Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 04, April-2016

Industrial Production of Medical Crude Extract from Argemone Mexicana

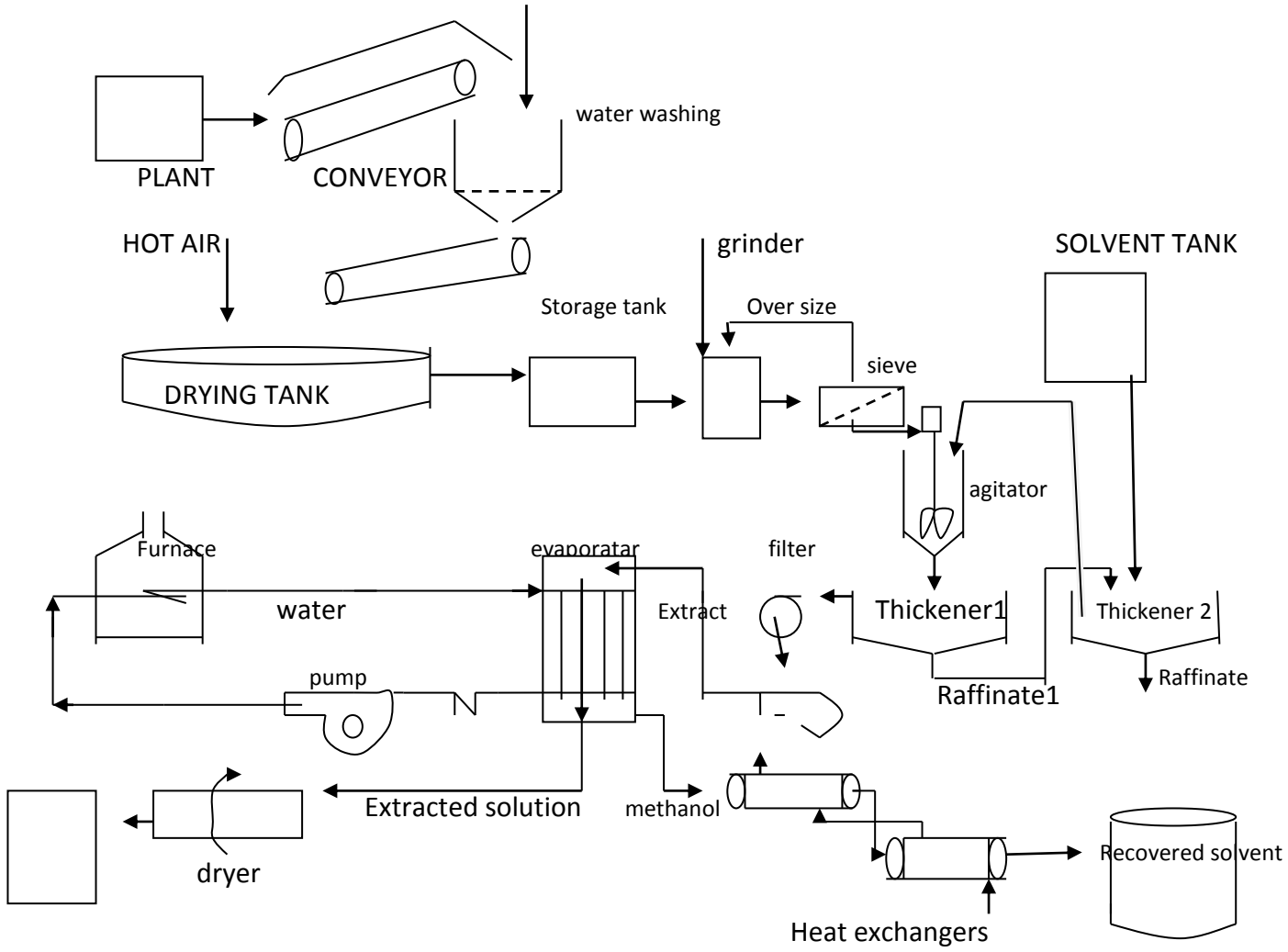
Samuel Habtai, Simon Tesfai, Simon Berhane, Meron Tesfagergish, Abraham Michael
Department: Chemical engineering
College: Eritrea Institute of Technology, Asmara, Eritrea

***Abstract* - Argemone mexicana Linn. (family:Papaveracea) is commonly known as "DANDER" in our country. It's glabrous, branching annual herb with yellow juice and yellow pale flower, it grows up to 1-1.5 meter and have a slightly branched tap root. Its stem is branched and usually, extremely prickly. It includes a yellow juice when it cut. Argemone mexicana is naturalized throughout the tropics and subtopic regions as an agricultural weed.**
In our country, the latex in the stem of that plant is used to cure open wounds traditionally by some mysterious practitioners.

INTRODUCTION

Medicinal plants being the effective source of both traditional and modern medicines are genuinely useful for primary health care. Over the years, WHO, advocated traditional remedies are safe remedies for ailments of both microbial and non microbial origins (WHO1978). About 80% populations of the developed countries use traditional medicines, derived from medicinal plants.
Some antibiotics have become almost absolute because of drug resistance and consequently new drugs must be sought for. Herbal treatment is one possible way to treat diseases caused by multi drug resistance bacteria. Though pharmacological industries have produced a number of new antibiotics in the last three decades, yet resistance to these drugs by microorganisms has developed. In general, bacteria have the genetic ability to transmit and acquire resistance to drugs, which in turn may be utilized as therapeutic agents.

GENERAL FLOW SHEET OF THE PLANT

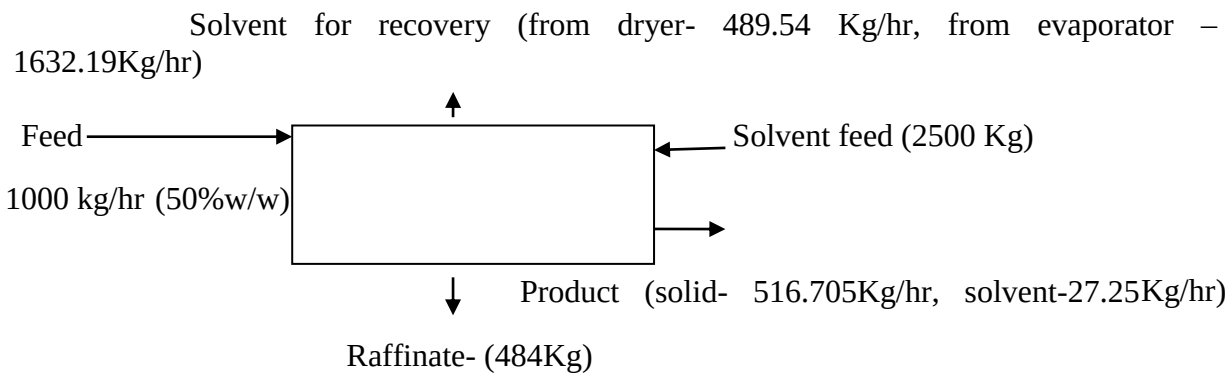


(This work is licensed under a Creative Commons Attribution 4.0 International License.)

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 04, April-2016

Large amount of Argemone Mexicana plants can be harvested by developing large farm lands. Planting those plants at 50 cm apart from each other, at the rate, 160,000 numbers of plants per hectare can be grown. The plant should be harvested before flowering period reaches. Averagely, 0.5-1kg can be obtained from each plant. Since these plants grows in open space and needed to use for medical purposes, it should be washed with running water to remove unwanted materials like mud, debris and others. Drying is done without any exposure of sunlight, under shaded areas in order to prevent the loss of some essential volatile components. For size reduction, we used roller mills, since the dried plants are very soft , needed to be grinded unto the size of 500um, easy to clean and safer for foreign materials exposure. The grinded, undersize particles pass the process, whilst the oversize returns back to the grinder. After grinder the oversize particles passes through continues counter current leaching; using two gravity thickeners connected in series with agitated tank is preferable method of extraction. The agitator used to elongate contact time between the solid - solvent intervention, while the solvent and solid pass counter currently to lead effective extraction in due time. the extracted fluid is forced to pass through rotary vacuum drum filter, in order to handle large throughputs with 99% efficiency . This filter is compatible for this process, since it has easy cake removal and washing processes .after filtration, the filtrate must be concentrated in a long vertical falling film evaporator by creating vacuum, since the raw materials are heat sensitive, volatile and boiling point rises are minimal. This evaporator concentrated the solution up to 50%.the partially concentrated solution will finally be concentrated up to 95% by passing through rotary counter current dryer, with the help of hot purified air.
At the end the product exposed to uv rays (200-400) nm for 24hrs and packed in air tight container to be shipped for pharmacological industries for further purification and process.

MASS BALANCE ON SYSTEM



ENERGY BALANCE AND DESIGN

Design of Agitator

Based on laboratory results and amount of feed entered, the volume of the tank calculated as (5.303) m^3. By considering the ratio of diameter to height of the tank as 1, diameter of the tank calculated as 1.9m, and by adding 20% offset height to the height of the thickener, height he will be 2.28m. Flow of the fluid inside agitator found as turbulence and with our choice of blade, which is 6-flat blade turbine, power number (NP) is found us 7.5.

Therefore power (P) = $NP*\rho*N_2^3*d_2^5$····· (1)

FROM (1) P =248kw

Where N2 is number of turns per second, d2, diameter of the tank and ρ is the density of the mixture of the large scale tank.

Design of thickener
Area (A) = (y-u)/Uc*Qcps/density····· (1)

From (1) A= 5.57m^2

Where y is to concentration of the feed solution, u, concentration of solid in under flow, Uc, Sedimentation rate, density of mixture and Qcps, feed flow rate per second.

Design of filter

It was just enlarging the lab scale of filter within the laboratory gained data's, calculating Area (A) as 1.3m^2.

(This work is licensed under a Creative Commons Attribution 4.0 International License.)

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 04, April-2016

Energy balance and design of evaporator

By adjusting, the operating pressure of the evaporator as 200mmHg and aiming 50% concentration achieved in the out let of the evaporator, the following designs are calculated.

$S*\lambda = F*Cp*\Delta T + Mv*\lambda_V$ ⋯⋯⋯ (1)

Amount of heat (q) = $S*\lambda$ ⋯⋯ (2)

From (1) & (2) q= 537.073 kW ⋯⋯ (3)

$q = U*A*\Delta T$ ⋯⋯⋯ (4)

$A = N*\pi*do*L$ ⋯⋯⋯⋯⋯⋯ (5)

From (3), (4) & (5),

Number of tubes inside the evaporator (n) = 189, WHERE λ represents latent heat of vapor, T, TEMPRATURE, A, for surface area and S, flow rate of steam.
And based up on above equations Length of the evaporator calculated as 3m, Tube sheet diameter (D) as 0.67m.

Dryer
By selecting number of transfer units (NTU) as 1.5 between the possible references, 1.5-2.5. As this case the wet bulb temperature of out let air (Twb) will be 35°c.

Then weight of bone dry air (m_s) = mass of solution (M_s)* weight% of feed⋯⋯ (1)

Next find (x_a&x_b), moist air per dry solid in and moist air per dry solid out……. (2)

$Qt/ms = Cp_s (Ts_b-Ts_a) + x_a Cp_l (T_V-Ts_a) + \Delta x\lambda + x_b Cp_l (Ts_b-Ts_v) + \Delta x Cp_v (Tv_b-Tv)$ …… (3)

From (3) Q_t= 587,715.768 Kj/hr

where Cps, Cpl, Cpv are specific heat of solid, solvent and vapor, and Tsb, Tsa, Tv, Tvb, are solution outlet, inlet temperature, vaporization temperature, wet bulb outlet temperature respectively.

$Q_t = mg(1+Ha)Csa(Tha-Thb)$……(4)

From (4) mg = 42,862.309Kg dry air

Inlet moist air = $mg'(1+Ha)$ = 43, 162.345 Kg/hr…… (5)

Let mass velocity of dry air (G), as 4000Kg/ (hrm^2) then,

$Ma/g = Ac$…….. (6)

Ac, cross-sectional area of dryer = 10.79 m^2, and diameter of dryer will be 3.7 meters

$Qt = k*\pi*D*L*G^{0.67}*\Delta T$…… (7), k is constant, 0.21, ΔT, logarithmic mean.

From (7) L = 24.918 m

Then L/D = 6.723

AT LAST, we have also designed two heat exchangers for methanol recovery,

1- Condenser with surface area of 178.08 meter square(m^2), length of 4.36 meter(m)
2- Cooler with surface area of 4.62 meter square(m^2), length of 1.04 meter(m)

LABORATORY EXPERIMENTS

Objectives

-To find a very active anti microbial medicine, to collect data's for industrial designs and to analyze and compare which part of the plant by which solvent could have better activity.

Material and equipment used

Rotary evaporator, vacuum filter, Erlenmeyer flask, wattman.1 filter paper, viscometer, Electronic balance, refrigerator, grinder, mechanical sieve(500um)mesh size, orbital magnetic shaker, Buchner funnel, Petridis, well borer, Autoclave, safety cabinet, incubator, refrigerator, gas flame, venire caliper.

(This work is licensed under a Creative Commons Attribution 4.0 International License.)

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 04, April-2016

EXPERIMENTAL PROCEDURE

First, we collect mature and contamination free Argemone Mexicana plant and latex from the villages around Asmara, Eritrea between the season of December and March, and then we allow drying by putting in concrete floor in the absence of sun light for almost two week to three weeks to prevent the loss of active components. After that the dried plant is grinded by grouping them as leaf, stem, seed, and mixture of all, which then passed through a 500micro meter mesh size sieve. Next all samples weighed as 50gram sample to undergo extraction process.

Extraction has done as cold process. All samples put in to Erlenmeyer flask differently along with solvents of different polarity, Methanol, Ethanol, and water. The flasks then corked and soaked for 48hrs, while undergoing shaking and mixing.

solvent(gram/milliliter)	Latex	leaf	seed	mixed
methanol	1.33g/(15ml)	50g/200ml	50g/200ml	100g/400ml
ethanol				50g/200ml
Cold water			50g/200ml	50g/400ml

Table 1- concentrations of samples used for taste and design purposes

After extraction, the extracted solution filtered by vacuum filter pump, using Whitman no.1 (filter paper). Then, it concentrated in Rota vapor at 40°c temperature, with the help of vacuum pump. Next, the samples kept in a hood for moisture removal.

To undergo antimicrobial assay, we collect staphylococcus aurous (ATCC25923/NTCC12981), Gram positive bacteria, E.Coli (ATCC25922/NTCC12241), Gram negative Bacteria, Candida albicans (ATCC10231/NCPF3179), Fungus. We put these organisms in saline water and brush them in to sterilize agar media and kept in incubator for 24hrs. After that we use well agar diffusion method to taste our samples, by pouring different concentration of samples (100, 75, 50, & 25) mg/ml of 100micro liter independently, in to 6mm diameter well created on the agar media, using sterilized well borer. Then all inoculated sample Medias incubated at 37°c for 24hrs. Then the inhibition zones are measured with venire caliper. The same method applied to standard antibiotic drugs (Chloramphenicol, Ciprofloxacin, and Penicillin) for comparison. And also we have tested the inhibition zones of the solvents independently to see their affect on the result.

RESULTS AND DISCUSSION

m.organisms	100mg/ml	75g/ml	50mg/ml	25mg/ml
C. albicans	40	35	28	20
S. aureus	35	29	23	19
E. coli	33	28	23	19

Table 1.1 diameters of the inhibitory zones (mm) of methanol extract of A. mexicana latex

m.organisms	100mg/ml	75g/ml	50mg/ml	25mg/ml
C. albicans	23	21	20	16
S. aureus	20	19	18	14
E. coli	15	13	12	10

Table 1.2 diameters of the inhibitory zones (mm) of methanol extract of A. mexicana leave

m.organisms	100mg/ml	75g/ml	50mg/ml	25mg/ml
C. albicans	20	19	18	16
S. aureus	18	16	16	14
E. coli	0	0	0	0

Table 1.3 diameters of the inhibitory zones (mm) of methanol extract of A. mexicana seed

m.organisms	100mg/ml	75g/ml	50mg/ml	25mg/ml
C. albicans	16	15	12	12
S. aureus	16	14	12	12
E. coli	16	14	12	10

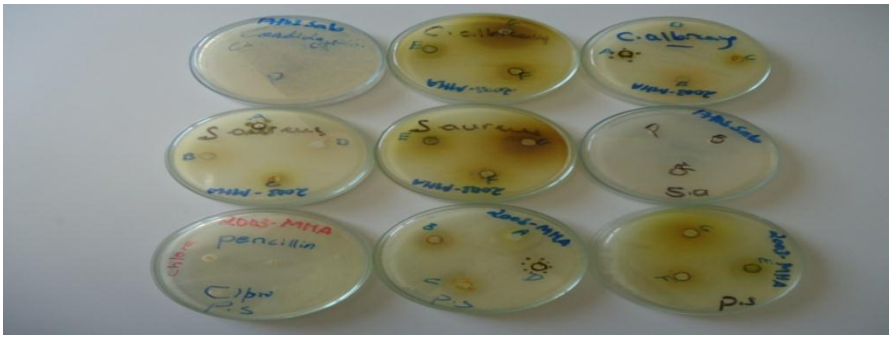
Table 1.4 diameters of the inhibitory zones (mm) of methanol extract of A. mexicana mixed

Standard drugs	S. aureus	E. coli
Pencillin (10µg)	40	0
Chloramphenical(30µg)	25	0
Ciprofloxacin (10µg)	24	27

Table 1.5 diameters of the inhibitory zones (mm) of standard drugs

(This work is licensed under a Creative Commons Attribution 4.0 International License.)

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 04, April-2016



SAMPLE PHOTO OF SOME EXTRACTS INHIBITION ZONES

As the tables above shown, methanol extract of latex has shown greater inhibitory zones than other parts of the plant, and among the solvents methanol shows higher reactivity. These observations may be attributed to two reasons. Firstly, the nature of biological active components, whose activity can be enhanced in the presence of methanol; secondly, the stronger extraction ability of methanol could have produced greater number of active constituents responsible for antimicrobial activity.

Plant location and lay out
Factors considered;
Supply of resources and utilities

Availability of suitable farm land and climate

Political strategic consideration

Environmental impact and effluent disposal

Transport facilities

Availability of labor

ENVIRONMENTAL IMPACT AND EFFLUENT DISPOSAL

All industrial processes produces waste products, and full consideration must be given to the difficulties and cost of their disposal. The disposal of toxic and harmful effluents will be covered by local regulations, and the appropriate authentication must be consulted during the initial site survey to determine the standards that must be met. As of this plant, we have planned to minimize the disposal as much as possible, since the raffinate solids can be produced for biodiesel and fertilizer purposes.
Economic analysis and cost estimation

Total investment (TI) sum of total fixed capital investment (TFCI) and annual production cost (APC)

TI = $251.1 million

Selling price of crude extract $80/kg

Selling price of recovered methanol$10/kg

Production of crude extracts 4,296,600/year

Production of recovered methanol 8,401,536/year

Total income =$ 427.728 million

Gross earnings = Total income- total investment

= $176.628million

Depreciation = 10% (FCI)

= $ 0.6 million

Payback period = total investment / (net profit + depreciation)

= 2 years

(This work is licensed under a Creative Commons Attribution 4.0 International License.)

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 04, April-2016

CONCLUSION

The crude extract found from this process can be used as an active agent for different kinds of antimicrobial medicines. As we have seen from this project, these kinds of processes have Higher economic values, consumable and higher profitability, if not for its solvent price, it would be non imaginable. Now a days, antimicrobial medicines such as penicillin, amoxicillin and others work is becoming less efficient, because these bacteria's are adapting it day by day that results for the total resistance. So finding such effective new herbal medicine is very important for existence of our future, for developing healthy environment.

REFERENCES

int j.electrochem. sci 8 (2013) 10878-10889

mem inst oswaldo cruz, rio de janiero, vol.101(6):645-648, sep 2006

Biochemical engineering- james Lee

solved examples in chemical engineering Dr. G. K. Roy

perry`s chemical engineering hand book 8 th edition

#83- hand book of evaporation technology paul e. Minton

kumar and pandey mintage journal of pharmaceutical and medical sciences/12-17

(This work is licensed under a Creative Commons Attribution 4.0 International License.)