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EXTRACTION OF NICOTINE FROM CIGARETTES TOBACCO USING EUTECTIC DEEP SOLVENT

Ali Saleh Albarak
Medical Applied College, Qassim University, Saudi Arabia

ABSTRACT

Tobacco smoke contains over 4,000 distinct chemicals that can be harmful to people in various ways. Because nicotine stimulates the production of serotonin, also known as the pleasure substance, in the brain, it is the most addictive of these substances. In many countries, tobacco use is a leading cause of death and a major contributor to a number of chronic diseases. Because of this, there is a greater need to extract nicotine, the most addictive substance, and deliver it to the body in ways other than smoking and burning, such as eating, breathing, or skin contact. Therefore, the term "therapeutic use of nicotine as a smoking cessation aid" refers to the use of nicotine to help you quit smoking. Choline chloride/ethyl alcohol, a deep eutectic solvent, was used in this research to extract the highest purity nicotine (3-(1-methyl-2-pyrrolidinyl) pyridine) from cigarette tobacco. Infrared analyses reveal that nicotine is the fatty substance extracted from cigarette tobacco. Furthermore, the effects of temperature and extraction time on nicotine production were investigated. The maximum nicotine extraction rate was found at 60 min. The maximum nicotine synthesis rate at 70 °C was 8.14%. The purity of the crude extract was 65% at that time, but increased to 98% upon processing.

Keywords: Nicotine, Cigarettes, Tobacco, Eutectic Deep

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1. INTRODUCTION

The principal alkaloid present in tobacco is nicotine, which is an organic chemical. (An alkaloid is a type of organic nitrogenous molecule that has a substantial effect on human physiology.) Nicotine is found throughout the tobacco plant, although it is notably concentrated in its leaves. By weight, the chemical accounts for around 5% of the plant. Nicotiana tabacum L., the tobacco plant, is native to America and named for Jean Nicot, the French ambassador to Portugal who brought tobacco seeds to Portugal. Nicotiana belongs to the genus Nicotiana. This plant, grown in Thailand's north and northeast, is largely used as a raw material in the production of cigarettes by the Thai Tobacco Authority. Unlike most other crops, tobacco leaves are economically valued. Tobacco leaves are traditionally classified into four categories, beginning at the plant's base: leaf, leaf, and tip [1]. Compared to the intermediate position (incisor) and upper stem (leaf and tip), the lower four or five leaves, known as the tufts, contain the least amount of nicotine, the highest concentration of reducing sugar, and the least amount of flavor and aroma [1]. Burley tobacco, a popular commercial tobacco type in Thailand, is offered by grade, which is directly tied to the position of the leaves on the stem. As a result, the chemical composition of the leaves relative to their position on the stem should provide critical information about their suitability for a particular application. Nicotine Tobacco leaves contain nicotine. Nicotine dissolves in a wide range of solvents, including alcohol, chloroform, ether, petroleum ether, kerosene and water. As a result, the solvent extraction method can be utilized to separate nicotine from tobacco leaves using a variety of solvents [2]. Nicotine is commonly utilized as a basic cigarette component in the tobacco industry, as well as the chemical, pharmaceutical, and precision agricultural industries. Nicotine is a medication used to alleviate withdrawal symptoms and help smokers quit [3]. The rapid degradation of nicotine from primary metabolism is a limitation of oral nicotine replacement therapy [4]. Recently, numerous nicotine dosage forms have been developed, including transdermal patches, oral sprays, lozenges, gum, oral films, and so on. There are advantages and disadvantages to each of these dosage forms. Unlike cigarette smoking, the transdermal patch has a steady and sustained release. The most common side effect is a local skin reaction at the contact site, which requires daily patch site changes [5]. Because the human oral mucosa is composed of non-keratinized cells, all oral regions are more permeable than the skin, even though both the skin and the oral mucosa are permeable [6]. Oral sprays can help people absorb nicotine more effectively Because nicotine does not stay in the bloodstream for very long, this dose form needs to be taken often. The directions for using nicotine gum are pretty complicated: patients must chew the gum slowly until they taste the nicotine, then stop chewing and hold it between their gum and cheek for about a minute. They must then resume chewing and repeat the process for about half an hour [7]. The onset and blood levels of nicotine are impacted by this chewing and swallowing action [8]. As a result, nicotine delivered using a fast-dissolving oral delivery system may reduce fluctuations caused by chewing or swallowing behaviors, and may eventually be used as a systematic technique to assist smokers who are attempting to cease feeling withdrawal symptoms. Rapidly dissolving oral administration systems are solid dosage forms that dissolve or disintegrate in the mouth in less than one minute and do not require chewing or drinking [9]. Despite the fact that this dose form requires repeated medicine administration, it is portable, which improves patient convenience and medication adherence. The two most essential factors when developing these dosage forms are dissolution in the oral cavity and the packaging's tensile properties. The concept behind fast-dissolving drug delivery systems was to provide patients with a simple way to take their prescribed medications.

The delivery technology uses an ultra-thin oral film that is put directly to the patient's tongue or other oral mucosal tissue. Saliva immediately wets the film, which quickly hydrates and adheres to the application site [10]. Following that, it rapidly dissolves, releasing the drug for absorption via the oral mucosa [11]. Thus, the current study will use maceration and acid-base extraction techniques to extract nicotine from the lower, middle, and upper areas of tobacco leaves (Figure 1) and determine the nicotine concentration of the extracts. The extract with the highest nicotine level was chosen to be used in fast-dissolving film compositions. In the lab, the mechanical, physical, and disintegration properties of the fast-dissolving nicotine film were evaluated. When someone inhales cigarette smoke, nicotine condenses molecules that are distributed throughout the lung fluid. This represents 100 square meters of the lungs' 300 million alveoli. Nicotine normally enters the peripheral nervous system after leaving the bloodstream and travels to the brain in 8-10 seconds without encountering any impediments (Figure 1). This is faster than an intravenous injection, which trances the smoker and relieves his craving by altering the nicotine levels in his blood. However, various factors are related to nicotine absorption, such as the volume, depth and frequency of inhalation, as well as the body conditions of the smoker [12]. Worldwide, smokers consume approximately 15 tons of nicotine from tobacco per day [13]. This alone is enough reason for us to consider this natural product. This work aims to extract and identify nicotine, the main toxic component in tobacco leaves

2. EXPERIMENTAL

This method uses a suitable solvent to selectively dissolve one or more compounds. The extractant is the name given to the mixture of dissolved components. When nicotine is extracted from tobacco powder, its solubility in water is 50 mg/ml at 40 °C, 100 mg/ml at 50 °C, and 150 mg/ml at 70 °C. Nicotine is more soluble in the deep ethyl alcohol/choline chloride solvent (200 mg/ml) than in water (50 mg/ml), and is therefore extracted from the aqueous extract of tobacco powder. Since nicotine is denser than water and insoluble in water, the solvent and nicotine composition can be separated based on the differences in density between the solvent and water mixture. Draining the solvent composition through a separatory funnel allows the solvent mixture to pass through while polar solvents, such as water, remain in the funnel. This is done by removing the remaining water from the solvent mixture. To obtain the highest nicotine content among cigarette tobacco, an examination was carried out in the first stage of the experiment. The steps were as follows: Ten grams of sodium carbonate, which acts as a base and reacts with tannins to generate sodium salts of tannins, were added to twenty grams of tobacco sample, which was then cooked for thirty minutes. The solution was then filtered using vacuum filtration method. Nicotine was then extracted in an organic solvent using liquid-liquid extraction with the resulting filtrate. Since nicotine is more soluble in solvent formulations than in other solvents, it is used as a solvent in liquid-liquid extraction. The organic layer is withdrawn from the separating funnel and allowed to evaporate with the solvent mixture inside. To make pure white nicotine, the crude brown nicotine is now transferred for recrystallization. The solvent mixture acts as the solvent for recrystallization. We determined that the nicotine content in tobacco plants is higher after conducting the above experiment and comparing the collected nicotine levels. The next experiment involves extracting nicotine with different bases and solvents. Extraction Steps We will extract nicotine from tobacco using a number of solvents with sodium carbonate as a base. Twenty grams of tobacco are cooked for 30 minutes on a base of sodium carbonate. We call this process solid-liquid extraction. The next step is filtration, and vacuum filtration is used instead of gravity filtration to save time.

The resulting filtrate is used for liquid-liquid extraction using a range of solvents such as ethanol, acetone, methane, and solvent combinations. In order to extract the purest nicotine, a separate liquid extraction is performed for each solvent, and the final product in the organic layer is then stored for evaporation. The white, raw crystalline nicotine, which is obtained through vacuum filtration and multiple extractions, must be recrystallized. Nicotine can be analyzed using a Perkin-Elmer gas chromatograph equipped with a flame ionization detector (FID), a GP-100 printer plotter, and an electronic integrator. A BP1 (30 m polydimethylsiloxane) limited-phase fused silica capillary column is used. With an inlet pressure of 10 psi and a flow rate of 0.4 ml/min, nitrogen gas can be used as the carrier gas. The temperature is regulated between 60-160 °C. The split ratio is used to inject the sample. 5. The retention factor (RF) for each component is calculated using the following formula The factors of time and temperature on the amount of nicotine produced from cigarette tobacco are shown in Figure 2,3

Rf = $Grams\ of\ caffeine$ (Rf)$Distance\ travelled\ by\ the\ component\ substance\ from\ the\ baseline$ / $Distance\ travelled\ by\ the\ sovent\ from\ the\ baseline$

On a single TLC plate, pure and extracted nicotine were analyzed, and any differences in Rf were compared

3. RESULTS AND DISCUSSION

3.1. Fourier Infrared measurement

Fourier transform infrared spectroscopy was used to determine the amount of nicotine in tobacco. Nicotiana tabacum L., commonly known as tobacco, belongs to the genus Nicotiana. Cigarettes are the major product of tobacco crop. Fourier transform infrared spectroscopy of nicotine in tobacco. The infrared spectrum was recorded continuously. The absorption peak in the range of 400–4000 cm-1 was measured as a function of time (Fig. 1). A fully automated approach for the detection of nicotine in tobacco using Fourier transform infrared spectroscopy has been proposed. The approach involves extracting nicotine directly with CHCl3. Samples were weighed into empty extraction cartridges and moistened with ammonia. The cartridges were mounted in a flow manifold and extracted with 2 ml of CHCl3 for 2 min. Then 400 µl of the extract was injected into a microflow cell using a CHCl3 holder. The area of this peak was interpolated using a calibration line . It was constructed from standard nicotine solutions treated with chloroform. During the process, the method produced a nicotine detection limit of 0.1 mg/ml, with a standard deviation of less than 2%. The extraction time was required for 10 minutes.

3.2. Solvent Extraction

Some solvents can dissolve nicotine properties. From cigarettes this is the basis for the solvent extraction method for nicotine extraction. Since ether and petroleum ether solvents are selective in dissolving alkaloids, they are later useful in extracting nicotine, an alkaloid found in tobacco. If the correct ratio of petroleum ether to ether is used, the extraction technique will produce more nicotine in less time. But all of these solvents mentioned above are considered very toxic, so they were replaced by the deep eutectic solvent, which is known to be non-toxic and very safe, and there are hundreds of formulations of it.

In this research, we have chosen one of these safe solvents from the deep eutectic solvent family, but we will not mention details about it because we are in the process of submitting this research to one of the national bodies to obtain a patent on this research, which is based primarily on the name of the solvent. The solvent was composed of two solvents, one of which is a large amount of choline chloride and the other is a form of ethyl alcohol. The results of the study revealed that adding choline chloride/ethyl alcohol had a significant effect on the extraction response time and yield. The desired results were achieved. The ideal solution is to combine one liter of ethyl alcohol and two liters of choline chloride.

3.3. Effect of time and temperature

The extraction time can be anywhere between 10 minutes and 60 minutes (Figure 2). In this case, the maximum value is 8.14%, with a minimum of 3%. The effect of operational factors such as working time, temperature and deep mixture ratio on nicotine extraction from tobacco plants was investigated. The nicotine content of raw materials, residual materials and extracts was determined using HPLC technique. The first deep solvent provided the highest overall extraction yield (8.14%). Figures 2 and 3 reveal that the most efficient method for nicotine extraction from tobacco plants was using a deep solvent for 60 min and at 70 °C. The results were compared with those obtained from conventional extraction using sodium hydroxide and ethanol, in which the nicotine efficiency was 6.5 wt% using the same particle size of the raw material. The extract contained nicotine content. The main areas of this study include the extraction of nicotine from tobacco and its use as a safe and non-toxic deep solvent method to help smokers quit smoking. It is important to highlight that its use can be expanded in response to industry needs to include the manufacture of other products containing nicotine, a medicinal drug with many medical applications, such as an inhalation spray or a cream for skin application. We have successfully extracted nicotine from tobacco using the “liquid-liquid separation” technique. We used a mixture of deep eutectic solvents as the extraction solvent. The solvent was then removed from the extract, leaving only white crystals, which were considered to be pure nicotine. Cleaning Rotary evaporation was used to concentrate the resulting suspension of crude tobacco extract at 60°C.

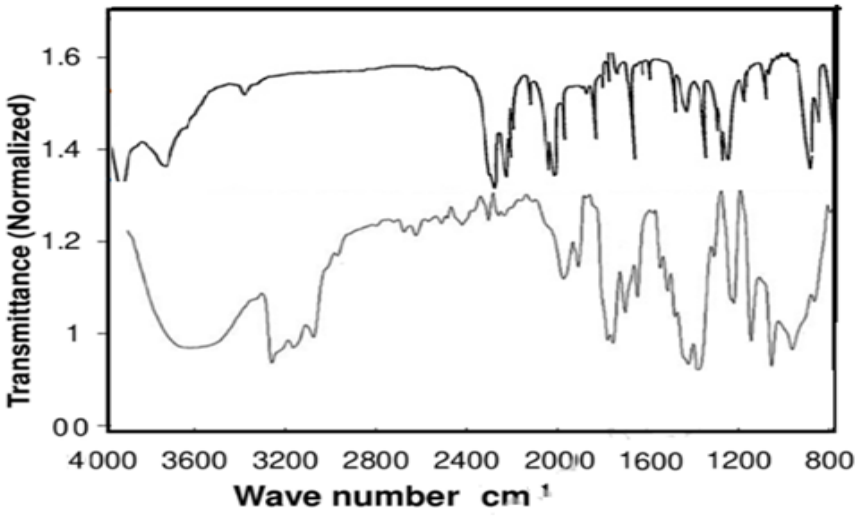
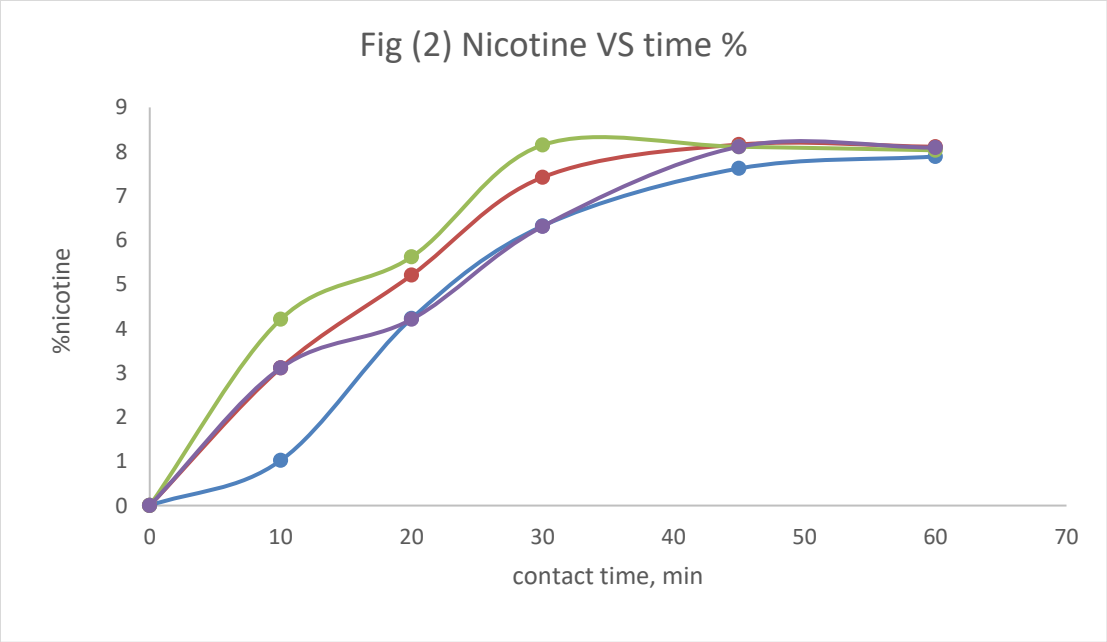
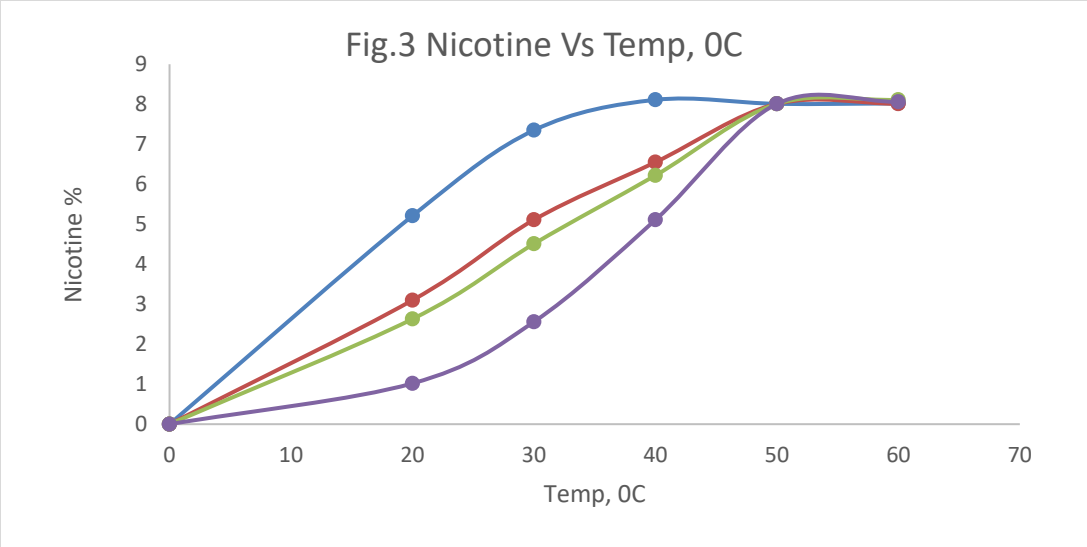


Figure (1) FT-IR spectrum of extracted nicotine by normal and eutectic solvents





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