A Literature Review on The Possible Sources For Production Of Fatty Acid

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***Abstract*— The main purpose of this research review is to find out the possible sources for production of Fatty acids (FA). There is a lot of sources of Fatty Acid which is come form animal origin, plant origin and also can be produce from the *synthesis of bacteria*. But for this research just only focused only one source from each origin that may be discussed in thid review of production FA. Fatty acids is a carboxylic acid which is consisting of hydrocarbon chain and also consist a terminal carboxyl group (-COOH). Fatty acids also brought high potential industrial demand in many sector such as industry foods, agriculture, pharmaceutical, cosmetic, textile, and many more industries related to fatty acids. Fatty acids production also can be review in Malaysia scenario for the last few years (2013, 2014 and 2015) and their local consumptions, import and export. Production of Fatty acid in Malaysia could be achieve by review on the commodity of tall oil Fatty Acids. This tall oil fatty acids commodity will show the trend of the production fatty acids at the local region in Malaysia, import and export. So, it is suggested to get a data on the last 3 years with regards to production for import and export quantity. Fatty acids also have beneficial value towards human health that is come from the essential fatty acids linolenic and linoleic fatty acids which may be discussed further in this review.**

Keywords : Fatty acid, lard derivatives, coconut oil , spent mushroom compost, essential fatty acids.

I. INTRODUCTION

There are three (3) types of Fatty Acids which categorized as saturated, monounsaturated and polyunsaturated Fatty Acids. Generally, all Fatty Acids have chains of carbon (C) atoms with hydrogen (H) atoms linked to the carbon atoms.

- Saturated Fatty Acids-
  The maximum possible number of H atoms attached to every C atom is called as saturated Fatty Acids.
- Unsaturated Fatty Acids-
  A pair of H atoms in the middle of the chain is missing that can led to creating a gap and then forming a double bond instead of single bond of C-H. Monounsaturated Fatty Acids consist only one double bond whereas polyunsaturated consist more than one double bond.

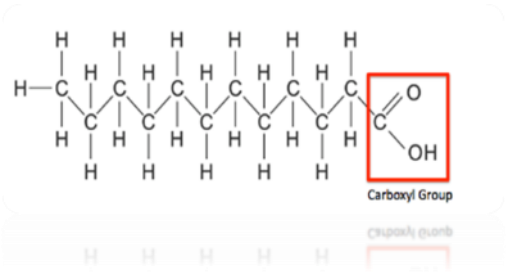

Figure (1) : The example of structural formula of Fatty Acids that consist of carboxyl group (-COOH) at the end of the hydrocarbon chain.

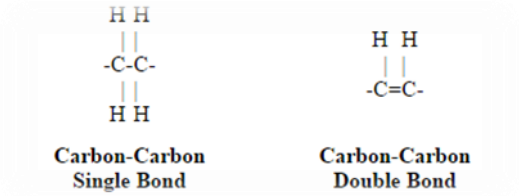

Figure (2) : The difference in structural formula between saturated and unsaturated Fatty acids. ("Fatty acid", 2016).

Table (1): Examples of Saturated Fatty Acids. (Fatty acid, 2016)

Comman name	**Chemical Formula**
Lauric acid	$CH_3(CH_2)_{10}COOH$
Myristic acid	$CH_3(CH_2)_{12}COOH$
Palmatic acid	$CH_3(CH_2)_{14}COOH$
Stearic acid	$CH_3(CH_2)_{16}COOH$

Table (2): Examples of monounsaturated Fatty Acids. (Fatty acid, 2016)

Common name	**Chemical Formula**
Oleic acid	$CH_3(CH_2)_7CH = CH(CH_2)_7COOH$

Table (3) : Example of polyunsaturated Fatty Acids. ("Fatty acid", 2016)

Common name	**Chemical Formula**
Linoleic acid	$CH_3(CH_2)_4CH = CHCH_2CH = CH(CH_2)_7COOH$
Linolenic acid	$CH_3(CH_2)CH = CHCH_2CH = CHCH_2CH = CH(CH_2)_7COOH$

Table (4): The most common fatty acids with its melting and boiling point. *(Chemistry.elmhurst.edu,2017)*

Carbon Atoms : Double Bonds	**Common name**	**Melting Point (°C)**	**Boiling Point (°C)**
Saturated Fatty Acids			
12 : 0	Lauric acid	44.0	298.9
14 : 0	Myristic acid	58.0	250.5
16 : 0	Palmitic acid	63.0	351.0
18 : 0	Stearic acid	70.0	361.0
20 : 0	Arachidic acid	77.0	328.0
Unsaturated Fatty Acids			
16 : 1	Palmitoleic acid	1.0	162.0
18 : 1	Oleic acid	16.0	360.0
18 : 2	Linoleic acid	-5.0	230.0
18 : 3	Linolenic acid	-11.0	230.0
20 : 4	Arachidonic acid	-49.0	169.0

II. REVIEW

A. Fatty Acids and Health

Fatty acids play an important role to the human body- Numerous news and articles promote the beneficial effects of omega-3 and omega-6 Fatty Acids. As many knows, fats can provide caloric energy in our diet but in particular kind of fat we eat make difference to body and not good if consume it too much. Specific fatty acids are starting material for many vital signal molecules in plants and animals. For example, Mammals (including humans) cannot synthesize these predecessor molecule on their own. So, a failure to obtain these fats from the diet can have major problems that make human body weak that can cause weight loss. Weight loss by lack in proper nutrition are important to focus. By the way, important to know that weight loss does not necessary translate into proper nutrition. Many people believe that to lose weight, they must eliminate fat from diet. But, it is wrong concept whereby certain types of fats are indispensable to the human body. Thus, many approach was discovered to settle this problem. By the early of twentieth century, the researchers admit that the human body needed basic set of vitamins. *("Essential Fatty Acids: The Work of George and Mildred Burr", 2012*) A group of scientists make some research regarding to the necessity of this requirement of sufficient nutrients to human health. Research was done by examining the effect of fat-free diets on rats. They fed rat with diet containing adequate calories with protein and all desired nutrients, but without fat. Another side, the rat was fed with same diet, but containing fat. They carefully observed the rats over several month. They observed that the rats on the fat-free diet powerless to life and could die in a week. Interestingly, the rat could return sickly animals to good health by adding dietary fats. Thus, the researchers assume that there is several kinds of fatty acids that is needed in the human diet, so they answered the questions regarding "does fatty acid beneficial to human health?" by systematically feeding the sick animals with a selection of known fats to see if there is any changes happen to the rat. At last, they discovered that by adding two particular purified fatty acids, linolenic and linoleic acids, would restored the sick mammal to health where the other fatty acids unable to do so. This make *linolenic* and *linoleic acids* becomes essential fatty acids

Linolenic and linoleic fatty acids contain long carbon chains of 18 carbons each. These "crucial" fatty acids are polyunsaturated meaning they contain multiple carbon-carbon double bonds (alkene functional group). The researchers have determined that the structural characteristics that makes these molecules different is the position of their double bond. The position of the double bond can be state in several ways. The common step is to begin numbering the carbons from the carboxylic acid (-COOH) with that carbon naming as carbon 1. For linoleic acid has double bonds at the 9 and 12 carbon's position, whereas linolenic acid has carbon-carbon double bonds at the 9, 12 and 15 carbon's position. As researchers examined, they noted that to numbering the carbon at linolenic acid, the first carbon located furthest from the carboxylic acid (-COOH). Thus, linoleic acid become omega-3 fatty acid and linoleic acid is an omega-6 fatty acid.

These beneficial fats are known as Essential Fatty Acids (EFAs). It is become "essential" because of our body cannot produce them on its own so they must come from our dietary. The special of linoleic acid (omega-6) and linolenic acid (omega-3) is ("Essential Fatty Acids - Essential Fatty Acids - Nutrients - Home", 2016):

1. Formation of healthy cell membranes
2. Proper development and functioning of the brain and nervous system
3. Proper thyroid and adrenal activity
4. Hormone production
5. Regulation of blood pressure, liver function, immune and inflammatory responses
6. Regulation of blood clotting: Omega-6 FAs encourage blood clot formation whereas Omega-3 oil reduces clotting. The ideal is to achieve a balance between omega-6 and omega-3 fatty acids
7. Crucial for the transport and breakdown of cholesterol
8. Support healthy skin and hair

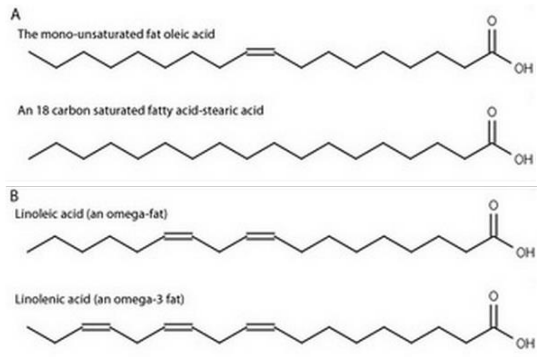

Figure (3): Chemical structure of the Essential Fatty Acids ("Essential Fatty Acids - Essential Fatty Acids - Nutrients - Home", 2016)

B. Fatty acids production based on Tall Oil Fatty acids (TOFA) commodity.

Tall Oil Fatty Acids - Tall oil fatty acid basically is the composition of large amount of fatty acid with small amount of rosin acids and unsaponifiables. Tall oil can be defined as *mixtures of any various oily liquid that can be produce from process acidifying the liquor* that has three major components which is resin acids, fatty acids and unsaponifiables (neutral compounds). With focused on the tall oil fatty acid, it is produced from the fractional distillation of crude tall oil that is converted it in several tall oil fractions which is tall oil rosin, tall oil rosin ester and tall oil fatty acid (TOFA). TOFA is cheap cost of unsaturated fatty acid usually oleic acid, palmatic acid and linoleic acid. It is source of high boiling point fatty acid and widely used in industry of synthetic lubricants. The characteristics of tall oil fatty acids are it is light in colour and low in rosin, cost purchase of TOFA can be classify as cost-effective due to it consistency source of liquid fatty acid. The content of tall oil fatty acid consist of long carbon chain (carbon-18) with attached carboxyl group (-COOH) and carbon-carbon double bond (unsaturation compound) which make up fats and oils. (*foreverest, 2016*)

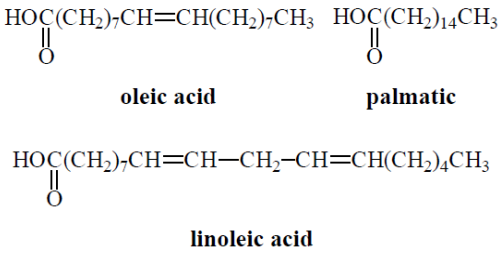

Figure (4) : Example structural formula of Tall oil Fatty Acids (TOFA)

Table (5) : Grade of TOFA with its composition (*foreverest, 2016*)

Tall Oil Fatty Acid	Abietic Acid %	Acid value mgKOH/g	Colour Gardner	Fatty Acids %	Unsaponifiables %
1st Grade	≤3	≥192	≤5	≥95	≤2
2nd Grade	≤5	≥190	≤7	≥95	≤2
3rd Grade	≤9	≥188	≤10	≥90	≤10

Application of Tall Oil Fatty Acids (TOFA)- Tall oil fatty acid was designed to meet widely range of applications due to its high acid number, lower rosin and lighter in colour. Generally, tall oil having a variety of uses in industry. The application of tall oil as foam agent in the flotation process for recover low grade Copper, Lead and Zinc bearing ores, and as a solvent agent in a variety of textile and synthetic fibre manufacturing processes. The refine of fatty acids are used in soap and detergent which act as cleansing agent. Tall oil fatty acid also act as a base to the lubricating greases, cutting oil, textile oil and very obvious use to metal polished and drying agents in paint. The fatty acids are unsaturated, if this substance on exposure to the air, it will undergo autoxidation spontaneously. TOFA also can undergo polymerization to form resin-like materials which form a tough protective coating. Figure (5) show Malaysia import of TOFA from various countries in year 2013,2014 and 2015. Malaysia greatest input of TOFA was in the year 2015 from Sweden amounting USD 4.3 Million.

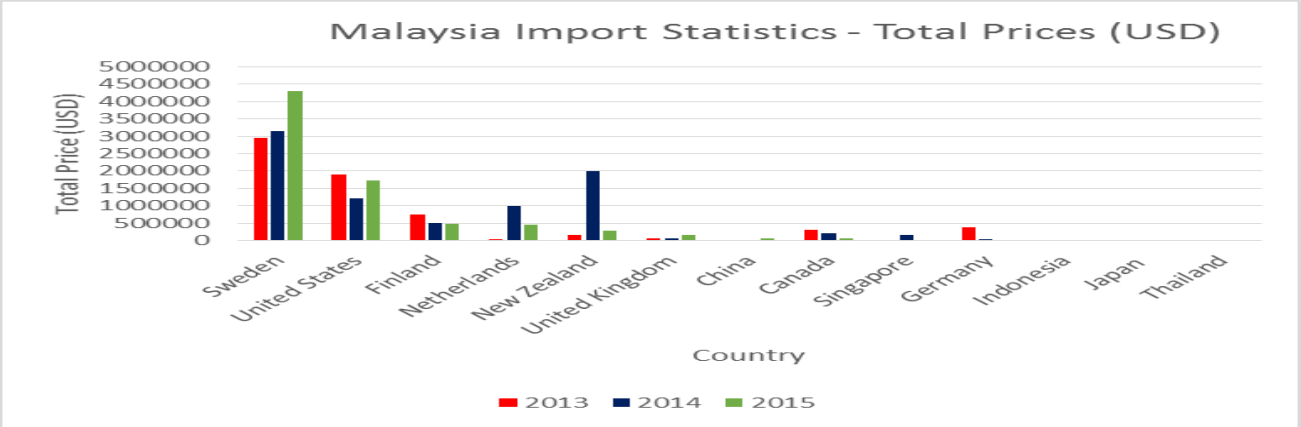

Figure (5) : Bar chart on the Import of Tall Oil Fatty Acids in Malaysia Scenario for the year 2013, 2014 and 2015 *(Department of Statistics Malaysia) (Matrade.gov.my,2017)*

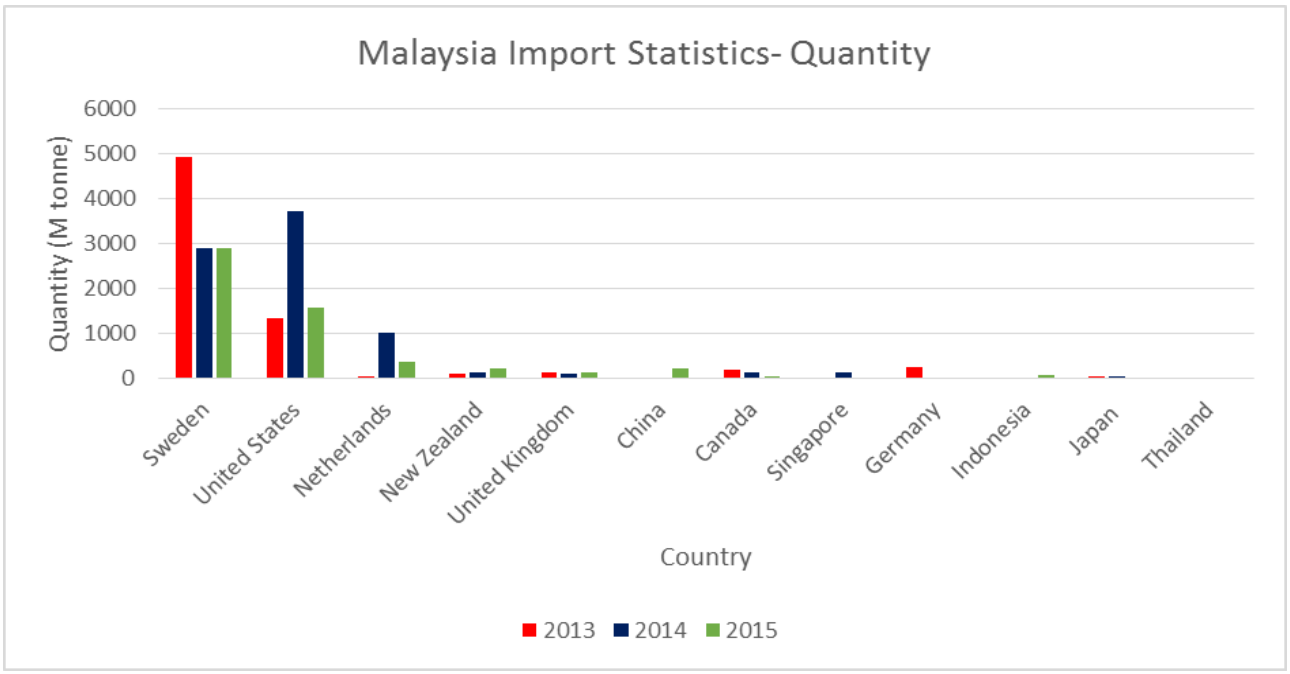

Figure (6): Bar chart on the Quantity (Metric Tonne) of Import of Tall Oil Fatty Acids in Malaysia Scenario for the year 2013, 2014 and 2015 *(Statistic Department Malaysia) (Matrade.gov.my,2017)*

From the figure (5) and figure (6) as shown, data that were obtained from the *Department of Statistics Malaysia*, obviously the Malaysia Import Statistics for the last 3 years dominated by Sweden country and follow by United States. The World Malaysia import of tall oil fatty acids achieved USD 7,638,539 with the quantity import 6022 Metric tonnes for the year 2015. There is so much value of expenditure by Malaysia to acquire the tall oil fatty acid. In fact, the tall oil fatty acid is very useful for many industry such as industry of agriculture, pharmaceutical, cosmetic, textile, and many other industry that need TOFA as the crude fatty acids for raw material for many production. Thus, to reduce the amount of Malaysia import of TOFA, Malaysia need to make an iniative for production TOFA by ourselves since cost purchase of TOFA can be classify as cost-effective due to it consistency source of liquid fatty acid. In addition, Malaysian economic growth will also increase if Malaysia already have tall oil fatty acids and ready to supply TOFA to another country. Malaysia as producer's country of tall oil fatty acids is a great idea for purpose of economic growth and make Malaysia as developed and competitive country.

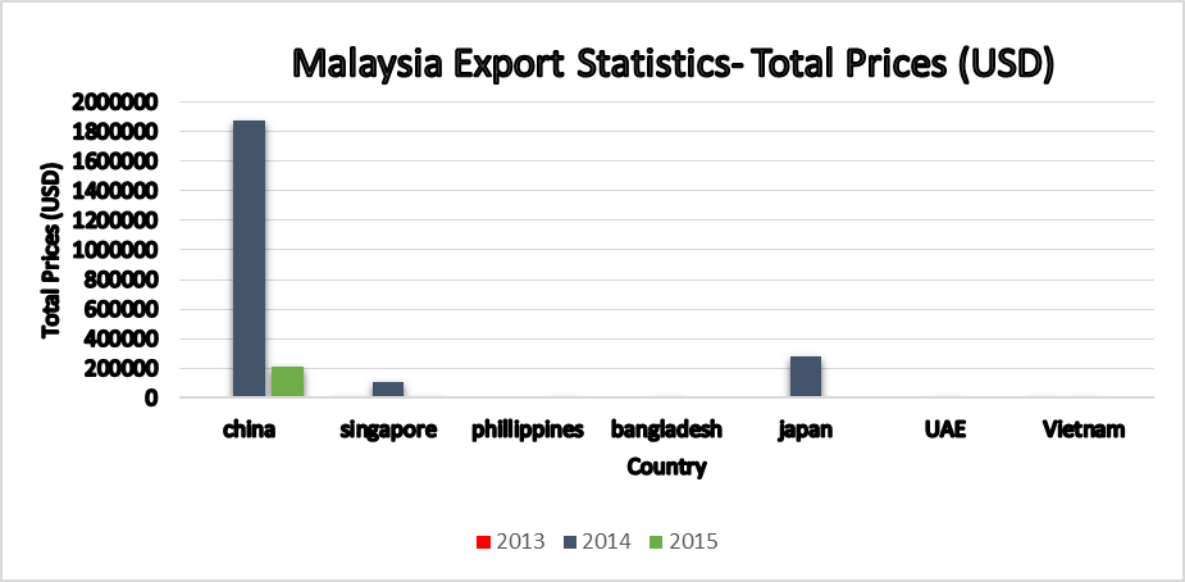

Figure (7) : Bar chart of on Export Prices (USD) of the commodity of Tall Oil Fatty Acids in Malaysia Scenario for the year 2013, 2014,2015, respectively. *(Statistic Department Malaysia) (Matrade.gov.my,2017)*

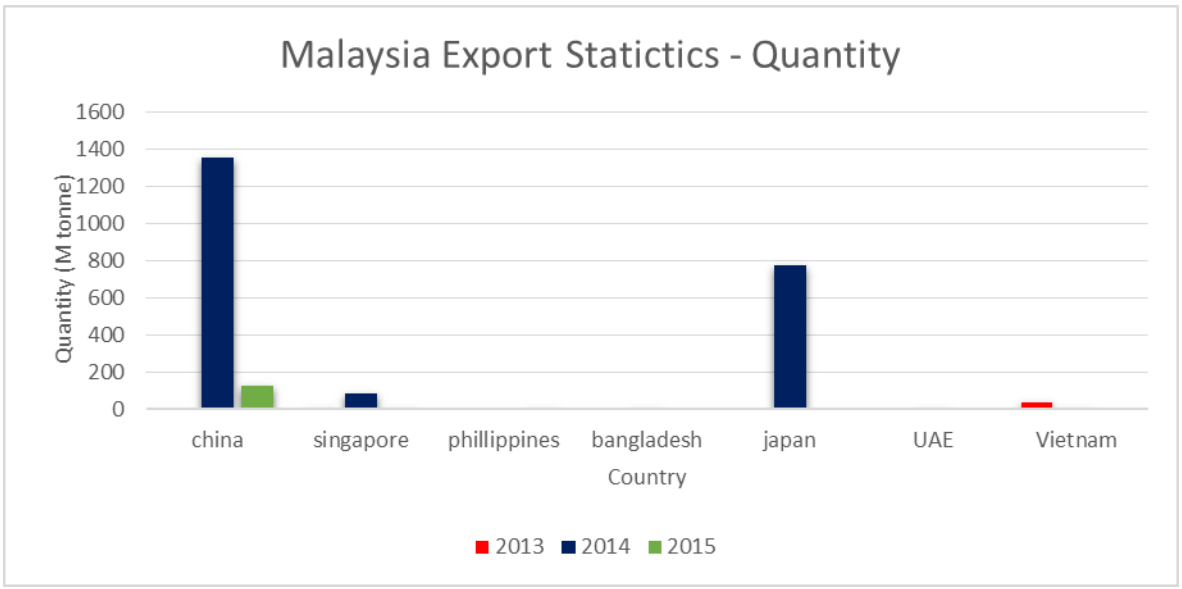

Figure (8) : Malaysia Export in Quantity (Metric Tonnes) of the commodity of Tall Oil Fatty Acids in Malaysia Scenario for the year 2013, 2014 and 2015 respectively. *(Statistic Department Malaysia) (Matrade.gov.my,2017)*

As the data shown in the Figure (7) and Figure (8) Malaysia Export of the commodity Tall Oil Fatty Acid was very slightly compared to the Malaysia Import of TOFA. As we can see, the data were obtained from the Department of Statistics Malaysia shows that the demand of Tall Oil Fatty Acids just only form Asia continents is about USD 216,956 and quantity 127 Metric tonnes in year 2015. China was predominant country that request TOFA from Malaysia with USD 209301 and quantity of TOFA is 123 Metric tonnes at year 2015. Exports play an important role for every country in this world. As the export increases, the economic growth also increases. This can influence the level of economic growth and employment in Malaysia.

C. Sources of Fatty Acids

There are a lot of sources of Fatty Acids. Only a few example of sources and production of fatty acid from different origin of source was reviewed such as:

1. Volatile Fatty Acids from synthesis of bacteria- Spent Mushroom Compost (SMC)

   The residual compost waste generated by the mushroom production industry is called as spent mushroom compost, SMC. SMC is available at nursery suppliers, and its formulation generally consists of a combination of dried blood, wheat straw and ground chalk, where composted together. It is an excellent source volatile fatty acids production because SMC rich of residual enzymes. SMC also

can be used as soil conditioner because its content consist of nitrogen which is good for soil fertility. SMC can produce VFAs by considering the total solid content, TS by undergo hydrolysis process. SMC contains many kinds of residual enzymes such as protease, cellulose, hemicellulose and laccse. However, due to its chalk content of SMC, it may be alkaline, and should not be used on acid-loving plants as it will overly raise the soil's pH levels.

Spent Mushroom compost (SMC) may also contain pesticide residues whereby gardener of mushroom using pesticide to kill damaging agents towards perfect mushroom growth. If the compost pile was stored outside, it may contain grubs or other insects attracted to decaying matter of SMC. Usually, Mushroom gardener use chemicals to treat the straw, and also to sterilize the compost. Hence, the organic gardener must be cautious regarding the producing of spent mushroom compost. If in hesitation, samples of SMC should be analysed first to examine the content of contamination in spent mushroom compost. The organic gardener or mushroom gardener should be able to advice to the consumer of SMC regarding this issue. Commercially available 'spent' mushroom compost is not always truly spent. SMC is sold by mushroom farms when it is no longer producing commercially feasible yields of mushrooms. Thus, new invention have been decided on SMC waste by managing it towards useful waste. The present commercial VFAs are mostly produced by chemical processes. These processes consume large amounts of fossil carbon resources as raw materials and can cause environmental problem. Therefore, new idea was developed to focus on developing biological routes for VFA production from potential organic residue materials such as Spent Mushroom Compost (*Fang et al., 2016*)

Figure (9) : Spent Mushroom Compost (*"spent mushroom compost", 2016*)

2. Fatty acid in Lard- Pig Deravatives

Lard, one of the pig derivatives, it was obtained from the rendering of adipose tissue of hog. Pig is rich with fats with mainly composed from Triacylglycerols (TAG), diacylglycerols (DAG), free fatty acids and other minor components like phospholipids, sterols, tocopherols, carotenoids and fat soluble vitamins. The composition of TAGs with differentiation of lard with other animal fat that has been investigated using high performance liquid chromatography (HPLC) with refractive index detector. The validity of used samples of Fatty Acid from lard was determined based on FAs profiles.

Fatty Acid Composition of Fats and Oils

	Percent of Total Fatty Acids		
Kind of Fat or Oil	Saturated	Monounsaturated	Polyunsaturated
Safflower oil	9	13	78
Sunflower oil	11	20	69
Corn oil	13	25	62
Olive oil	14	77	9
Soybean oil	15	24	61
Peanut oil	18	48	34
Sockeye salmon oil	20	55	25
Cottonseed oil	27	19	54
Lard	41	47	12
Palm oil	51	39	10
Beef tallow	52	44	4
Butterfat	66	30	4
Palm kernel oil	86	12	2
Coconut oil	92	6	2

The main saturated fatty acids in edible oils are (from shortest to longest chains) are capric, lauric, myristic, palmitic, and stearic acids. The main monounsaturated is oleic acid. The main polyunsaturated are linoleic and alpha-linolenic, with the difference between those two 18-carbon fatty acids simply where the first double bond occurs, which is at the number 6 carbon in linoleic (omega-6 fat) and at the number 3 carbon in alpha-linolenic (omega-3 fat). And of course there are all important highly unsaturated marine oils, EPA and DHA, which are 20 carbon chains in the omega-3 family as well. With compare lard to olive oil. Olive oil contains 77% oleic acid, that heart healthy, monounsaturated fat that we are supposed to fed more. Lard contains 47% oleic acid, which is more than palm oil (39%) and double the amount in corn oil (25%), *more* than double the amount in cottonseed oil (19%) and sunflower oil (20%), and nearly triple that in grape seed oil (15%) and safflower oil (13%). The oleic acid content of lard also exceeds that in beef tallow (44%), butter fat (30%). Lard's content have a fair amount (41%) of the 18-carbon saturated fat, stearic acid, which has been shown in clinical testing to contain lower cholesterol composition. However, from religion point of view, lard is prohibit as edible oils because of lard is a pig derivative and lard is classified as non-halal foods.

3. Fatty Acids from Coconut Oil

Coconut oil is one of the most vital raw materials for the oleochemical industry. The whole range of its fatty acid composition is used as the starting material for a wide variety of olechemical products, Fatty acids are the building blocks that, with proper selection and application of oleochemistry, are converted to higher valued products. Cocunut oil considered a saturated oil. From table (6) , it can be seen that coconut oil approximately 92% saturated fatty acid, from caproic to stearic and only around 8% unsaturated fatty acid, composed of oleic acid and linoleic acid. (C.Gervajio, 2005)

Types of Fatty Acids from Coconut Oil

1. *Lauric Acid*. A pure-cut Carbon-12 fatty acid with a purity of 99% minimum with traces of Carbon-10 and Carbon-14 fatty acid fractions.
2. *Whole distilled coconut fatty acid*. A refined product whose fatty acid compostion is identical to that of the original oil.
3. *Myristic acid*. A pure-cut Carbon-14 fatty acid with a purity of 98% minimum and traces of Carbon-12 and Carbon-16 fatty acid fractions.
4. *Topped coconut fatty acid*. The C12-C18 fraction after topping off the C8-C10 fraction.
5. *Lauric, myristic acid*. The medium-chain fatty acid fraction comprising approximately 72% C-12 and 26% C-14 fatty acid fractions with traces of C-10 and C-16 fatty acid fractions.
6. *Caprylic, capric acid*. The low molecular weight fraction consist around 55% C-8 and 40% C-10 fatty acid fractions with small amounts of C-6 and C-12 fractions.

Table (6): Fatty Acid Compositions (C.Gervajio, 2005)

Fatty Acid Composition of Coconut and Palm Kernel Oils

Fatty Acid	Formula	Coconut Oil (%)	Palm Kernel Oil (%)
Caproic	$C_6H_{12}O_2$	0.2–0.8	0–1
Caprylic	$C_8H_{16}O_2$	6–9	3–5
Capric	$C_{10}H_{20}O_2$	6–10	3–5
Lauric	$C_{12}H_{24}O_2$	46–50	44–51
Myristic	$C_{14}H_{28}O_2$	17–19	15–17
Palmitic	$C_{16}H_{32}O_2$	8–10	7–10
Stearic	$C_{18}H_{36}O_2$	2–3	2–3
Oleic	$C_{18}H_{34}O_2$	5–7	12–19
Linoleic	$C_{18}H_{32}O_2$	1–2.5	1–2

III. RESULTS AND DISCUSSION

A. Synthesis of Bacteria- Spent Mushroom Compost

For the synthesis using bacteria, Spent Mushroom Compost (SMC) (Fang et al., 2016) have been introduce, basically focused on the issue of the volatile fatty acids. The effect of the total solid (TS) content was studied. Total solid content was be examined from spent mushroom compost as the compounds protein, ammonium (NH_4^+) and phosphate (PO_4^{3-}) release, VFAs were begin to analysed. When the experiment was carried out, the optimal fermentation time was 4 day for VFAs production. The longer time of fermentation will led to VFAs consumption and will also produce methane. The optimal TS content for production of VFAs was in range from 6% to 18% and 15% be the ideal value. The highest concentration of volatile Fatty Acids would reached 2781 mg/L that can be produce from volatile fatty acids. Likewise, the maximum concentration of soluble protein and polysaccharide can achieved approximately 1648 mg/L and 1394 mg/L respectively. The NH_4^+ and PO_4^{3-} release was in a range of 2.11-7.59 mg/gVS and 0.26-1.13 mg/gVS respectively. If NH_4^+ -N and PO_4^{3-} can be erased, the application of VFAs usage significantly enhanced. (Fang et al., 2016).

Figure 10 show the flow for the soluble small molecule compounds generated during hydrolysis were converted to VFAs. The total VFAs production at several total solid, TS contents is shown in Figure 4.2. It can be seen that the VFAs concentration initially increased and then maintained relatively stable, even slightly decreased. The maximum concentration of VFAs was 2781 mg/L with a TS content of 15%, which was 76.12% higher than that with a TS content of 6%. More organic matters were hydrolysed and further transformed to VFAs with a higher TS content. However, when the TS content further increased to 18%, the VFAs production slightly decreased, compared with the TS content of 15%. Too high TS content might limit the mass transfer between fermentation substrates and microorganisms and hinder the acidification rate (Yi et al., 2017). In this review of experiment for production of VFAs, the maximum VFAs concentration reached at the 4th day of fermentation, which extended two days compared with the time for the maximum soluble protein and polysaccharide production because of the further degradation of these organics. The suitable fermentation time was shorter than that for VFAs production from other lignocellulose wastes (Yi et al., 2014).

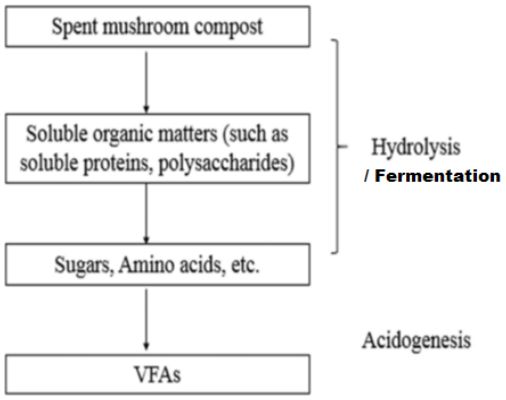

Figure (10) : Pathway of volatile Fatty Acid (VFA) formation from spent mushroom compost. (Fang et al., 2016).

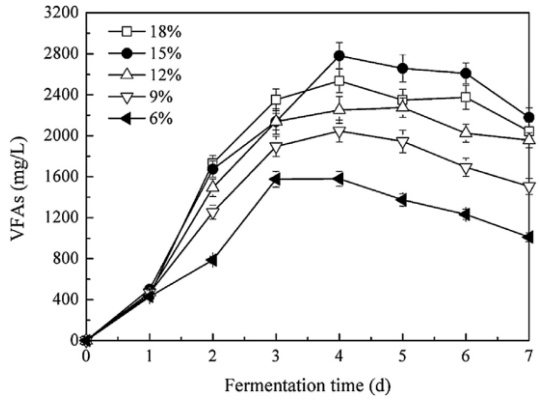

Figure (11) : Effect of TS content of VFAs production. (Fang et al., 2016).

B. Fatty acids in Lard – Pig derivatives

The sources of Fatty Acids from animal origin could be obtain goat, cow, whales, lard, chicken and many more species that potential to produce fatty acids. By focusing one species of animal which is famous producer of Fatty Acid, Lard. Lard is one of the pig derivatives is highly composed from triacylglycerols (TGA), free fatty acids and minor components like sterols, phospholipids, tocopherols, carotenoids, and fat soluble vitamins (Gunston,2004). Lard is cheapest edible fats and oils. Thus, lard is widely used in food industry by added in intentionally into the food products to reduce cost and give highly fat contents. (Rohman.A, 2012).

Fatty acids is one of the lipid classes, are the most vital components of edible fats and oils in which they are typically found in the ester form with glycerol backbone (triglycerides) TAG. Due to the nutritional value, quantitative analysis of FAs composition is a important work in food research area, especially in lipid studies (Carrasco-Pancorbo, Navas-Iglesias and Cuadros-Rodríguez, 2009). In addition, FAs composition can vary from one source to another or even from one organ to others. Therefore, FAs profiles can be used for determining the purity or authenticity of animal fats (Hauff and Vetter, 2010). The determination of level of FAs in the studied samples (lard and others animal) was initially conducted. The fatty acid composition of lard and other animal fats (beef, chicken, and mutton) as well as cod liver oil (CLO) as determined using gas chromatography with flame ionization detector. These results were in agreement with those obtained by several authors (Indrasti et al., 2010). Lard was differentiated by higher level of unsaturated fatty acids. The main fatty acids composed of lard are palmitic, stearic, oleic and linoleic acids.

TAG composition was determined with HPLC using refractive index detector. Figure (11) showed the chromatogram of lard describing the TAG composition along with its retention time.

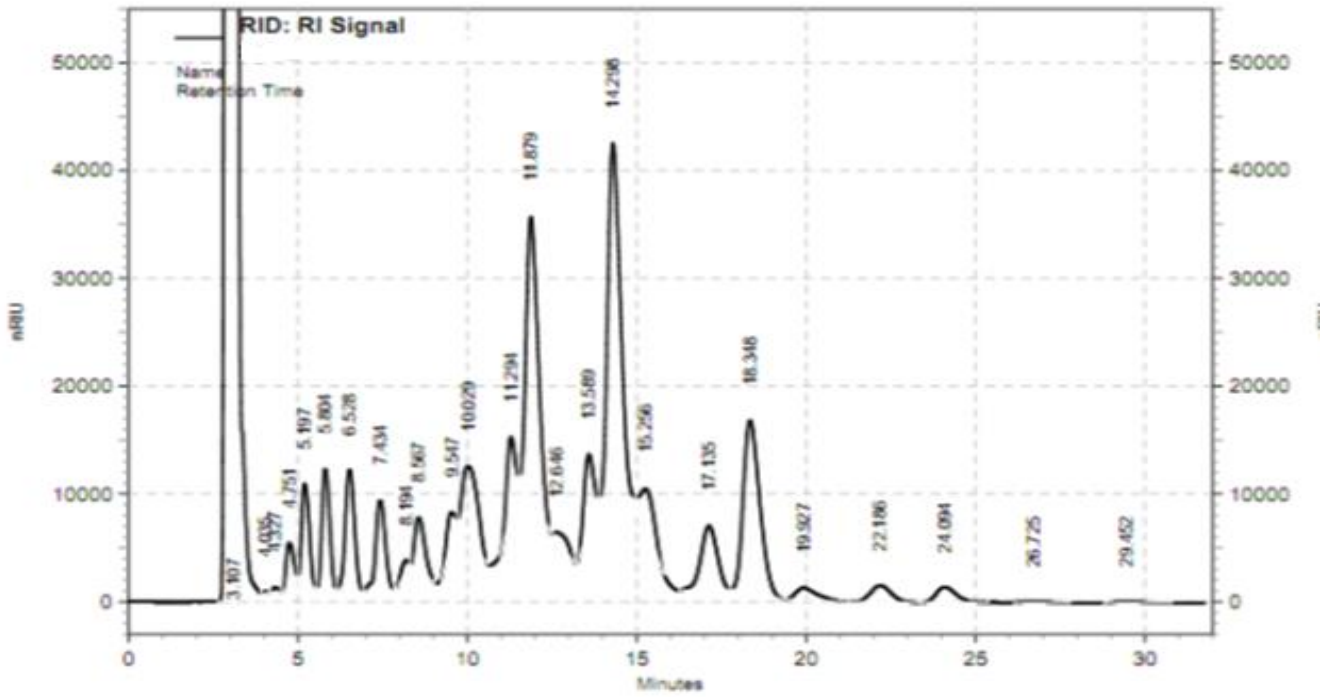

Figure (11) : The chromatogram of TAG as determined using HPLC with refractive detector. The retention time corresponding to TAG composition for lard (Rohman.A, 2012)

C. Fatty Acids form Coconut Oils

Fatty acids can also be produce from fruit bunch coconut in order to produce many type of fatty acids. Coconut Oils is considered vegetable oil, have as much or more saturated fatty acid content than lard, beef and butterfat. Indeed, all components are not liquids at room temperature like the other vegetable oils, but solids.The coconut oil is widely use in food industry and coconut oil considered as potential fatty acids produces as it can increase fats

Coconut oil comes from the meat of matured coconuts harvested from the coconut palm. Coconut oil is widely used in food and medicine industry. It is high in saturated fat content, and because of it, it has a long self-life. Even though coconut oil has a high saturated fat content, it is good for weight loss. The properties of coconut oil that make it so special. For the proper utilization of anything uses of coconut oil, it is necessary to have information regarding that substance of coconut oil such as its physical characteristics.

The main component of crude oil which are important and affect the characteristics of oil, are as follows (Appaiah et al., 2014):

- Triacylglycerols
- Fatty Acids
- Phospholipids
- Tocopherols
- Trace metals
- Sterols
- Volatiles
- Mono- and di-acylglycerols

Table (6) : Fatty acids product specification from coconut oil (C.Gervajio, 2005)

Fatty Acid Product Specifications

Fatty Acid Products	Product Code	Iodine Value	Acid Value	Saponification Value	Titer (°C)	Unsaponifiable Matter (% maximum)	Color Lovibond 5.25 inches Y (maximum)	Color Lovibond 5.25 inches R (maximum)	Approximate Carbon Chain Distribution C6	C8	C10	C12	C14	C16	C18	C18:1	C18:2
Whole distilled coconut fatty acid (C8–C18)	Philacid 0818	6–10	268–274	269–275	21–25	0.5	15	1.5	0.5	7.5	6.5	48	18	9	2	7	2
Caprylic–capric acid (C8–C10)	Philacid 0810	0.8 maximum	355–365	356–366	1–5	0.5	—	—	4	55	39	3	—	—	—	—	—
Topped coconut fatty acid (C12–C18)	Philacid 1218	8–12	254–260	254–260	25–29	0.5	15	1.5	—	—	1.0	55	22	10	2.5	8	2
Lauric acid (C12)	Philacid 1200	0.3 maximum	279–281	279–281	42–43	0.5	8	0.8	—	—	0–1	99 min.	0–1	—	—	—	—
Myristic acid (C14)	Philacid 1400	0.3 maximum	245–247	245–247	53–54	0.5	8	0.8	—	—	—	0–2	98 min.	0–2	—	—	—
Lauric–myristic acid (C12–C14)	Philacid 1214	0.5 maximum	268–273	268–273	33–35	0.5	10	1.0	—	—	1	72	26	1	—	—	—

Table (7): Fatty acid profile of coconut oil (CarbSane, 2017)

Fatty acid profile of coconut oil			
Fatty acid	Saturation	Carbons	Percent
Caproic	Saturated	6	0.5
Caprylic	Saturated	8	7.8
Capric	Saturated	10	6.7
Lauric	Saturated	12	47.5
Myristic	Saturated	14	18.1
Palmitic	Saturated	16	8.8
Stearic	Saturated	18	2.6
Arachidic	Saturated	20	0.1
Oleic	Monounsaturated	18	6.2
Linoleic	Polyunsaturated	18	1.6

IV. Conclusion

- There are variety of possible sources for production of Fatty Acids such as from synthesis of bacteria : Spent Mushroom Compost , Fatty acids from lard derivatives and Coconut oil. There is a lot of sources but this review just focused only three (3) source from different origin and also review the special fatty acids of linolenic and linoleic fatty acids towards human body which is it is can be classify as the essential fatty acid. Thus, the objective could be achieved.

- The output production of fatty acids based on commodity of tall oil fatty acid was dominant to Sweden as the highest import and China which is highest in export of commodity tall oil fatty acids.

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