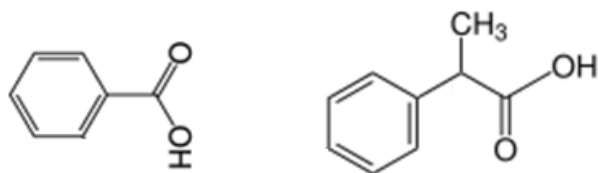
The -O- in Aspirin is similar to Ponstan-(NH)-

b. Ponstan frequency 2391Hz is close to Depon and Nurofen frequency of 2395Hz. Ponstan is also responding at 2395Hz, during frequency finding phase A, but during phase B was centered 2391Hz. Below it is seen the common part between Depon and Ponstan

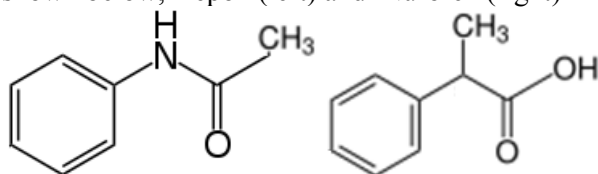


c. Aspirin frequency 2494Hz is close to Nurofen frequency of 2491Hz and 2497Hz. Aspirin is also responding at 2491Hz and 2497Hz during frequency finding phase A, but during phase B was centered

2494Hz. The similar part between in their molecules is shown below, Aspirin (left) and Nurofen (right)



d. Depon and Nurofen respond to 2390Hz and 2395Hz respectively, which are very close. They The similar part between in their molecules is shown below, Depon (left) and Nurofen (right)



Studying the molecular structures of these four pain-relievers, it can be noticed that they have similar parts in their molecular structure. The frequency may detect part of the molecular structure. The above a. b. c. d. observation on the similarities between the molecular structures and the detected frequency response will give insight to relate the molecular structure with frequency. The total of all the frequencies that a material is detected, is the frequency response of that material. It may be the signature that verifies the identity of the material.

5 Conclusion

In conclusion, an apparatus emitting electromagnetic signals was used and a method was developed to detect materials. The apparatus and method were tested on the detection of four pain-reliever medicine that have similarities in their molecular structures. Frequencies found that detect each of these four medications at the low frequencies range. Some frequencies are common, or very close, between these four materials. Further work needs to be done to find the relation between frequency and molecular structure.

Another aspect of work that should be looked at is if the method can be applied to find the biochemical composition of plants. With the existing methods a large sample is required which is costly in processing. Also specific ways of preserving both the samples and the substances are needed. The process has to be repeated, resulting significant delay. This new method is promising as it could detect substances inside the plants. In addition, due to the fact that it is non-invasive, the plants do not

need any treatment at all, thus reducing the time of the experiment and the cost of the process. Further work needs to be done to examine this.

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