International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 3 Issue 11, November-2014

Studies on Extraction of Ingredient Oil from Lemon Grass

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***Abstract*- The work done will focus on the study and optimization of extraction of ingredient oil from lemongrass. This study investigates the influence of operating parameters like time, size, type of grass on the extraction of oil. Lemon grass is an important herbal and aromatic plant and its oil is one of the major essential oils used in the perfumery and cosmetic industry. It is widely used in the scented soaps, sprays, deodorants, polishes and medicines. The extracted oil is rich in Citral A & P. Citral is the starting material for the manufacture of vitamin A. In the present experiment citral is isolated by Hydro-distillation of lemon grass, which is used to make lemongrass tea. The distillate contains 90 % citral and 10 % neral, the isomer about the 2,3-bond. Various experiments are carried out on a lab scale to optimize the parameters and get the maximum yield. The extracted oil is analyzed by using gas chromatography. The result indicates that the wet grass gives the maximum extract. The Yield can be raised from 8% to 12% by using Hydro-distillation and pre heated water as solvent.**

Keywords- lemongrass, ingredient oil, optimization, extraction, time, size, gas chromatography.

I. INTRODUCTION

Lemon grass (Cymbogen citratus) is found in many parts of world. It is mainly grown as an ornamental plant however lemongrass has many other uses such as a food crop eg. It is used in herbal tea because of its sharp lemon flavor. It is used as the perfume in soaps and a medicine to treat various health ailments, decreasing acne, athlete's foot, flatulence, muscles aches and scabies[1]. Further, bioactivity studies have shown that the various components of this ingredient oil contains antimicrobial, antifungal, antibacterial and mosquito repellent properties make it a valuable product to be extracted [2]. The citral isolated from oil is used in the manufacturing of vitamin A, Because of those attributes lemon grass is of great use and value in the agriculture sector, especially for the protection of stored agricultural product. Crude essential oils are obtained by steam distillation of variety of natural products like plants, grasses, wood stumps saw dust, flowers, kernel and social hygiene of mankind in terms of their use in cosmetics, toiletries, medicinal formulations, aroma therapy, surface coatings etc.[3].

Most of the essential or ingredient oil occurring in nature consists of mixture of hydrocarbons like terpens [4] sequiterpenes, oxygenated compounds like alcohol esters, ether, aldehydes, ketones, lactones, phenols and waxes. Out of these oxygenated compounds like alcohols are the principal odour carriers [2]. They are more stable against oxidation agents. The unsaturated hydrocarbon like terpenes are less stable and are responsible for degrading oils. To make essential or ingredient oils more stable, so that they retain most of their odor and flavor, these terpenes are removed so that only oxygenated compounds are retained.

The lemon grass oil is obtained by steam distillation or hydrodistilation of lemon grass. It is the most common and cheapest oil available in market [5]. The steam distillation or hydrodistilation process to obtain ingredient oil from leaves and the aromatic industry use this method because it is cheap when compared with technologically advanced methods as supercritical fluid extraction. [6].

The main objective of this work is to optimize the lemongrass oil extraction process variables (parameters) to define the best operational conditional with regard of yield and composition of lemon grass oil considering as function of time and raw state material.

II. MATERIALS AND METHODS

A. Materials:

Wet and dry lemon grass, water, distillation column, condenser, heating element, measuring cylinder, conical flasks, burette, glass bottles with stopper, gas chromatography.

B. Experimental methods:

Lemon grass (chopped r un-chopped) and water is filled in the distillation still and the lid is fitted tightly, so that oil and vapor do not leak. As steam forms it carries the oil from the plant material i.e. lemon grass and both oil and steam pass to condenser through vapor line. Where the vapors get condensed and oil and water are separated in separators. Oil being lighter is separated from the top and water being heavier is separated from the bottom of the separator.

Essential oils are highly sensitive as such that distillation is carried out at low temperatures. Further direct heat contact provided by steam, initially gives wet ability to grass at high temperatures, enhancing diffusion and osmosis of the oil. Rate of oil vaporization of the plant material in

distillation is not influenced by relative volatility of oil components but by their solubility in water. Extraction of oil from lemon grass is a rate process. Also oil removed per unit is directly proportional to oil remained in grass. The balance equation for batch distillation can be given by first order kinetics;

$-dx/dt=kx$ (1)

$–dx/x=kdt$ (2)

$lnX/x=kt$ (3)

$ln(1/1-y(t))=kt$ (4)

Where x is average concentration of oil in grass at time t

X is initial concentration of oil in grass before distillation starts;

t is time of distillation, $y(t)$ is the fraction of oil extracted.

If above model holds good then the plot of $1/1-y$ versus t shall produce a straight line passing through origin. The analysis of oil can be done qualitatively and quantitatively with the help of gas chromatography – mass spectroscope apparatus.

III.EXPERIMENTAL WORK

The grass and water are mixed in desired quantities and are filled in the distillation apparatus. The temperature is set and after the boiling point of water the vapors start generating with oil extract. The oil distillate is collected in measuring flask and extract of oil is measured.

The kinetic data i.e oil yield at half hour interval of time in all the experiments carried out in the lab will be presented in table. Using this data we will plot he graph as oil yields verses time for these experiments. Fractional yield of oil y is calculated as the ratio of oil extracted till time t to the cumulative amount of oil extracted. To verify the model we again plot the graph of 1/1-u versus t to show the straight line behavior. This will also show that oil extracted is directly proportional to the oil remaining in grass.

IV RESULT AND DISCUSSION

The following are the results obtained from the experiments conducted to extract the ingredient oil from lemon grass.

Sr.No.	Weight of plant taken (grams)	Condition of grass		Packing	temperature	Oil produced in ml	
		Dry (Chopped in cm approx.)	*Wet (Chopped in cm approx.)*			*dry*	*Wet*
1	300	2	2	loose	100ºC	25	31
2	250	1.5	1.5	loose	100ºC	23	42
3	300	1	1	loose	100ºC	35	38
4	290	0.6	0.6	loose	120ºC	30	33
5	250	0.3-0.4	0.3-0.4.	loose	120ºC	54	57
6	300	Below 0.1	Below 0.1	loose	130ºC	49	52
7	300	Below 0.1	Below 0.1	loose	130ºC	50	53

According to the above table it is clearly seen that the oil extracted from wet grass is more than that of dry grass. So the analysis of extraction process for oil from wet grass is given as follows;

Here y and ln(1/1-y) is calculate using the formula which is mentioned in experimental work. The graphs are plotted as time vs yield of oil and time vs ln(1/1-y).

For experiment no 1.

Time in minutes	Yield in ml	y	ln(1/1-y)
30	7	0.22	0.25
60	15	0.48	0.65
90	19	0.61	0.94
120	22.5	0.72	1.27
150	25.5	0.82	1.71
180	28.5	0.91	2.40
300	31.0	_	_

For experiment no 2.

Time in minutes	Yield in ml	y	Ln (1/1-y)
30	7	0.17	0.186
60	15	0.30	0.356
90	24	0.57	0.640
120	29	0.69	0.970
150	33	0.78	1.50
180	37.5	0.09	2.70
300	42	_	_

For experiment no 3

Time in minutes	Yield in ml	y	Ln (1/1-y)
30	7	0.18	0.19
60	18	0.46	0.615
90	27	0.70	0.203
120	31.5	0.82	1.713
150	35.0	0.91	1.40
180	-	-	-
300	38.5	_	_

For experiment no 4

Time in minutes	Yield in ml	y	Ln (1/1-y)
30	10	0.3	0.356
60	20	0.6	0.91
90	23.5	0.71	0.23
120	27	0.82	1.70
150	30	0.91	-
180	-	-	-
300	330	_	_

For experiment no 5

Time in minutes	Yield in ml	y	Ln (1/1-y)
30	16.4	0.25	0.33
60	29.9	0.52	0.73
90	47.3	0.82	1.70
120	51.5	0.90	2.30
150	54	0.94	2.80
180	55.4	0.96	3.20
300	57.2	_	_

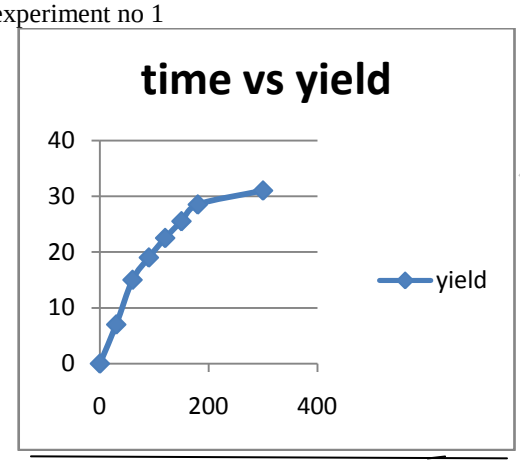
For experiment no 6

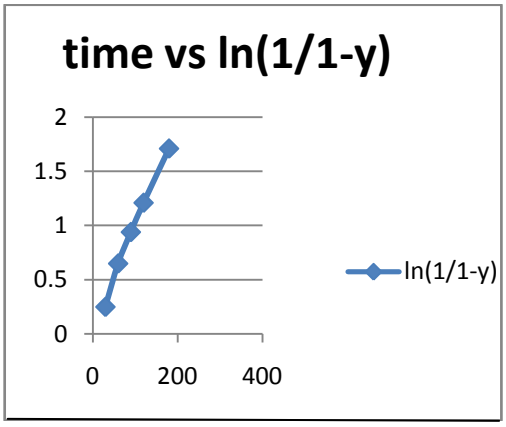
Time in minutes	Yield in ml	y	ln (1/1-y)
30	17	0.32	0.1385
60	30	0.57	0.844
90	39	0.74	1.347
120	45	0.86	1.96
150	49	0.94	2..813
180	51	0.97	3.5
300	52.25	_	_

For experiment no 7

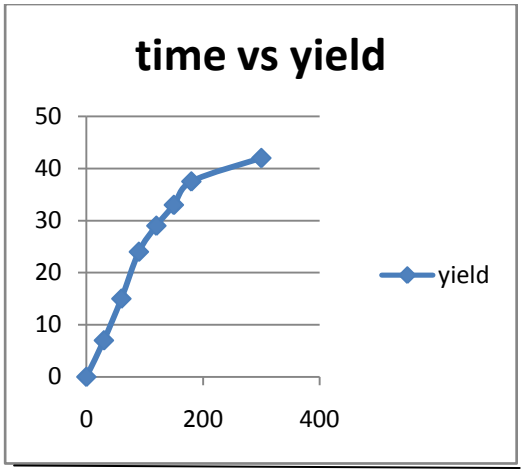
Time in minutes	Yield in ml	y	Ln (1/1-y)
30	17	0.32	0.385
60	30	0.50	0.820
90	40	0.75	1.31
120	46	0.86	1.96
150	50	0.94	2.80
180	52	0.47	3.54
300	53	_	_

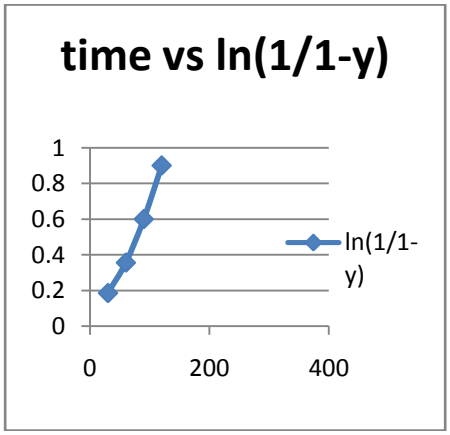
The graphs obtained are as follows;
For experiment no 1





For experiment no 2.





Similar type of graphs are obtained for other experiments too. The graph of time vs ln(1/1-y) is a straight line which will not pass through the origin but will have an intercept. It shows that the extraction of oil does not start at the starting of the distillation but it takes time. The straight line in second graph indicates that the extraction process follows first order equation.

These samples are analyzed with the help of gas chromatography the results are as follows;

The peak that is generated at the around 15 minutes is lemongrass oil according to the reference retention time.

V. CONCLUSIONS

According to the data obtained from the experiments carried out following are the conclusions drawn;

1. The loose packing and the wet material in raw material in distillation still enhances the oil yield from plant material.
2. The kinetic studies of distillation process showed that oil is not instantly extracted and if it is the dry grass the yield is less.
3. The plot of time vs ln(1/1-y) is a straight line i.e. it follows first order kinetics.
4. Oil removed per unit time is directly proportional to the oil remaining in the grass.

5. The yield percent is raised from 8% to 12% by using water as solvent. As no chemicals are used ther is no need of purification for final product.

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