CHARACTERIZATION OF COCOA (THEOBROMA COCOA) POD

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ABSTRACT

Cocoa pod is a waste product of cocoa seeds and have been found very useful industrially for making black soaps which are highly medicinal for treating various ailment. The oil of the pod was investigated to reveal the various compounds present in the oil, Essential fatty acids and other organic compounds were revealed by the use of Gas Chromatography Mass Spectrophotometer.

Key words: Theobroma cacao, oil, Gas chromatography Mass spectrophotometer

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Introduction

Many research work have been done on various waste products like the cocoa pod, cola nut, wall nut. However, little attention has been given to the oil of these various waste products which abound in the forest after harvesting and removing the beans and seeds. Kola (2006) described the proximate, phytochemical of cocoa pod. This research work focuses on the characterization of the oil extracted from the cocoa pod using gas chromatography mass spectrophotometer.

Materials and methods

Cocoa pods were collected on the 15th July, 2012, from cocoa farm in Ikota, Ifedore local Government area, Ondo State, Nigeria, its geographical coordinates are 7° 21' 0" North, 5° 9' 0" East, The pods were washed, cut into small pieces using knife, sun dried for ten days and then grinded into powder form using blender.

Oil Extraction and GC Analysis

The oil of the sample was extracted using soxhlet extractor and petroleum ether as solvent. The compositions of the fatty acids was determined using gas chromatography of the purified methylated sample (methylation was done using BF3 methanol), 1µl was injected into a HP 5890 series II gas chromatograph fitted with a FID and an HP-FFAP capillary column. The helium carrier gas flow was 8ml/min. The detector temperature was 280^{0}C. The injector split 1:50 at 220^0**C**. A temperature programmer was used with an initial temperature of 160^0**C** held for 5minutes, raised from 200 to 220^{0}C at a rate of 2^{0}C/ min and 220^{0}C held for 30 minutes. The fatty acid methyl esters were identified from the spectral data.

Results and discussion

Characterizations of many waste plants have revealed both non-essential fatty acids, essential fatty acids and many useful organic compounds. Essential fatty acid are been considered because of their high need by human body for its various physiological functions, as the body cannot synthesis them on their own. The GC-MS of cocoa pods showed the following compounds: 1-Butylheptyl cyclohexane, n-Eicosane, 3,6-dimethylundecane,5-Ethyl-2-methylheptane,2,3,3-Trimethyloctane,3,4,5,6-Tetramethyloctane,n-Heptadecanoic acid (palmitic acid), Pentadecanoic acid, Octadecanoic acid(stearic acid), Eicosanoic acid (Arachidic acid) 2-ethylhexyl isobutyl ester, 2-Methyl-6-propyldodecane, 2-ethylhexylundecylester, 1methylnonyl cyclohexane and 9,12-octadecadienoic acid (linoleic acid). The presence of very useful organic acids and essential fatty acids in the oil extract is a good indication that the if the compounds are isolated using chromatographic techniques,

well purified and modified, could be used as part of food formulation, drug composition and in making industrial chemicals. N-Hexadecanoic acid (palmitic acid), this is the most common fatty acid found in animals, plants and microorganisms [5]. It is also the major component of the oil from palm trees (palm oil, palm kernel oil and coconut oil). However, palmitic acid can also be found in meats, cheeses, butter, and dairy products. It has been shown (in rats fed on a 20% fat (palmitic acid), 80% carbohydrate diet) to alter aspects of the central nervous system responsible for the secretion of insulin and to suppress the body's natural appetite-suppressing signals from leptin and insulin -- the key hormones involved in weight regulation[1]. Furthermore, excess carbohydrates in the body are converted to palmitic acid, it is the first fatty acid produced during fatty acid synthesis and the precursor to longer fatty acids. Palmitate negatively feeds back on acetyl-CoA carboxylase (ACC), which is responsible for converting acetyl-CoA to malonyl-CoA, which in turn is used to add to the growing acyl chain, thus preventing further palmitate generation [10]. In biology, some proteins are modified by the addition of a palmitoyl group in a process known as palmitoylation. Palmitoylation is important for membrane localisation of many proteins[5]. N-Pentadecanoic acid is a saturated fatty acid, rare in nature, being found at the level of 1.2% in the milk fat from cows [7]. The butter fat in cow's milk is its major dietary source [11] and it is used as a marker for butterfat consumption. Moreover, n-octadecanoic acid (stearic acid) is one of the most common saturated fatty acids found in nature following palmitic acid [5], it can be used as a binding agent for products like lotions, soaps, deodorants and candles. It also serves the same function in food products, such as butter flavoring, vanilla flavoring, chewing gum, fruit waxes and butter. Eicosanoic acid, heptadecanoic acid or margaric acid, is a saturated fatty acid. It occurs as a trace component of the fat and milk fat of ruminants, [6] but it does not occur in any natural animal or vegetable fat at concentrations over half a percent [2]. The presence of Arachidic acid in the cocoa pod oil, if the compounds can be separated using column chromatography, purified and modified, is a good discovery for the production of lubricants because its source is very cheap and readily available locally when compared to the capital intensive exploitation and exploration of crude oil in which lubricants are being produced. Nigeria being one of the world leading cocoa producer and cocoa pod being a waste product from cocoa farm, its abundance can be readily guaranteed. Linoleic acid is an essential fatty acid that must be consumed for proper health. A diet only deficient in linoleate causes mild skin scaling, hair loss,[3] and poor wound healing in rats[10]. However, achieving a deficiency in linoleic acid is nearly impossible consuming any normal diet and is thus not considered to be of clinical concern. Industrially, linoleic acid is used in making quick-drying oils, which are useful in oil paints and varnishes. These applications exploit the easy reaction of the linoleic acid with oxygen in air, which leads to crosslinking and formation of a stable film. Reduction of linoleic acid yields linoleyl alcohol. Linoleic acid has become increasingly popular in the beauty products industry because of its beneficial properties on the skin. Research points to linoleic acid's anti-inflammatory, acne reductive, and moisture retentive properties when applied topically on the skin.[9],[8],[4].The metabolism of linoleic acid is illustrated below

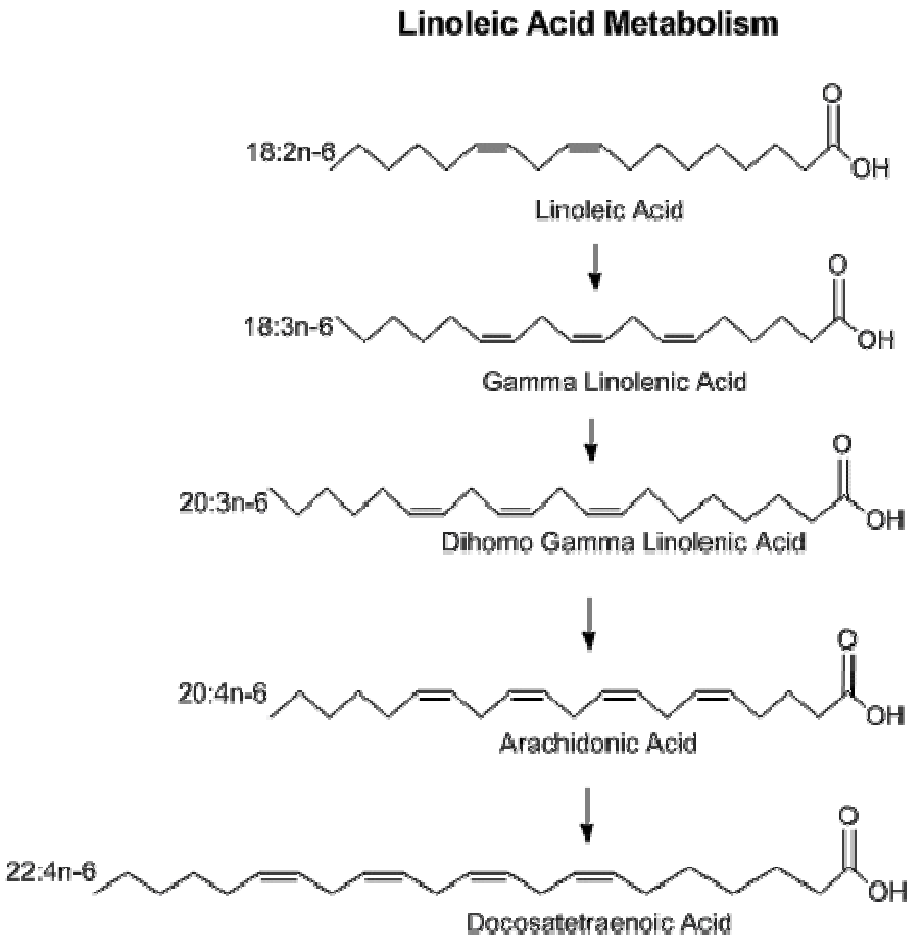
Linoleic Acid Metabolism
18:2n-6
OH
Linoleic Acid
18:3n-6
OH
Gamma Linolenic Acid
20:3n-6
OH
Dihomo Gamma Linolenic Acid
20:4n-6
OH
Arachidonic Acid
22:4n-6
OH
Docosatetraenoic Acid

Table1: Showing Gc-Ms of cocoa pod

Compound Name	Compound formula	Molecular Weight	CAS
(1-Butylheptyl)cyclohexane	$C_{13}H_{34}$	238	1315-80-9
n-Eicosane	$C_{20}H_{42}$	282	112-95-8
3,6-dimethylundecane	$C_{13}H_{28}$	184	17301-28-9
5-Ethyl-2-methylheptane	$C_{10}H_{22}$	142	13475-78-0
2,3,3-Trimethyloctane	$C_{11}H_{24}$	156	62016-30-2
3,4,5,6-Tetramethyloctane	$C_{12}H_{26}$	170	62185-21-1
n-Heptadecanoic acid(palmitic acid)	$C_{16}H_{32}O_2$	256	57-10-3
Pentadecanoic acid	$C_{15}H_{30}O_2$	242	1002-84-2
Octadecanoic acid(stearic acid)	$C_{18}H_{36}O_2$	284	57-11-4
Eicosanoic acid(Arachidic acid)	$C_{20}H_{40}O_2$	312	506-30-9
2-ethylhexyl isobutyl ester	$C_{12}H_{26}O_3S$	250	0-00-0
2-Methyl-6-propyldodecane	$C_{16}H_{34}$	226	55045-08-4
2-ethylhexylundecylester	$C_{19}H_{40}O_3S$	348	0-00-0
1methylnonyl)cyclohexane	$C_{16}H_{32}$	224	13151-73-0
9,12-octadecadienoic acid(linoleic acid)	$C_{18}H_{32}O_2$	280	60-33-3

Recommendation

From the research work it can be recommended that the oil of the sample is a good source of essential fatty acids and many useful organic compounds, if the oil can be separated using flash column chromatography, characterized using various spectroscopic techniques like mass spectrophotometer, 13C and 1H NMR, FT/IR in order to reveal the structures and chemical properties of the compounds, they can be used in the formulation of food components, as thickening agents, drug formulation and the rheological properties of the oil should be analyzed to check the viscosity for its suitability as lubricant.

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