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Extraction of Cashew Nut Shell Liquid from Cashew Nut Shell

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ABSTRACT

CNSL has many applications such as friction linings, paints, laminating resins, rubber compounding resins, cashew cements, polyurethane based polymers, surfactants, epoxy resins, foundry chemicals, and intermediates for chemical industry. Liquid from Cashew Nut shell is generally extracted by three methods are mechanical, roasting and solvent extraction which contains oil of about 20 to 25%. Solvent extraction (expeller) process of oil extraction is more feasible. CNSL using solvent extraction with different solvents. For solvent Petroleum Ether, Hexane and Ethanol shows the % yield 42%, 25% and 40% resp. Petroleum Ether can easily separate after extraction and has higher yield than other with low cost. Size of cashew nut shell has influence on the recovery of oil and recovery of oil large size cashew nut shells is more than small size. By the Experimental analysis the moisture contentof the shell at the time ofoil extraction has a great influence on the extraction recovery of the oil. The average recovery of CNSL at shell moisture of 8-10 on wet basis was 80 – 85 %. The highest recovery of when the shell moisture content at 10 % wet basis. The ration of feed to solvent also important factor to be consider for extraction process which effect on the yield of CNSL. Optimum value for feed to solvent is 1:4.

Keywords: Cashew Nut Shells Liquid, SolventExtraction, Different Solvents Petroleum Ether, Hexane and Ethanol, Moisture Content.

1. INTRODUCTION

Liquid from Cashew Nut shell is generally extracted by three methods are mechanical, roasting and solvent extraction which contains oil of about 20 to 25%. The expeller process of oil extraction is more feasible for adoption on industrial scale. Cashew nut shell liquid is a versatile by-product of cashew processing which has tremendous potentials as a versatile industrial raw material with its diverse applications.Cashew-Nut Shell Liquid Oil (CNSL) is an important by-product of cashew. India's Cashew-Nut Shell Liquid Oil Export Market. Along with quality cashew kernel, Indian cashew nut industry is producing quality Cashew-Nut Shell Liquid oil which is also exportable. Indian cashew nut industry has big market for CNSL. CNSL oil is used in industries has good demand from industrially developed countries like USA and China are the top most importers.The thick vesicant oil liquid contained in the shell of cashew nut, called cashew nut shell liquid. The shell is formed of three concentric layers the epicarp, the mesocarp and the endocarp. The mesocarp is spongy and comprised of a mass of tissues and ducts containing about 35% of sticky, resinous liquid called cashew nut shell liquid (CNSL). The CNSL is highly caustic-brown in color and inedible. Itaffords the fruit some natural protection against insects. CNSL consists of two highly reactive phenolic compounds which are anarcardic acid (90%) and cardol (10%).

2. LITERATURE REVIEWS

Experimental study shows the effect of processing methods on the yield of cashew kernel oil sample dry roasting produced significantly higher oil yield 44.10 % than other processing methods 39.80 %, 35.14 % and 34.40 % for oil roasting, hand cracking and steam cooking respectively.By study shows that the oil and dry roasting methods are the best processing techniques to be employed to ensure that high percentage of wholesome cashew kernels are produced. Same two methods gave raise to high yield of cashew kernel oil extracted using solvent and screw press extraction methods as compare to hand cracked and steam cooked methods.[1]**Solvent extraction method which was done** in using petroleum ether which is normally used in the extraction of plant kernel oil. The oil extraction was done in small quantities of 20 g of milled cashew kernel and the extraction was allowed for 6 h at 60oC in a Soxhlet-extractor with 200 ml solvent and the oil was separated by simple distillation/evaporation. [1].**In 2015, Studied by Ashok Praha Chaudhari and NuancingScanting Thakor** show that Liquid from Cashew Nut shell is extracted by three methods Mechanical, Roasting and Solvent Extraction. The expeller (mechanical) process of oil extraction is more feasible for adoption on industrial scale. The influence of moisture content of cashew nut shells on the extraction of CNSL (Cashew Nut Shell Liquid) by screw press method was studied to find out the role of moisture content in the oil yield and there by optimizing the moisture content of shells for the extraction process. Extraction of CNSL by screw press method average oil content in cashew nut shells was found to be 26.45%. CNSL content of cashew nut shells imply that there is a good scope for processing the shells for oil. [2]**By the Experimental analysis the moisture content** of the shell at the time ofoil extraction has a great influence on the extraction recovery of the oil. The average recovery of CNSL at shell moisture of 8.12 % on wet basis was 80.57 % and that at shell moisture of 12.17 % wet basis and 14.20 % wet basis was 85.54 % and 84.01 % respectively. The highest recovery of 86.68% when the shell moisture content was 10.06 % wet basis. The moisture content of the cashew nut shells at the time of extraction (% recovery) of CNSL has a great influence on the oil recovery. Hence by analysis it's found that 10.06% moisture content Wet basis in cashew nut shells is the optimum moisture content for extraction of oil from cashew nut shells in order to get the maximum oil recovery of 86.68 %. [2]**In screw pressing of soaked and sundried flaxseed oil recovery increased from 78** to 88 % as moisture content increased from 5 to 7 %, and it decreased to 76 % at 9 % moisture content. Higher moisture content increased plasticity and thereby reduced the level of compression and contributed to poor oil recovery. By the experimental analysis 10.06 % wet basis is the optimum moisture level at which we obtained maximum yield of CNSL. [2] **In 2018, Experimental analysis carried out by Alex Folami Adisa, Elijah Oladimeji Aina and Salami Olasunkanmi Ismaila,** the shells were handled separately but were given the same pre-treatment of moisture conditioning to 14 – 17 % (A), 17-20 % (B) and 20-23 % (C) all on the wet basis. The highest percentage oil recovery of 21%, 19.5%, 15.5% at 10 minutes and A, B, C respectively were obtained for 5 kg sample of cashew nut shell while at 2 minutes

pressing duration and A, B, C moisture contents, the percentage oil recovery were 12.5%, 10.5% and 9% respectively. The optimum percentage of liquid recovery was 20.5% for sample mass of 5 kg and pressing duration of 10 minutes. The maximum extraction efficiency of 84%, 78% and 62% at A, B C moisture contents and 10 minutes pressing duration respectively were obtained for 5 kg sample of cashew nut shell while at 2 minutes and A, B, C moisture contents, the extraction efficiencies were 50%, 42% and 36% respectively.[3]**Cashew nut shells can be classified based on the sizes in three classes.** The medium size cashew nut shells ranging between 16 to 20 mm are having 80% share in the commercially available sample of shells. The moisture content of the cashew nut shells at the time of extraction (% recovery) of CNSL has a great influence on the oil recovery. Average oil content in cashew nut shells was found to be 26.45 %. CNSL content of cashew nut shells imply that there is a good scope for processing the shells for oil. Size of cashew nut shell has influence on the recovery of oil andrecovery of oil large size cashew nut shells is 88.54% [11].

EXPERIMENTAL ANALYSIS

Materials

1. Cashew Nut Shell.
2. Ethanol.
3. Hexane.
4. Petroleum Ether
5. Separating Funnel
6. Simple Distillation column.
7. Extraction Apparatus.

Process Solvent Extraction

Extraction with Petroleum Ether

1. Take 100 gm cashew nut shell are dried in oven or sunlight to remove the moisture.

2. Calculate the % moisture content in the cashew nut shell.

3. Crush the cashew nut shell in small size.

4. Take 1: 4 ratios of cashew nut shell to solvent.

5. Then cashew nut shell was soaked in 400 ml of Petroleum Ether for extraction.

6. Mixture put in separating funnel were two distinct layers are form.

7. Extract (Upper) phase and Raffinate phase from which E.P. contains CNSL.

8. The mixture was then heated at 55 ^{0}C-60 ^{0}C (B.P. solvent) for 8 hrs. (Distillation column)

9.Petroleum Ether was recovered at this temperature and CNSL separated.

10. The residue in the flask is the substance called cashew nut shell liquid (CNSL).

11. Calculate % yield of CSNL.

Extraction with Hexane

1. Take 100 gm cashew nut shell are dried in oven or sunlight to remove the moisture.

2. Calculate the % moisture content in the cashew nut shell.

3. Crush the cashew nut shell in small size.

4. Take 1: 4 ratios of cashew nut shell to solvent.

5. Then cashew nut shell was soaked in 400 ml of hexane for extraction.

6. Mixture put in separating funnel were two distinct layers are form.

7. Extract (Upper) phase and Raffinate phase from which E.P. contains CNSL.

8. The mixture was then heated at 65 ^{0}C-70 ^{0}C (B.P. solvent) for 8 hrs. (Distillation column)

9. Hexane was recovered at this temperature and CNSL separated.

10. The residue in the flask is the substance called cashew nut shell liquid (CNSL).

11. Calculate % yield of CSNL.

Extraction with Ethanol

1. Take 100 gm cashew nut shell are dried in oven or sunlight to remove the moisture.

2. Calculate the % moisture content in the cashew nut shell.

3. Crush the cashew nut shell in small size.

4. Take 1: 4 ratios of cashew nut shell to solvent.

5. Then cashew nut shell was soaked in 400 ml of ethanol for extraction.

6. Mixture put in separating funnel were two distinct layers are form.

7. Extract (Upper) phase and Raffinate phase from which E.P. contains CNSL.

8. The mixture was then heated at 70 ^{0}C- 80 ^{0}C (B.P. solvent) for 8 hrs. (Distillation column)

9. Ethanol was recovered at this temperature and CNSL separated.

10. The residue in the flask is the substance called cashew nut shell liquid (CNSL).

11. Calculate % yield of CSNL.

RESULTS AND DISCUSSION

% Yield of CNSL

% Yield of CNSL = [Mass of CNSL Extracted / Mass of Cashew Nut Shell] *100

1. Yield using Petroleum Ether l Solvent

% Yield of CNSL = [Mass of CNSL Extracted / Mass of Cashew Nut Shell] *100 = 42 %

2. Yield using Hexane Solvent

% Yield of CNSL = [Mass of CNSL Extracted / Mass of Cashew Nut Shell] *100 = 25 %

3. Yield using Ethanol Solvent

% Yield of CNSL = [Mass of CNSL Extracted / Mass of Cashew Nut Shell] *100= 40 %

Observations

Sr. No.	Solvent for Extraction	% Yield of CNSL
01	Petroleum Ether	38 – 42
02	Hexane	22 -25
03	Ethanol	35 – 40

Table % Yield of CNSL for Different Solvents

Observation table shows the % yield of CNSL using solvent extraction with different solvents. For solvent Petroleum Ether, Hexane and Ethanol shows the % yield 42%, 25% and 40% resp. As per observation Petroleum Ether is the best suitable for extraction of CNSL from the cashew nut shell. Petroleum Ether

can easily separate after extraction and has higher yield than other with low cost.

Factors Affected on the Yield of CNSL

1. Size of Cashew CNS

Size of cashew nut shell has influence on the recovery of oil and recovery of oil large size cashew nut shells is more than small size.

2. Moisture Content of CNS

By the Experimental analysis the moisture contentof the shell at the time ofoil extraction has a great influence on the extraction recovery of the oil.

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 CNSL. The optimum value for feed to solvent is 1:4 on which maximum yield for CNSL extraction.

4. Solvent for Extraction

Selected solvent should be easily separated from the CNSL and giving high yield operation with low cost. Solvent have low boiling point. Solvent like petroleum ether are suitable for extraction of CNSL.

CONCLUSION

Liquid from Cashew Nut shell is generally extracted by three methods are mechanical, roasting and solvent extraction which contains oil of about 20 to 25%. The Solvent extraction (expeller) process of oil extraction is more feasible for adoption on industrial scale. CNSL using solvent extraction with different solvents. For solvent Petroleum Ether, Hexane and Ethanol shows the % yield 42%, 25% and 40% resp. As per observation Petroleum Ether is the best suitable for extraction of CNSL from the cashew nut shell. Petroleum Ether can easily separate after extraction and has higher yield than other with low cost. Selected solvent should be easily separated from the CNSL and giving high yield operation with low cost.Size of cashew nut shell has influence on the recovery of oil and recovery of oil large size cashew nut shells is more than small size. By the Experimental analysis the moisture contentof the shell at the time ofoil extraction has a great influence on the extraction recovery of the oil. The average recovery of CNSL at shell moisture of 8-10 on wet basis was 80 – 85 %. The highest recovery of when the shell moisture content at 10 % wet basis. The moisture content of the cashew nut shells increases more than 1 the recovery decrease slightly. The ration of feed to solvent also important factor to be consider for extraction process which effect on the yield of CNSL. The optimum value for feed to solvent is 1:4 on which maximum yield for CNSL extraction. Hence, by the study the factor like Feed to solvent ratio, Moisture content in CNS, size of CNS and the solvent for extraction all are important factor that impact on the yield of CNSL.

FUTURE SCOPE AND BENEFITS

India's Cashew-Nut Shell Liquid (Oil) Export Market. Along with quality cashew kernel, Indian cashew nut industry is producing quality Cashew-Nut Shell Liquid oil which is also exportable. Indian cashew nut industry has big market for CNSL. CNSL oil is used in industries has good demand from industrially developed countries like USA and China are the top most importers. India is the largest producer and processor of cashews.CNSL is a versatile raw material and has many industrial

applications. There are currently more than 200 patents for its industrial application. CNSL has many applications such as friction linings, paints, laminating resins, rubber compounding resins, cashew cements, polyurethane based polymers, surfactants, epoxy resins, foundry chemicals, and intermediates for chemical industry. India has the largest area under cashew and stands as the second largest producer of cashew (7lakh MT) in the world. India has a comparative advantage in the production and processing of cashew nuts on account of its skilled labor force. India is the largest processor and exporter of cashew in the world. Maharashtra ranks first in the production 28.78 % of the country.Cashew nut shell liquid (CNSL) is a by-product from cashew nut processing. CNSL is a dark brown viscous liquid present inside a soft honey comb structure of the cashew nut shell. It contains phenolic compounds, mainly cardanol. Cardanol is a monohydroxyl phenol with a long carbon chain in the met position. It has the potential as a substitute for phenol in resin phenolic-based products.

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NOMENCLATURE

AV - Acid Value

BP - Boiling Point

CNS - Cashew Nut Shell

CNSL - Cashew Nut Shell Liquid

CKO - Cashew Kernel Oil

FFA - Free Fatty Acid

SV - Saponification Value