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Research Article

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Characteristics and Usefulness of Palm Oil in the Production of Calcium Stearate

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Abstract Palm oil extract was study to determine the possible chemical compounds present in it as well as to examiner the usefulness of these compounds in the production of calcium stearate. The palm oil used for this studywere sourced within Rivers State metropolis. Atomic Absorption Spectroscopy (AAS) was used to analyze the elemental composition of the palm oil. Gas chromatogram (GC) was used to analyze the chemical composition of the palm oil for the purpose of characterization. The GC analysis revealed the presence of the following component parameters, which include C8 component, lauric acid (C_{12}), myristic acid (C_{14}), palmitic acid (C_{16}) Behenic acid (C_{20}), stearic acid (C_{18}), oleic acid ($C_{18:1}$), linoleic acid ($C_{18:2}$), magaric acid (C_{17}). The conversion for possible utilization of agricultural waste such as palm oil residues is important in not only protecting the environment but also in minimizing the cost of disposal, conservation of palm oil residues for other purposes and reduction in the conversion into the production of calcium stearate in Nigeria for economic diversification is a welcome development. The research demonstrates the usefulness of palm oil in the production of calcium stearates.

Keywords Production, calcium stearate, characteristics, Palm Oil, Extract

Introduction

Production of calcium stearate using local raw material of palm oil extract is one of the major constituent and the determination of the physiochemical parameters and the characterization of the palm oil will be found useful in the intermediate and end product achieved. This research work derived its importance primarily from the numerous uses of calcium stearate as enumerated in this research work. Furthermore, it gives the reader the choice of selecting the best and cheapest process with optimum desired product as well as high conversion rate to be achieved at the end of the process. The significance of this research work has made it economically viable to use local raw materials which are readily available in Niger Delta of Nigeria environment and time efficient to convert the local raw materials that are considered as waste to a more useful product.

Calcium stearate is made of components of lauric, magaric, oleic, beheric, stearic, palmitic, and myristic acids as well as C_8 components. Palm fatty acid extracted from the distillation process posses the following properties such as lubricity or fluidity characteristics on the powder products as well as preventing them from further consolidating [1]. Other important characteristics are that it influences the emulsification process by controlling the viscous property of calcium stearate during production. This leads to increase in lubricity at a low dose when compared with conventional products achieved from sucrose fatty acid esters [2].

Dror and Schlantman [3], conducted a research on the stearates and observed that greatest commercial utilization are obtained from commercial fatty acids extracted from natural and materials which posses high level in concentration of stearic acid and palmitic acids and this is attributed to the high level of OH-group found in the fatty acid molecule as well as in 12-hydroxystearates compound which is more soluble in polar solvents to their research. They compared the melting point characteristics of the process and their results

revealed that the melting point of metal salts is higher than the mixture of the predominantly stearic and palmitic acids [3-5].

In the case of fatty acid with shorter chain, in which characteristics of laureates are rapidly influenced by the individual metal base. The characteristics of the metallic stearate in terms of the gelation and water repellence are maintained through the process, whereas the separating and lubricating properties induced the process significantly [6-9].

The presence of the double bond in the fatty acid, oleates contributes to the low melting point in the stearates compounds as well as improved the solubility of the product slightly. In most cases, the recommended properties of metallic stearate considered by various research groups include the following: the lubricating and separating properties, water repellence, and gelling capacity, stabilizing effect and foam inhibition properties [10-13].

Research conducted on the characteristics of metallic stearate as a lubricant as well as releasing agents was attributed to its melting point. However, metallic stearate in its solid form can be grinded into fine dry powder which is found useful as a dry lubricant when applied in a process and its hydrophobic nature of the solid power form of the metallic stearates is highly recommendable. The metallic stearate characteristic can be also attributed to the lubrication as well as the release properties in terms of water repellency; hence the influence of these characteristics can be determined based on the concentration of cation, fatty acid chain length as well as other functional parameters and properties that control the system that is the water crystallization composition [14-18].

Research conducted on the characteristics of gelling properties of aluminum stearate revealed the significance of the mono-di- and tribasic stearate formation and its importance in the gelation characteristics of aluminum stearate as well as the viscosity, polarity and solvent properties of the liquid component [13]. Calcium stearate and others such as magnesium stearate and zinc stearate are found useful in the manufacturing process of thermoplastics. In most cases, aluminum stearate and magnesium stearate are used as foam inhibitors for various suspensions component [15]. The aim of this research work is the identify the various compounds present in the palm oil as well as to extract the major component found useful in the production of calcium stearate.

Materials and Methods

Sampling

In the investigation of calcium stearate production, the following sample materials were used palm oil. The palm oil was collected from an abattoir in Port Harcourt and transported to Laboratory of the Department of Chemical/Petrochemical Engineering, Rivers State University for onward processing.

Equipment and Materials Used for the Analysis

The materials used for this investigation are stated below: Palm oil, reactor, litmus paper, heating mantle, distillation flask, receiving flask, condenser, water hose, acid resistance bottle, measuring cylinder, beakers and conical flask and thermometer

Reagents Used for the Analysis

The following reagents were used during the production of calcium stearate:

1. Sodium hydroxide
2. Concentrated hydrochloric acid
3. Ethanol
4. Distilled water

Production of Stearic Acid from Palm Oil

The following procedure was used in the production of stearic acid from palm oil. 9.5gm of base (NaOH) was measured and introduced into 3 litres acid resistant transparent plastic container. In the solution 1 litre of alcohol (ethanol) was added and tightly cocked and agitated for 10min until a base pallet dissolved forming ethanozide solution.

The ethnozide solution was mixed with 500ml of dissolved palm oil and solution was stirred and heated to about 55^{o}C with continuous stirring for a period of 1 hour. After preheating, the oil was stirred and turned to separating funnel which allows settlement within 48 hrs.

After 48 hours, two layers were observed and were separated through decantation. The lower layer was triglycerine and the upper stearic acid which was subjected to distillation process to remove the volatile components. The stearic acid was allowed in the distillation flask to cool to room temperature. The stearic acid was further dehydrated and crushed to powder.

Flow Diagram for Palm Oil Processing (Extraction of Stearic Acid from Palm Oil)

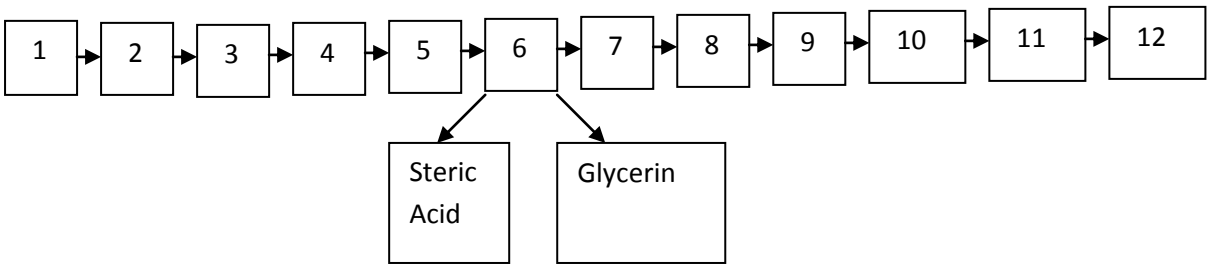

Figure 1: Flow Diagram for Extraction of Stearic Acid from Palm Oil

The following are Steps for extraction of Stearate from Palm Oil

1. Purchase of palm oil
2. Storage of palm oil
3. Heating (bleaching)
4. Addition of additives (base)
5. Reaction of the additives with the bleached oil
6. Formation of Glycerin and Stearic acid
7. Separation of the products (decantation)
8. Recovering of stearic acid (paste)
9. Dehydration of the stearic acid to solid
10. Crushing of solid stearate to powder form
12. Final production (Stearate) in a container

Stream A + Stream B

Gave the calcium Stearate

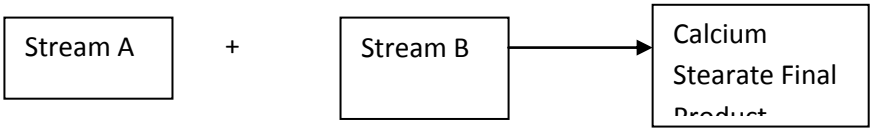

Figure 2: Flow Diagram for Calcium Stearate Production

$$2C_a^{2+} + \left(C_{17}H_{35}COO-\right)_2 \rightarrow 2C_{17}H_{35}COOC_a + H_2 \uparrow$$

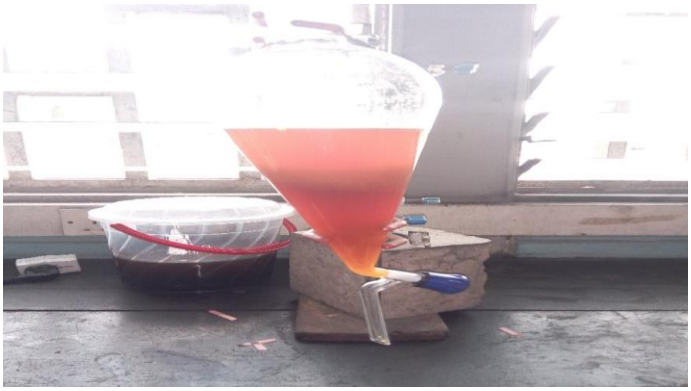

Figure 3: Decantation Process of Palm Oil

Figure 4: Distillation Process of Palm Oil

Figure 5: Decantation Process of Palm Oil

Results and Discussion

The results obtained from this research work is presented in Figures and Tables shown below

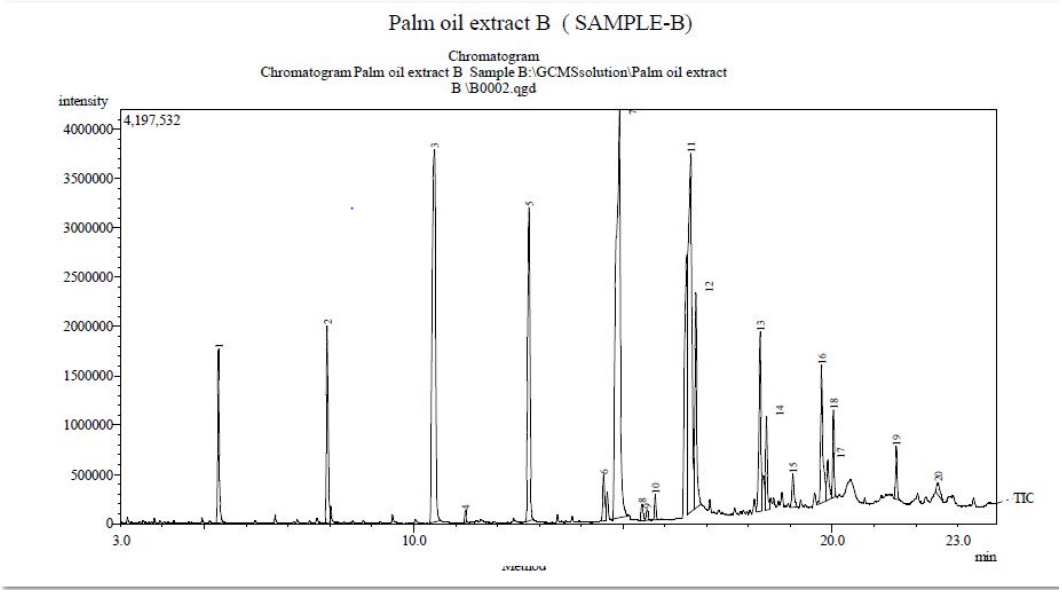

Figure 6: Palm Oil Extract GC Analysis Result

Figure 6 illustrates the characterization of palm oil extract intensity using the chromatogram (GCMS solution). The GC – 2010 analysis with the following information was used, column over temperature (70 ^{o}C), injection

temperature (250 ^{o}C). The over temperature programme is within the range of 0-10.00 of rate, 70 ^{o}C to 280 ^{o}C for temperature and 0.00 – 5.00 min for the holding time.

The various individual compounds obtained from the chromatogram (GCMS solution) on the palm oil extract is illustrated in this research work.

Table 1: Analysis of Palm Oil Initial Concentration

Parameters	Chemical Name	Concentration of Components (PPM)
C_8		1.8972
C_{12}	Lauric acid	3.4449
C_{14}	Myristic acid	3.2017
C_{16}	Palmitic acid	6.1841
C_{20}	Behenic acid	0.2338
C_{18}	Stearic acid	22.8227
$C_{18:1}$	Oleic acid	13.4397

Table 1 illustrates the concentration of the palm oil initial characteristics with the following components identified as C_8,C_{12}, C_{14}, C_{16}, C_{20}, C_{18}, and $C_{18:1}$, which values is as stated above in the Table 1 with stearic acid value > oleic acid value >palmitic acid value >lauric acid value >myristic acid value > C_8>behenic acid value

Table 2: Analysis of Palm Oil Extract from Top Sediment

Parameters	Chemical Name	Concentration of Components (PPM)
C_8		1.6512
C_{12}	Lauric acid	3.4115
C_{14}	Myristic acid	3.1744
C_{16}	Palmitic acid	6.1411
C_{20}	Behenic acid	0.3945
C_{18}	Stearic acid	15.2122
$C_{18:1}$	Oleic acid	23.4065

Table 2 illustrates the concentration of the palm oil sediment characteristics with the following components identified as C_8,C_{12}, C_{14}, C_{16}, C_{20}, C_{18}, and $C_{18:1}$, which values is as stated above in the Table 2 with oleic acid value >stearic acid value >palmitic acid value >lauric acid value >myristic acid value > C_8> behenic acid value. The process of the heating increased the stearic acid concentration which is one of the major constituent need with high concentration to achieve the production of calcium stearate with good quality.

Table 3: Palm Oil Extract Analysis

				PEAK REPORT TIC				
PEAK	**R. TIME**	**I. TIME**	**F. TIME**	**AREA**	**AREA %**	**HEIGHT**	**HEIGHT %**	**A/H**
1	5.229	5.275	5.467	5011319	3.90	175126	6.23	2.85
2	7.934	7.883	7.992	5773091	4.49	1997795	7.08	2.89
3	10.497	10.383	10.642	21424396	16.68	3775056	13.37	5.68
4	11.237	11.200	11.283	257874	0.20	122091	0.43	2.11
5	12.759	12.657	12.858	12425164	9.67	3179340	11.26	3.91
6	14.540	14.483	14.592	1511968	1.18	461395	1.63	2.28
7	14.916	14.692	15.108	29512262	22.98	4135583	14.65	7.14
8	15.452	15.408	15.533	515435	0.40	167165	0.59	3.08
9	15.578	15.533	15.625	276302	0.22	107461	0.38	2.57
10	15.774	15.625	15.833	561870	0.44	254568	0.90	2.21
11	16.622	16.542	16.692	21690388	16.89	3633966	12.87	5.97
12	16745	16.692	16.875	7668877	5.97	2180506	7.73	.52
13	18.277	18.183	18.333	6586313	5.13	1818098	6.44	3.62
14	18.433	18.392	18.492	2623278	2.04	943161	3.34	2.78
15	19.060	18.992	19.167	1190342	0.93	334552	1.19	3.56
16	19.748	19.842	19.842	5646199	4.40	1391308	4.93	4.06

17	19.899	19.842	19.983	1604809	1.25	412302	1.46	3.89
18	20.032	21.483	20.100	2144737	1.67	890200	2.15	2.41
19	21.536	21.483	21.608	1330931	1.04	539400	1.91	2.47
20	22.523	12.467	22.642	688473	0.54	122542	0.43	5.62
	Total			12844028	100.00	28225615	100.00	

Table 3 illustrates the palm oil extract analysis of the peak at various time dependent and the results obtained demonstrates increase in various time with increase in the area and height**.**

Table 4: Oven Temperature for Palm Oil (Palm Oil Extract)

Rate	Temperature (^{o}C)	Hold Time (mm)
=	70.0	0.00
10.00	280.0	5.00

Table 4 illustrates the oven operating temperature for palm oil extraction condition in the process. The process demonstrates the rate in relationship to the temperature and the holding time

Conclusion

The research conducted on the chemical composition of palm oil revealed the usefulness of the raw material in the production of calcium stearate. The process of distillation was carried out in this research by heating the palm oil to enhance improvement in the quality as well as increase the kinetics of the palm oil used in the process. This process demonstrated reduction in moisture content initially present in the raw material as well as illustrates the separation in colour of the palm oil in the reactor as can seeing in this paper. This study demonstrates the effect of temperature in changing the initial chemical composition of the palm oil making it possible for constituent extract adequate material for the production of calcium stearate.

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