EXTRACTION OF NICOTINE FROM TOBACCO

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Abstract - *Tobacco products contain a complex mixture of chemical components, with nicotine being the most prominent and addictive substance. This study aims to analyze the ratios of nicotine and other critical components in various tobacco products and evaluate their combined impacts on health and addiction. Using advanced analytical techniques such as gas chromatography-mass spectrometry (GC-MS) and high-performance liquid chromatography (HPLC), chemical profiling was performed on a diverse range of tobacco samples. The findings reveal significant variations in the ratios of nicotine, tar, and secondary additives, highlighting synergistic effects that enhance nicotine's addictive properties. A comprehensive understanding of the chemical dynamics within tobacco products, offering valuable data for public health initiatives, regulatory frameworks, and the development of less harmful alternatives*.

***Key Words*: Gas Chromatography-Mass Spectrometry, HPLC, nicotine, carbonyl compound.**

1.INTRODUCTION

A plant that is grown all over Indonesia, tobacco is categorized as a plantation crop. Cigarettes, chewing tobacco, cigarettes, and other items are all part of the global tobacco industry, which is one of the biggest retail product categories worldwide[1]. However, some detrimental effects on social, health, and environmental situations have been linked to tobacco cultivation. The tobacco business continues to make a substantial contribution to the Indonesian economy in spite of these detrimental effects. Many people find work in this business, especially in rural locations where there may not be many other job possibilities. The public's concern over the detrimental effects of tobacco farming has grown, nevertheless, and initiatives are underway to support sustainable tobacco production methods that reduce these effects. Waste from tobacco varies

It is known that tobacco leaf waste still has a significant nicotine content. The roots of the tobacco plant can potentially release nicotine. Root exudation releases a certain quantity of nicotine into the soil environment. The rhizosphere's release of nicotine enhances the uptake of nitrogen, calcium, iron, and zinc, which in turn encourages the emergence and vigor of seedlings, the levels of chlorophyll, and the subsequent growth of maize. According to earlier studies, nicotine's nitrogen content is found in the roots and is subsequently taken up by the soil before being dispersed throughout the entire plant, with the exception of the seeds. Although not as much as in the leaves, nicotine was also present in the stem. Additional garbage, including agro-industrial waste and tobacco dust.

In the nightshade family, tobacco is a robust herbaceous plant that belongs to the genus Nicotiana. Tropical America was its birthplace, and it is currently being grown all over the world. The Solanaceae family includes the cultivated tobacco plant Nicotiana tobacco, which yields ingredients for medications, cosmetics, and fragrances. Of the alkaloids found in tobacco, nicotine is the main alkaloid, making up about 95%. Nicotine is extracted from tobacco waste, which is abundant in China and can be used to boost the value of this otherwise useless substance. Nicotine is the component of tobacco that has the greatest physiological impact. An image of tobacco leaves given below.

Fig-1: Tobacco leaves

2. LITERATURE REVIEW

Nicotiana tabacum L (NTL), a tobacco plant, is a source of nicotine. This plant belongs to the nightshade family, which also includes coca leaves, tomatoes, potatoes, eggplant, and red peppers[2]. Nicotine is derived from tobacco plants, currently known as Nicotiana tabacum, which bears the name of Jean Nicotodevillemain, the French ambassador to Portugal in 1560, who brought tobacco seeds and leaves to Paris and promoted their use in medicine. Tobacco and its seeds were conveyed to Ambassador Nicot from Brazil by Luis de Gois. The tobacco plant is a widely recognized economic crop. Between 400 and 500 million tons of tobacco are produced and consumed in China each year. Furthermore, almost 200 million tons of tobacco waste are generated each year.

3. METHODOLOGY

Let's look at a high-resolution photograph I (x, y) that was taken by a UAV over an agricultural area where tobacco is being planted. In this image, (x, y) stands for the coordinates of the pox ell. When UAVs fly at relatively low altitudes (a few hundred meters), they can capture photos with great spatial resolutions. Because UAV photos have a great level of detail, a lot of post processing is done to further exclude the areas that are not tobacco plants.

starting with the isolation of a number of potential areas in each picture that displayed signs of having identifiable tobacco plant life. When examining images to determine whether they contain tobacco or nontobacco vegetation in each area under inspection, it is important to carefully choose several spots within the image. It reliably and accurately divides various areas into two groups: those with healthy crops and those with toxic ones that are ready to be eradicated with specialized herbicides that we developed at great expense, but they are well worth it because they guard against harmful environmental hazards brought on in part by human activity all over the world, which raises air pollution levels to the point where even airplanes cannot fly over some areas.

Four important factors must be taken into consideration when effectively identifying possible tobacco plant regions.

1.**Noise Filtering**: Before using an extra-green technique for accurate soil area identification, we first remove any undesired noise from our data using a Gaussian kernel with optimum values. Using these methods, our method finds the essential characteristics needed to precisely isolate target sites in intricate imagery data sets

(x, y) = I (x, y) * w (x, y), where Id is the UAV image that has been denoised.

Dimensions of w (x, y) are m = 3 3; variance $\sigma 2 = 0.25$; and mean $\mu = 0$.

2.**Soil Region Detection**: Soil regions are typically visible in UAV photos. The extra-green method, which is defined as follows, is used to eliminate the soil regions and preserve the plant regions in UAV photos in order to lessen the influence of soil regions:
Bpr (X, Y) is equal to Bgr (X, Y) ∩ Bgb (X, Y).

Igr (x, y) = Ig (x, y) − Ir (x, y)

Bgr (X, V) = 1 lgr (X, Y) > w1 Bgb (X, V) = 1 lgb (X, Y) > w2

3.Plant Region Extraction

As specialists in our industry, we have observed a fascinating feature in tobacco plants: their inner portions tend to seem brighter than the surrounding leaf sections. This behavior may help us identify appropriate crop growth zones using UAV photography. We use a number of techniques to accomplish this effectively and precisely, such as translating our denoised UAV Image Id into LAB color space for improved color calibration and accuracy. The B channel picture (IB) is then extracted because, in contrast to the brightness or A channels, it offers the best contrast between the central and leaf areas. We employ morphological reconstruction via erosion through a marker image F to remove any possibility of background interference within our retrieved IB.

4. Tobacco Plant Morphology

When we examine the morphology of tobacco plants, we find that N. tabacum and N. rustica are the two main species that are frequently utilized for commercial purposes. The physical characteristics of these plants vary greatly, including the height of the plant, the angle at which the leaves affix to the stem, and the morphology of the leaves (i.e., shape, size, thickness, tip form, petiole/sessile attachment style).

Furthermore, adventitious roots that emerge from the main stem make up the majority of the shallow root networks found in tobacco plants. Depending on the species, tobacco plants have distinctive leaf forms and traits. The leaves of Nicotiana rustica are usually petiolate, ovate or cordate in shape, with a dark green glossy surface. They grow spirally with equal spacing and exhibit hetero blastic development. On the other hand, Nicotiana tobacco leaves are primarily sessile.

Resources and Techniques

Resources
Samples of tobacco, beakers, a Buchner funnel, filter paper, a conical flask, a 250 ml separation funnel, a measure cylinder, a weighing scale, a stand, a water bath, A mortar and pestle, test tubes, a test tube stand, tongs, a Bunsen burner, and sodium fusion tubes.

The Needed Chemicals

Methanol, sodium metal, sodium hydroxide, diethyl ether, anhydrous potassium carbonate, picric acid, Sulfuric acid, ferrous sulfate, ferric chloride, phosphoric chloride, potassium iodide, and hydrochloric acid.

Nicotine Extraction Steps Involved

Step1: A weighing balance was used to weigh one gram of each of the five tobacco samples that were collected, and the samples were then put into a beaker.

Fig-2: five tobacco samples

Step 2: Five grams of NaOH were dissolved in one hundred milliliters of water to create a 100 milliliter 5% NaOH solution. The sample and the aforementioned solution were combined in the beaker and vigorously swirled for fifteen minutes. The Buchner funnel was then used to filter the mixture. After moving the cigarettes to a beaker once more, 30 milliliters of distilled water was added, swirled, and filtered once more.

Fig-3: NAOH extracting

Step 3: All of the filtrates were gathered together; if there were any contaminants, they were re-filtered. After being moved into a separating funnel, the filtrates were extracted using 25 milliliters of diethyl ether. After three iterations of the extraction, the four filtrates were gathered in a beaker.

Fig-4: Extraction Ether

STEP 4: Two grams of anhydrous potassium carbonate were used to dry the extract. It was then filtered and left on a water bath to evaporate the ether. Since excessive heat hydrolyzes nicotine, further heat was avoided.

Fig-5: Ether Evaporation

Step 5: To dissolve the resulting oil, 4 milliliters of methanol were added after the ether had evaporated.

Fig- 6: methanol add

Step 6: The beaker was filled with 10 milliliters of saturated picric acid solution. The crystals of nicotine di picrate were then precipitated by cooling it in an ice bath.

Fig-7: Nicotine dipicrate Precipitation

Step 7: After letting the crystals dry, they were weighed.

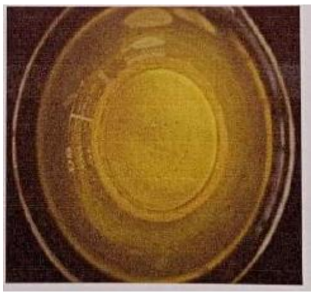

Fig-8: Crystallization

Nicotine Content in Tobacco[4]

Table -1: Nicotine Content in Tobacco

Product	Amount of Nicotine
Cigar	13.3-15.4mg(Large Cigar)
E-Cigarette	0.5-15.4mg(15 puffs)
Pipe(Tobacco)	30.08-50.89mg
Chewing Tobacco	144mg(Whole)
Hookah	1.04mg(per Puff)

Nicotine-to-Tar Ratio in Tobacco

Table-2: Nicotine-to-Tar Ratio in Tobacco

BRAND	TAR YIELD (mg/cig)	NICOTINE YIELD (mg/cig)
MEVIUS OPTION FIZZY GOLD 1 100'S ROUND FT 20S BOX (<=90MM)	1	0.1
VIRGINIA S. SUPERSLIMS MENTHOL FTKS 20S BOX (<=90MM)	2	0.3
KENT CORE 4 FTKS (NAKED-WRAP) 20S BOX (<=90MM)	3	0.4
ESSE BLUE FT 20S BOX (<=90MM)	4	0.4
ESSE MENTHOL FT 20S BOX (<= 90MM)	5	0.4

Evaluation of Nicotine's Quality:

The nitrogen test, or LASSAIGNE'S test

An approximately pea-sized piece of sodium metal was placed in a sodium fusion tube and heated gradually until it melted and produced a gleaming globule. The fusion tube was filled with a little amount of the sample, which was heated first slowly until the reaction with the sodium metal stopped, and then vigorously until the fusion tube turned red. In a mortar filled with 10 milliliters of distilled water, the red hot tube was submerged. Filtered, the solution was then gently simmered for five minutes. Following collection and cooling, the filtrate was utilized as the fusion extract or stock solution.

The IODOPLATINATE TEST is a general alkaloids test: Reagent: 98 milliliters of water were mixed with 2 milliliters of a 5% (w/v) solution of platinic chloride and 5 grams of potassium iodide, and the mixture was thoroughly cleaned.

A generic reagent for nitrogenous bases is called Dragendorf's test:

The reagent With the use of heat, 1 g of bismuth subnitrate was dissolved in 3 mL of 10 M hydrochloric acid, which was then diluted with water to get 20 mL. The mixture was supplemented with 1 g of potassium iodide.

Examining the color of nicotine :

An HCl solution containing concentrated vanillin was mixed with the sample.

Example : Empty beaker weight (W1 gm) = 35.423 gm Beaker weight plus sample weight (W2 gm) equals 35.446 gm.
The sample's mass (W2–W1) = 35.446 - 35.423 = 0.023gm It was discovered that 23 mg of nicotine could be recovered from one gram of tobacco.

Quality indices in flue-cured tobacco

Table-3: Quality indices in flue-cured tobacco.

Constituent/Quality Index	Acceptable Limits
Total Nitrogen %	1.0 - 3.0
Nicotine %	0.7 - 3.0
Total Sugars %	10.0 - 26.0
Reducing Sugars %	8.0 - 24.0
pH	4.6 - 5.5
Reducing Sugars/ Total N	7 - 13
Reducing Sugars/Nicotine	7 - 13
Total N/ Nicotine	< 1.2
Chloride %	< 1.5
Filling value at 60% R.H. & 20oC	3.3 - 3.8cc/g shreds
Equilibrium moisture content at 60% R.H. & 20oC	11 - 15%
Pore Volume	0.13 - 0.18 ml/g
Combustibility	2.5 - 3.5 mm/min
Leaf burn	3 - 6 sec.

4.RESULT

When it comes to producing tobacco with a pleasing flavor, the quality of the leaves is just as important as their output. Features including size, color, texture, and odor are important to take into account while evaluating the quality of tobacco. Tobacco is greatly affected by soil composition, cultural customs, and curing techniques. The highest yield came from the conventional curing process. The standard method of curing tobacco leaves was used for this study[3].

Table-4:rich agro-climatic diversity

rich agro-climatic diversity, India has the unique position of growing all types of tobacco which are broadly classified as:		
1.	FCV Tobacco	Andhra Pradesh & Karnataka
2.	Bidi Tobacco	Gujarat & Karnataka & Andhra Pradesh
3.	Cigar & Cheroot	Tamil Nadu & West Bengal
4.	Hookah Tobacco	Assam, West Bengal, Bihar & UP
5.	Chewing & Snuff	Tamil Nadu, West Bengal, Bihar, Assam & U.P.
6.	Natu, Burley, Lanka & HDBRG	Andhra Pradesh
7.	Pikka Tobacco	Orissa

A list of tobacco types that are registered in the system is shown in Fig-9.

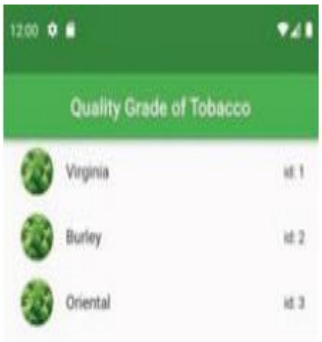

Fig-9 : Tobacco Types

The tobacco variety to be examined is then chosen. Additionally, the Take tab is used to upload the image of this species' tobacco leaf (Fig-10).

Fig-10 : Tobacco leaf

To remove detrimental effects from light variations in uploaded photographs (due to weather, location, date and time of capture, orientation, etc.), color correction is done using an X-rite checker.

The ideal curing period for the tobacco leaves was determined using the CCT values. The following Equation 3 was used to transform the numbers into a percentage QG in order to make them easier to understand

$$QG\ (\%) = 100 \cdot (T_F - CCT)/(T_F - CCT_T)$$

CCT stands for the daily mean value in Equation 3, and ideal curing time (CCTT) is the CCT value obtained when the ideal curing time is reached. In this investigation, the value of CCTT was found to be 3000 K.

Table 5 shows how the correlated color temperature was used to calculate the quality grade values.

Table-5: correlated color temperature with quality values

CCT (K)	T_S	2500	3000	5000	T_F
QG (%)	111	105	100	79	0

The calculated CCT and QG values are displayed in the mobile interface (Fig-11).

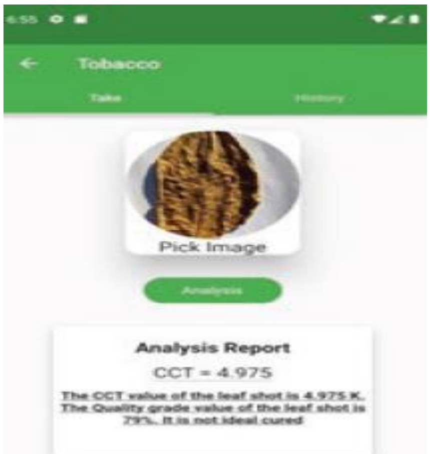

Fig-11 : The calculated CCT and QG values

Fig-12 shows how the average CCT value varies based on the day that each leaf sample was taken. The tobacco leaf turns from green to light brown during the curing process, signifying a shift in tobacco quality.

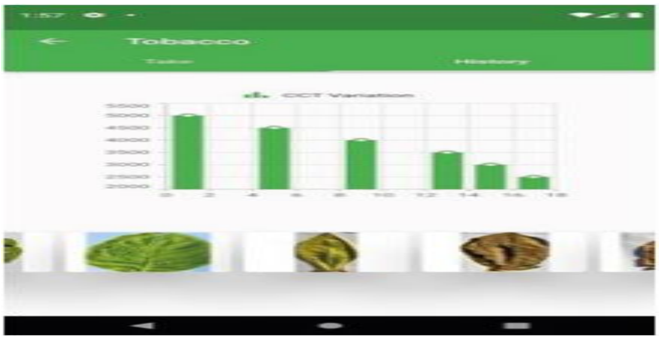

Fig-12 average CCT value varies based on the day that each leaf sample

Sl.No.	Tobacco samples	Weight
1	A (beedi/bidi)	23 mg/g
2	B (Gold Flake)	15 mg/g
3	C (Benson and Hedges)	8 mg/g

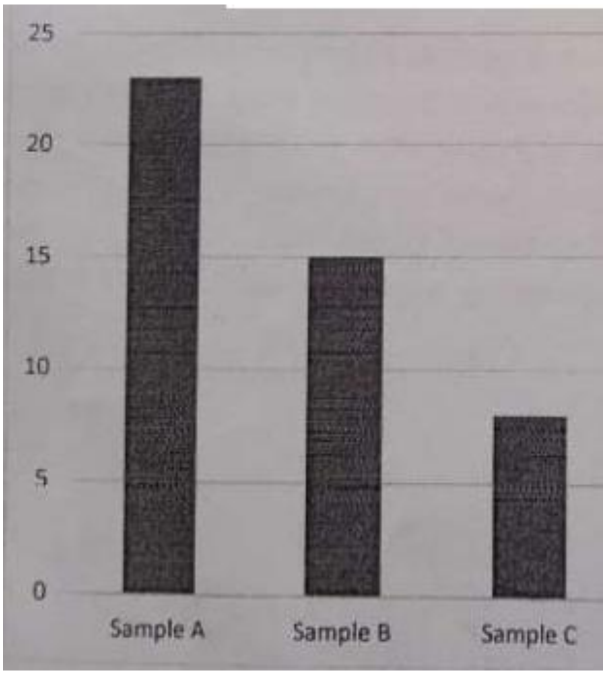

Fig-13: Weight of Nicotine in Different Tobacco products

5. CONCLUSIONS

Important details regarding the general caliber of the tobacco product can be gleaned from the physical characteristics of tobacco leaves[5]. One important determinant of tobacco leaf quality is color. Because fully grown leaves are typically thought to be of greater quality than immature leaves[6], the color of the leaves might reveal information about the plant's maturity. In addition to color, other physical attributes including surface texture, size, and shape can also provide important details about the quality of tobacco leaves[7]. Higher-quality leaves are thought to be more uniform in size and shape than irregular or inconsistent ones. Physical characteristics can be helpful in assessing the general quality of tobacco leaves, however it's crucial

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