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Original Research Article

Changes of Fatty Acid Composition Effected by Blending of Vegetable Oils

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Abstract

This study investigated the blending of palm oil with palm kernel oil, soya bean oil and groundnut oil. Palm oil was blended with palm kernel oil, soyabean oil and groundnut oil in three different proportions i.e., PO:PKO (70:30, 90:10 and 50:50); PO:SO (70:30, 90:10 and 50:50) and PO:GO (70:30, 90:10 and 50:50). Fatty acid composition of individual oils and their blends were determined. The palmitic acid was the major fatty acid (40.05%) in palm oil followed by oleic and linoleic acid. Palm kernel oil contained the highest fatty acid to be a saturated fatty acid like palm oil but this time, lauric acid (40.25%) followed by myristic acid and cis-vaccenic acid (an isomer of oleic acid). Soyabean oil contained 67.38% polyunsaturated fats, 22.68% monounsaturated and 9.94% saturated fats. On the other hand, oleic acid in groundnut oil was the prominent fatty acid which was 60.71% of the total fatty acid followed by linoleic acid (11.17%) and palmitic acid (10.14%).On the basis of fatty acid composition of the blends, PO:GO (70:30), had the ideal ratio which gives saturated, monounsaturated and polyunsaturated fatty acid ratio of 1:2:1. Therefore blending of vegetable oil has an effect on the fatty acid composition.

Keywords: Blending, Fatty Acid Composition, Vegetable oil

INTRODUCTION

Oils obtained from plant source are termed vegetable oils. These include: palm oil, cotton seed oil, ground oil, sunflower oil etc. (Grosso and Guzman, 1995).

Edible oils from plant sources are of interest in various food applications and industries. Vegetable oils are used principally for food (mostly as shortening, margarines, and salad and cooking oils) and in the manufacture of soap and detergents, in paints and varnishes, and for a variety of other industrial items (Grosso and Guzman, 1995).

Oil may be classified as hard or soft oil depending on saturated or unsaturated fatty acids ratio (Grosso and Guzman, 1995). If a triglyceride has two or three unsaturated fatty acids, it tends to be liquid at any temperature above 0^0C. The term 'soft oil' is used to define the liquid oils containing a very high percentage of unsaturated fatty acids such as soyabean oil (86%) (Grosso et al, 1999).Increasing the saturated fatty acid content of soft oils reduces the degree of chemical oxidation as unsaturated fatty acids of the soft oils can easily oxidize and become unstable. Palm oil and palm kernel oil are regarded as hard oils. They are generally composed of triglycerides containing two or three saturated fatty acids and may be solid or semi-solid at ambient temperatures.

The world has come to realize that high amount of saturated fats in foods are one of the main causes of coronary heart diseases such as atherosclerosis. According to Ramsden et al. (2009), the intake of unsaturated and polyunsaturated fats can help in reducing the risk of coronary heart diseases. For these reasons, blending of oils has come to stay. The blending

of oils is gaining importance in food applications and should be regarded as the best modification technique. This is because it is cheap and non-destructive. Blending of oils modifies fatty acid composition without any chemical or biological process.

Lands (1992) and Okuyama (2007) also found that the ratio of omega-3 and omega-6 fatty acids ingested by humans is significant in maintaining cardiovascular health. Altering this ratio also can change bodies' metabolic and inflammatory rate (Tribole, 2006). Grundy, (1994) stated that an ideal oil blend should have saturated, monounsaturated and polyunsaturated fatty acids in the ratio 1:2:1. Therefore the objective of this study is to determine the best blend among palm oil, palm kernel oil, soya bean oil and groundnut oil, blended at different proportions.

MATERIALS AND METHODS

Sample Collection and Preparation

Palm oil (PO), groundnut oil (GO), soya bean oil (SO) and palm kernel oil (PKO) were purchased from some local super markets in Benin City, Edo State. The samples were kept in the refrigerator overnight below 4^0C for storage. They were taken out of the refrigerator well in advance prior to study, to attain thermal equilibrium with the ambient temperature of the lab. All chemicals and reagents used were of analytical grade. A 100ml mixture of palm oil and other vegetable oil were placed in triplicates in 250ml beakers for each blend and were mixed by using a mechanical stirrers at 180rpm for 15min. Blends of palm oil viz PO + GO, PO +SO and PO + PKO were prepared in three ratios i.e 90:10, 70:30 and 50:50.

Determination of fatty acid content

Extraction

Twenty grams (20g) of the homogenized sample was mixed with 60g of anhydrous sodium sulphate in agate mortar to absorb moisture. The homogenate was placed in a 500ml beaker. Extraction with 300ml of n-hexane was carried out in 24hours. The crude extract obtained was evaporated using a rotary vacuum evaporator of 40^0C to dryness. The residue was transferred with the n-hexane into a 5ml florisil column for clean up

Florisil Clean Up

Florisil is then heated in an oven at 130^0C over night (Ca – 15h) and transferred to a 250ml size beaker and placed in a desiccator. A 0.5g anhydrous $NaSO_4$ was added to 1.0g of activated flosiril (magnesium silicate) (60-100nm mesh) on an 8ml column plugged with glass wool. The packed column was filled with 5ml n-hexane for conditioning. Open stopcock to allow n-hexane until it just reaches top of sodium sulphate with a receiving vessel while tapping gently the top of the column till the flosiril settled well in the column. The extract was transferred to the column with the aid of a disposable pasteur pipette from an evaporating flask, the evaporating flask was rinse twice with 1ml portions of n-hexane and added to column. The eluate collected in an evaporating flask was rotary evaporated to dryness. The dry eluate was then dissolved in 1ml n-hexane for thin layer chromatographic analysis.

Fixed Setting for Optimum Operation

Generally the operator must adjust gas flows to the columns, the inlets, the detectors, and the split ratio. In addition, the injector and detector temperature must be set. The detectors are generally held at the high end of the oven temperature range to minimize the risk of analyte precipitation. All of these parameters should have been set to the correct values, but double check all the instrument: Buck 53D gas chromatograph equipped with an m-column, automatic injector, mass spectroscopy, (100m x 0.25mm film thickness) CA, USA. The detector temperature is set at 250^0C, the injector temperature is set at 22^0C, the integrator chart speed is set at 2cm/min and the oven temperature is set at 180^0C. The GC is allowed to warm up. While warming, the temperature condition is set as shown in table 1 below:

When the instrument is ready, the "NOT READY" light will turn off, and you can begin your run. Inject a 1 microliter sample into column a using proper injection technique.

RESULTS AND DISCUSSION

Fatty Acid Composition of Individual Oils

The fatty acid composition of palm oil, palm kernel oil, soyabean oil and groundnut oil has been presented in tables, 2, 3, 4 and 5 respectively. The dominated fatty acid for palm oil was the saturated fatty acid, palmitic acid with percentage 40.05%. The dominated fatty acid for palm kernel oil was the saturated fatty acid, lauric acid with percentage 40.25%. The dominated fatty acid for soyabean oil was the polyunsaturated fatty acid, linoleic acid with percentage 59.41%. The dominated fatty acid for groundnut oil was the monounsaturated fatty acid, oleic acid with percentage 60.71%. Soyabean oil contained more polyunsaturated fatty acids whereas groundnut oil contained more monounsaturated fatty acid and palm oil was slightly richer in saturated fatty acids.

Table 1. Warm up temperature condition

Initial Temp	Hold	Ramp	Final temperature
70^0C	5min	10min	220^0C
220^0C	2min	5min	280^0C

Table 2. Major fatty acid components of palm oil

Component	Retention Time (Minutes)	Concentration (%)	Common Name
C12:0	5.226	1.67%	Lauric Acid
C14:0	10.073	1.82%	Myristic Acid
C16:0	15.216	40.05%	Palmitic Acid
C18:2	20.153	12.51%	Linoleic Acid
C18:3	25.733	2.90%	Linolenic Acid
C18:1	30.126	34.65%	Oleic Acid
C20:0	35.093	0.52%	Arachidic Acid
C18:1	40.296	5.88%	Cis-vaccenic Acid

Table 3. Major fatty acid components of palm kernel oil

Component	Retention Time (Minutes)	Concentration (%)	Common Name
C12:0	5.226	40.25%	Lauric Acid
C14:0	10.073	18.07%	Myristic Acid
C16:0	15.216	7.29%	Palmitic Acid
C18:3	20.153	9.61%	α -Linolenic Acid
C18:3	25.733	5.27%	γ-linolenic Acid
C18:1	30.126	7.91%	Oleic Acid
C20:0	35.093	0.95%	Arachidic Acid
C18:1	40.293	10.65%	Cis-vaccenic Acid

Table 4. Major fatty acid components of soyabean oil

Component	Retention Time (Minutes)	Concentration (%)	Common Name
C12:0	5.226	0.91%	Lauric Acid
C16:0	10.073	8.52%	Palmitic Acid
C18:2	15.216	59.41%	Linoleic Acid
C18:3	20.153	5.15%	α -Linolenic Acid
C18:3	25.733	2.82%	γ-linolenic Acid
C18:1	30.126	16.97%	Oleic Acid
C20:0	35.093	0.51%	Arachidic Acid

Table 5. Major fatty acid component of groundnut oil

Component	Retention Time (Minutes)	Concentration (%)	Common Name
C12:0	5.226	1.08%	Lauric Acid
C16:0	10.076	10.14%	Palmitic Acid
C18:2	15.220	11.17%	Linoleic Acid
C18:3	20.153	6.13%	α -Linolenic Acid
C18:3	25.733	3.36%	γ-Linolenic Acid
C18:1	30.126	60.71%	Oleic Acid
C20:0	35.093	0.60%	Arachidic Acid

Table 6. Major fatty acid components of blend of palm oil and palm kernel oil with ratio 90:10

Component	Retention time (minutes)	Concentration (%)	Name
C12:0	5.433	16.69	Lauric Acid
C14:0	9.683	17.60	Myristic Acid
C16:0	12.846	25.92	Palmitic Acid
C18:2	15.366	10.95	Linoleic Acid
C18:1	42.743	6.91	Oleic Acid

Table 7. Major fatty acid component of blend of palm oil and palm kernel oil in the ratio 70:30

Component	Retention time (minutes)	Concentration (%)	Name
C12:0	5.433	9.96	Lauric Acid
C14:0	9.683	9.59	Myristic Acid
C16:0	12.846	29.52	Palmitic Acid
C18:2	15.590	10.24	Linoleic Acid
C18:1	42.743	17.53	Oleic Acid

Table 8. Major fatty acid components of blend of palm oil and palm kernel oil to the ratio 50:50

Component	Retention time (minutes)	Concentration (%)	Name
C12:0	5.373	22.55	Lauric Acid
C14:0	9.490	27.21	Myristic Acid
C18:2	14.436	10.12	Linoleic Acid
C16:0	35.206	12.47	Palmitic Acid
C18:1	42.100	4.65	Oleic Acid

Table 9. Major fatty acid components of blends of palm oil and soyabean oil in the ratio 90:10

Component	Retention time (minutes)	Concentration (%)	Name
C12:0	5.336	2.43	Lauric Acid
C14:0	9.296	5.98	Myristic Acid
C16:0	14.523	20.33	Palmitic Acid
C18:2	17.970	4.35	Linoleic Acid
C18:3	24.766	38.72	Linolenic Acid
C18:1	39.746	17.36	Oleic Acid

Table 10. Major fatty acid components of blends of palm oil and soyabean oil in the ratio 70:30

Component	Retention time (minutes)	Concentration (%)	Name
C12:0	5.333	3.67	Lauric Acid
C14:0	9.296	8.84	Myristic Acid
C16:0	14.523	27.81	Palmitic Acid
C18:2	17.970	8.42	Linoleic Acid
C18:3	24.766	13.82	linolenic Acid
C18:1	39.746	22.00	Oleic Acid

Table 11. Major fatty acid components of blends of palm oil and soyabean oil in the ratio of 50:50

Component	Retention time (minutes)	Concentration (%)	Name
C12:0	5.433	15.44	Lauric Acid
C14:0	9.683	16.28	Myristic Acid
C16:0	12.846	23.97	Palmitic Acid
C18:2	15.523	18.83	Linoleic Acid
C18:1	42.743	6.40	Oleic Acid

Table 12. Major fatty acid components of blends of palm oil and groundnut oil in the ratio 90:10

Component	Retention time (minutes)	Concentration (%)	Name
C12:0	5.340	4.50	Lauric Acid
C14:0	9.296	11.04	Myristic Acid
C16:0	14.523	31.66	Palmitic Acid
C17:0	30.476	1.77	Margaric Acid
C18:1	39.746	31.88	Oleic Acid

Table 13. Major fatty acid components of blends of palm oil and groundnut oil in the ratio 70:30

Component	Retention time (minutes)	Concentration (%)	Name
C12:0	5.226	2.66	Lauric Acid
C16:0	10.076	25.26	Palmitic Acid
C18:2	15.220	4.89	Linoleic Acid
C18:3	20.153	15.24	$\propto$ - linolenic Acid
C18:3	25.733	8.36	γ - linolenic Acid
C18:1	30.126	25.18	Oleic Acid
C20:0	35.093	1.50	Arachidic Acid
C18:1	40.296	16.90	Cis-vaccenic Acid

Table 14. Major fatty acid components of blends of palm oil and groundnut oil in the ratio 50:50

Component	Retention time (minutes)	Concentration (%)	Name
C12:0	5.433	2.30	Lauric Acid
C14:0	9.680	3.65	Myristic Acid
C16:0	12.846	27.67	Palmitic Acid
C18:2	15.596	13.30	Linoleic Acid
C18:1	42.743	30.81	Oleic Acid

Parvathi (2013) and Geervani (1993) reported that groundnut oil contain 51.86% of oleic acid.

The rich saturated fatty acid of palm oil means that they have a higher solid fat content; a property that is required in some food applications. For example, consistency of fat spreads formation of layers in pastry. Groundnut oil rich in monounsaturated fatty acids are more suitable for frying since they are more heat resistant. Polyunsaturated fatty acids mainly linoleic acid which is dominant in soyabean oil is an omega – 6 – fatty acid. Omega-6 fatty acid is an essential nutrient because the human body is unable to synthesize it and the body needs it every day. It can only be obtained through a balanced diet. The amount of omega-6- fatty acids in the diet is important as it impact the body's function, such as blood pressure, blood clothing, blood lipid levels, immune response and the inflammation response to injury infection (FAO, 2010). A proper amount of omega-6- fatty acid helps maintain and improve health.

Fatty Acid Composition of Oil Blends

The essence of the oil blends was to get an ideal ratio

which gives saturated, monounsaturated and polyunsaturated fatty acid ratio of 1:2:1 as stated by Grundy (1994). Grundy (1994) reported that an ideal saturated, monounsaturated and polyunsaturated fatty acid ratio was 1:2:1. Of all the oil blends ratios, only palm oil blended with groundnut oil in 70:30 proportions had SFA: MUFA: PUFA ratio to be 1:2:1. For this we can say that palm oil blended with groundnut oil in 70:30 proportion was the best blend for all the blends in the study. Table 2-14

CONCLUSION

The result of this present study revealed that palmitic acid is the major fatty acid in palm oil followed by monounsaturates and polyunsaturates. Lauric acid is the major fatty acid in palm kernel oil followed by monounsaturates and polyunsaturates. Oleic acid is the major fatty acid in groundnut oil followed by polyunsaturates and saturates. Linoleic acid is the major fatty acid in soyabean oil followed by monounsaturates and saturates. Palm oil can be blended with other vegetable oil vizsoyabean oil, groundnut oil and palm kernel oil in different proportions to attain ideal ratio of saturated, monounsaturated and polyunsaturated fatty acid (1:2:1). Among all these blends, PO:GO (70:30) oil blend has ideal fatty acid ratio.

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