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Extraction of Oil from Watermelon Seeds

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Abstract : Oil content in the seeds is between 35-40% and the unsaturated fatty acid content in oil is 78-86% predominantly linoleic acid (45-73%). Rate of extraction of oil from date seed depends on type of solvent, partial size of watermelon seed, time of extraction and temperature. Soxhlet extraction is the most common technique for oil seed extraction. Watermelon seed oil is obtained from date seed through Soxhlet extraction technique. % Yield and recovery of Oil using solvent extraction with different feed to solvent ratio. For solvent petroleum ether shows 1:2, 1:4 and 1:6 seed powder to petroleum ether ratio the % yield 18%, 28% and 32% resp. For solvent petroleum ether shows 1:2, 1:4 and 1:6 seed powder to petroleum ether ratio the % recovery 45%, 70% and 80% respl. The optimum value for feed to solvent is 1:4 on which maximum yield for watermelon seed oil extraction. As the feed to solvent ration increase more than 1:4 there is appreciable change in the yield but the cost of solvent increase. The 1:4 feed to solvent ration is to be optimum value for watermelon seed oil extraction. The time of extraction increased yield of oil also increase and up to maximum level. Extraction of date seed oil carried out 1.5-2.5 hrs. Optimum time for extraction is 2 hrs. Crushed seed in powdered form gives large surface area for solid-liquid contact. Temperature for extraction with petroleum ether, methanol and hexane up to 35-40.

INTRODUCTION

High amounts of unsaturated fatty acids, linoleic and oleic acids are present in seed of watermelon fruit. Watermelon seed oil contains considerable amount of PUFAs which are very receptive to oxidation and other side reactions that causes deterioration of oil. White seeds of watermelon contain 40% crude oil. Watermelon Seeds are waste product of Watermelon fruit. Extraction of Watermelon seed oil was carried out using Soxhlet apparatus. Three solvents were used for the extraction of Watermelon seed oil namely; n-Hexane, Acetone and petroleum ether.

Applications.

1.Watermelon seed oil has excellent humectant and moisturizing properties.
2. It is to be observed that it has positive effect over the both oily and dry skin.
3. It is easily absorbed by the skin and helps in restoring the elasticity of the skin.
4. Watermelon oil can be utilized by cosmetic industries.
5. Preparation of moisturizer which shows properties similar to market grade moisturizer.
6. Antioxidants property of oil beneficial role in skincare in combating free-radicals resulting from sun damage and pollutants

3.1 Experimental Analysis
Raw Materials
1. Water Melon Seed
2. Petroleum Ether (B.P. 35-40 ^{O}C)

Apparatus Requires
1. Soxhlet Apparatus
2. Simple Distillation
3. Digital Thermometers
4. Heating Element/Mental
5. Measuring Cylinders
6. Beaker and Filter Papers

Experimental Process Solvent Extraction

Extraction with Petroleum Ether for Feed to Solvent Ratio 1:2, 1:4 and 1:6

1. Take 50 gm water melon seed dried in oven (at 105 ^{O}C) or sunlight to remove moisture.
2. Crush the watermelon seed to form powder.
3. Take 1: 2,1: 4 and 1:6 ratios of watermelon seed powder (50 gm) to petroleum ether (100 ml),(200 ml) and (300 ml).
4. Take cotton cloth or filter paper and watermelon seed powder in cloth or filter paper.
5. Put cloth or filter paper in thimble of Soxhlet Extraction apparatus contains seed powder.
6. Take 300 ml,400 ml and 500 ml of the petroleum ether as solvent in round bottom flask of Soxhlet.
7. The mixture was then heated at 35 ^{O}C- 40 ^{O}C (B.P. solvent) for 1.5-2 hrs.
8. After extraction removal of round bottom flask from Soxhlet apparatus.
9. Date seed oil to be separated from the solvent using simple distillation.
10. Separation by simple distillation carried out at temperature 35-40 ^{O}C.
11. In distillation petroleum ether recover as top product and oil as a bottom product.
12. Calculate % recovery or yield of watermelon seed oil.

3.4 Factors Affected on the Yield of Date Seed Oil

3.4.1 Size of Watermelon Seed
Size of watermelon seed oil has influence on the Yield of oil small size date seed is more than large size. Crushed seed in powdered form gives large surface area for solid-liquid contact. Due to small size particles increase rate as well as yield of extraction of oil from watermelon seed.

3.4.2 Moisture Content of Watermelon Seed
By the Experimental analysis the moisture content of the watermelon seed at the time of oil extraction has a great influence on the extraction yield of the oil. Moisture should be lower for increase rate and yield of extraction.

3.4.3 Feed to Solvent Ratio

The ration of feed to solvent also important factor to be consider for extraction process which effect on the yield of oil. The optimum value for feed to solvent is 1:4 on which maximum yield for watermelon seed oil extraction. As the feed to solvent ration increase more than 1:4 there is appreciable change in the yield but the cost of solvent increase. 1:4 feed to solvent ration is optimum value for watermelon seed oil extraction.

3.4.4 Solvent for Extraction

Selected solvent should be easily separated from the oil and giving high yield operation with low cost. Solvent like petroleum ether is best suitable for extraction of oil. As per experimental analysis petroleum ether shows the higher yield than the acetone. As per observation Petroleum Ether is the best suitable for extraction of watermelon seed oil from the watermelon. Petroleum Ether can easily separate after extraction and has higher yield than other with low cost. The maximum % yield for solvent Petroleum Ether shows the 28-32 % resp.

3.4.5 Time of Extraction

As the time range of extraction increased the watermelon oil yield increases but up to a limit. The time of extraction increased yield of oil also increase and up to maximum level. The extraction of watermelon seed oil carried out 1.5-2 hrs. Optimum time for extraction is 1.5 hrs.

3.4.5 Temperature

At the lower temperature the yield of oil is low while at high temperature it Combustible. As compared to low and high temperature range the oil yield is high at moderate temperature. Extraction carried out at boiling temperature of solvent should be better for rate and yield of extraction. Temperature for extraction with petroleum ether up to 35-40 ^{O}C.

ECONOMICS

1. Watermelon seed contain 35–40 % oil which economical for extraction of oil.
2. Oil extracted from waste material to be available in the market easily with very low cost.
3. Selected method for oil recovery also economical and easy to operation.
4. Cost of solvent also low and it have very high recoverability.
5. Oil will be demanding due to presence of fatty acid and antioxidants property.
6. Watermelon seed oil has excellent humectant and moisturizing properties.
7. Watermelon oil can be utilized by cosmetic industries.
8. Preparation of moisturizer which shows properties similar to market grade moisturizer.
9. As industrial ingredients in soap production, cosmetics and foam ingredient.
10. The oil has high oxidative stability due to low content of polyunsaturated fatty acids.
11. Watermelon seed oil is good source of omega-6 fatty acids.
12. Antioxidants property of oil beneficial role in skincare.

3. 1 Future Scope and Development

Watermelon seed oil has lots of usage and applications as commercial and industrial use. It has excellent humectant and moisturizing properties. Oil can be utilized by cosmetic industries. Preparation of moisturizer which shows properties similar to market grade moisturizer. Antioxidants property of oil beneficial role in skincare in combating free-radicals resulting from sun damage and pollutants. Seed oil formulated into skincare products in form of emulsions and nano emulsions. Seed oil should be more effective than peel wax as an additive in cosmeceutical products to reduce and prevent cellular damage. Preparation of emulsions, soaps and detergents formulation. Oil is good source of omega-6 fatty acids. Watermelon seed has a great potential to use as an excellent source of edible protein. Watermelon seed proteins shows various amino acids mainly Histidine and Glycine. After extraction of oil from watermelon seed cake separated from oil. Cake produces contains very high protein value. That can be used to produce protein for human feed. So, we can increase the yield by optimize the various parameters that can affected on

extraction rate, yield and from the waste cake high value protein can be produce. Watermelon seed oil has lots of application so oil high demanding in market.

Result and Discussion

3.2 Experimental Material Balance

3.2.1 Extraction and Distillation Balance for Feed to Solvent Ratio 1:2

1. Extraction Balance
Watermelon Seed Powder + Petroleum Ether = (Solvent + Oil) + Powder Residue

50 gm + 100 ml = 59 ml + 60 gm + 31 ml of solvent Flash during Extraction

2. Distillation Balance
Watermelon Seed Oil + Petroleum Ether = Distillate (P.E.) + Residue (Oil)

59 ml = 40 ml Petroleum Ether + **9 ml Watermelon Seed Oil** + 10 ml of solvent Flash

3.2.2 Extraction and Distillation Balance for Feed to Solvent Ratio 1:4

1. Extraction Balance
Watermelon Seed Powder + Petroleum Ether = (Solvent + Oil) + Powder Residue

50 gm + 200 ml = 154 ml + 66 gm + 40 ml of solvent Flash during Extraction

2. Distillation Balance
Watermelon Seed Oil + Petroleum Ether = Distillate (P.E.) + Residue (Oil)

154 ml = 125 ml Petroleum Ether + **14 ml Watermelon Seed Oil** + 15 ml of solvent Flash

3.2.2 Extraction and Distillation Balance for Feed to Solvent Ratio 1:6

1. Extraction Balance
Watermelon Seed Powder + Petroleum Ether = (Solvent + Oil) + Powder Residue

50 gm + 300 ml = 256 ml + 64 gm + 30 ml of solvent Flash during Extraction

2. Distillation Balance
Watermelon Seed Oil + Petroleum Ether = Distillate (P.E.) + Residue (Oil)

256 ml = 220 ml Petroleum Ether + **16 ml Watermelon Seed Oil** + 20 ml of solvent Flash

3.3 % Yield and Recovery of Watermelon Seed Oil
Maximum amount of oil in watermelon seed oil up to 35-40 %. Hence according this composition yield can be calculated.

% Yield of Oil = [Mass of Oil Extracted / Mass of Watermelon Seed Oil] *100

% Recovery of Oil = [Oil Extracted / Maximum Amount of Oil in Seed] *100

3.3.1 Yield and Recovery Using Feed to Solvent Ratio 1:2

1. % Yield of Oil
% Yield of Oil = [9/50] * 100 = 18 %
2. % Recovery of Oil
% Recovery of Oil = [09/20] * 100 = 45 %

3.3.2 Yield and Recovery Using Feed to Solvent Ratio 1:4

1. % Yield of Oil
% Yield of Oil = [14/50] * 100 = 28 %
2. % Recovery of Oil
% Recovery of Oil = [14/20] * 100 = 70 %

3.3.3Yield and Recovery Using Feed to Solvent Ratio 1:5

1. % Yield of Oil
% Yield of Oil = [16/50] * 100 = 32 %
2. % Recovery of Oil
% Recovery of Oil = [16/20] * 100 = 80 %

% Yield and %Recovery of Oil

Feed to Solvent Ratio	% Yield With Oil	% Recovery Oil
1:2	18	45
1:4	28	70
1:6	32	80

Table % Yield and Recovery of Oil

Observation table shows % yield and recovery of Oil using solvent extraction with different feed to solvent ratio. For solvent petroleum ether shows 1:2, 1:4 and 1:6 seed powder to petroleum ether ratio the % yield 18%, 28% and 32% resp. For solvent petroleum ether shows 1:2, 1:4 and 1:6 seed powder to petroleum ether ratio the % recovery 45%, 70% and 80% resp.

Graphical Representation of % Yield

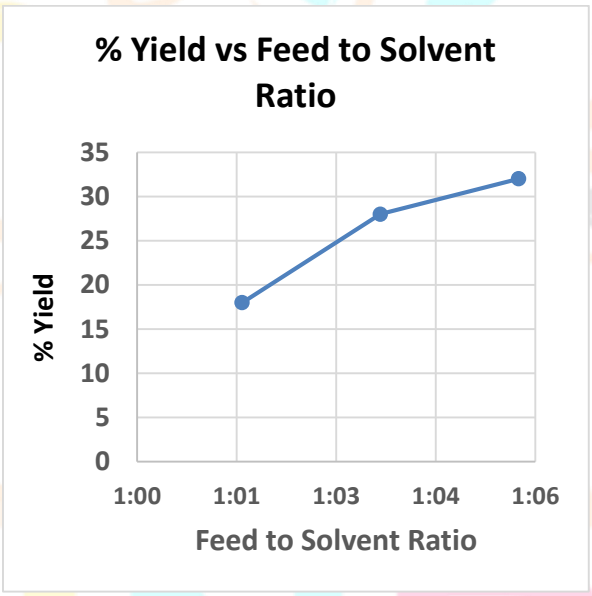

Fig. Graphical Representation of % Yield

Fig. shows the % yield Oil using solvent extraction with different feed to solvent ratio. For solvent petroleum ether shows 1:2, 1:4 and 1:6 seed powder to petroleum ether ratio the % yield 18%, 28% and 32% resp.

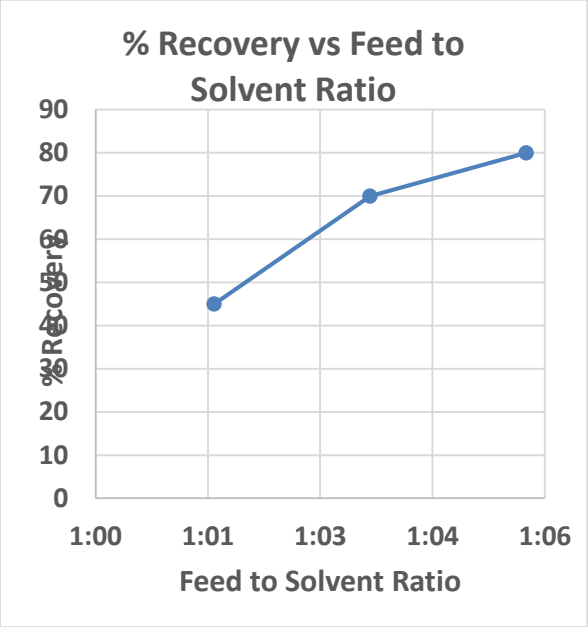

Fig. Graphical Representation of % Recovery of Oil

Conclusion

Solvent extraction is one of the traditional techniques of extracting vegetable oil. Oil seeds is one of the cheapest sources, applied to produce oil from seeds. Rate of extraction of oil from date seed depends on type of solvent, partial size of watermelon seed, time of extraction and temperature. Soxhlet extraction is the most common technique for oil seed extraction. Watermelon seed oil is obtained from watermelon seed through Soxhlet extraction technique. Oil content in the seeds is between 35-40% and the unsaturated fatty acid content in oil is 78-86% predominantly linoleic acid (45-73%). % Yield and recovery of Oil using solvent extraction with different feed to solvent ratio. For solvent petroleum ether shows 1:2, 1:4 and 1:6 seed powder to petroleum ether ratio the % yield 18%, 28% and 32% resp. For solvent petroleum ether shows 1:2, 1:4 and 1:6 seed powder to petroleum ether ratio the % recovery 45%, 70% and 80% resp. As per observation petroleum ether is the best suitable for extraction of oil from the watermelon seed. petroleum ether can easily separate after extraction and has higher yield than other with low cost. The ration of feed to solvent also important factor to be consider for extraction process which effect on the yield of oil. The optimum value for feed to solvent is 1:4 on which maximum yield for watermelon seed oil extraction. As the feed to solvent ration increase more than 1:4 there is appreciable change in the yield but the cost of solvent increase. The 1:4 feed to solvent ration is to be optimum value for watermelon seed oil extraction. The time of extraction increased yield of oil also increase and up to maximum level. The extraction of date seed oil carried out 1.5-2.5 hrs. The optimum time for extraction is 2 hrs. Crushed seed in powdered form gives large surface area for solid-liquid contact. Due to small size particles increase rate as well as yield of extraction of oil from watermelon seed. Extraction carried out at boiling temperature of solvent should be better for rate and yield of extraction. Temperature for extraction with petroleum ether, methanol and hexane up to 35-40 ^{O}C.

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