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Comparison of the Proximate Composition of Avocado Pear Food Spread and Fatty Acid Profile of its Oil Extract with Margarine

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Abstract— Avocado food spread was formulated using avocado pear fruit (*Persea americana*) (Zutano variety). Proximate analysis was carried out on the food spread using standard AOAC methods. Oil from the avocado food spread was extracted using soxhlet extraction method and characterized using gas chromatograph mass-spectrometry (GC-MS). Its fatty acid profile was compared with blue band margarine as control. The margarine had high concentration of Hexadecanoic acid methyl ester (palmitic acid) concentration of 50% which is a saturated fatty acid. It was rich in 9-Octadecenoic acid, methyl ester (32%) and 9, 12- Octadecenoic acid, methyl ester (5.69%) respectively. The avocado spread oil contained predominately 9-octadecenoic acid (z)-, methyl ester (oleic acid) a monounsaturated omega-9 fatty acids at the concentration of 45.69% and also 11 Octadecenoic acid, methyl ester (24.03%); Eicosanoic acid, methyl ester (13.17%), and 9,12-Octadecadienoic acid methyl ester (5.57%) respectively. Oil from Avocado pear has a healthy fat composition and should be commercially packaged for use as a food spread.

Keywords— Avocado, food-spread, margarine, oil extract, fatty acid profile.

1. Introduction

A food spread is an oily material usually produced from plant and animal fat made largely from vegetable oils that has been hydrogenated or modified for proper spreading texture [11]. Spreads are added to food in order to enhance the flavor, texture and nutritional properties of the food. Salads, sandwiches and many other home recipes will be bland and unattractive without food spreads. Common spreads include dairy spreads such as cheeses, creams, and butters; plant derived spreads such as jams, jellies and hummus. Food spreads are mostly used with baked foods and other moistened baked foods like bread; biscuits that are consumed instantly.

Avocado pear is a highly nutritious fruit containing 5-36% lipids [4]. It contains only small amounts of sugars (sucrose, glucose and fructose). The amain sugar found in avocado is D-mannoheptulose and the reduced form-perseitol which behaves more like a phytochemical (Meyer and Terry, 2008). The oil is rich in linoleic acid (Lu et al. 2009) and has many health benefits. The skin may be used to eliminate intestinal parasites and as a remedy for dysentery [12]. The pulp is incorporated into diets to reduce the cholesterol level of the blood [12]. It contains antioxidants, lutein, Beta- Sitosterol, oleic acids and folate [7, 10]. The avocado spread oil is rich is relatively unsaturated fatty acids so that partial substitute of avocado for unsaturated fat may have a favorable effect in reducing cholesterol level of the blood. It has good nutritional quality. It is largely known that margarine is water in-oil emulsion. Margarine consists of a continuous oil phase and with a finely dispersed discontinuous aqueous phase. Butter is perhaps the traditional spread developed since the inception

of ancient food technology. It is obtained by churning the cream that has been separated from warm cow's milk to a product consisting of unaltered fat globules and moisture droplets embedded in a continuous phase butter fat. Butter contains butterfat, water and curd. Curd is made up of casein, lactose and mineral matter [8].

2. Materials & Methods

2.1. Materials

The avocado pear was bought from Itam Market in Uyo, Akwa Ibom State of Nigeria. The avocado fruit was allowed to ripe within three (3) days, Zutano variety of avocado pear was used for the analysis.

2.2. Methodology

2.2.1. Proximate composition

2.2.1.1. Ash Content

Ash content was determined by transferring two (2) g of each sample into the crucible, which was placed in a furnace, set at a temperature of 500^{o}C. The sample was incinerated for 5 hours and transferred to a desiccator for cooling. Each sample was replicated three times and the values were recorded.

% Ash was calculated as follows:

$\frac{W_2-W_1}{W_1} \times 100$. Where W_1 = Weight of crucible

W_2 = Weight of ash + crucible

2.2.1.2. Crude protein content

Two (2) g of each sample was weighed into a digestion flask (Kjedahl). Ten (10) ml of H_2SO_4 was added to the flask as well as a digestion tablet (to accelerate the digestion process). The flask was heated in a muffle furnace until the solution became clear. The digested solution was allowed to cool and this was quantitatively transferred to 100ml standard flask and make up to the mark with distilled water. Twenty (20) ml proportion of the digest was pipette into a semi micro Kjedahl distillation apparatus and treated with equal volume of 40% NaOH solution. The ammonia evolved was steam distilled into a 100ml conical flask containing 10ml solution of saturated boric acid to which 2 drops Tashirus indicator (double indicator) was added. The tip of the condenser was rinsed with a few millimeters of distilled water in the distillate which was then titrated with 0.1M HCl until a purple- pink endpoint was observed. The blank determination was also carried out in a similar manner as described above except for the omission of the sample. The crude protein was obtained by multiplying the % Nitrogen content by the kjedahl factor (6.25).

Crude Protein = % Nitrogen × kjedahl factor

Calculation

$$\textbf{\% Nitrogen} = \frac{(\text{Sample Titre} - \text{Blank Titre}) \times 0.1 \times 0.014 \times 20 \times 100 \times 6.25}{\text{Weight of sample} \quad 10}$$

2.2.1.3 Fat Content Determination

Fat content was determined using the method described in [2]. The sample (2g), wrapped in a filter paper was weighed using a chemical balance. It was then placed in an extractor thimble which has already been washed dried in an oven. One hundred and fifty (150) ml of Petroleum ether (boiling point: 60^{0}C– 80^{0}C) was poured into 250ml capacity round bottom flask. The Soxhlet extractor was fitted into the round bottom flask

which was settled on a heating mantle. The Soxhlet apparatus was assembled and allowed to reflux for about 4 hours. The extract was poured into a dried pre-weighed beaker (W_1) and the thimble was raised with a little quantity of the ether back to the beaker. The beaker was heated on a stream bath to drive off the excess solvent. The beaker was then cooled in desiccators and weighed (W_2).

Calculation:

% Total fat content = $\frac{Weight\ gained\ in\ flask}{Weight\ of\ sample} \times \frac{100}{1}$

$$\frac{\mathrm{W1} - \mathrm{W2}}{Weight\ of\ sample} \times \frac{100}{1}$$

Where;

W_2 = weight of beaker + fat

W_1 = weight of empty beaker only

ash, fibre, protein, crude fat; carbohydrate and energy values) of the samples was determined using the method according to AOAC (1990).

2.2.1.4 Crude Fibre Determination

Crude fibre was determined using the method described in [2].

The sample (2g) was defatted with petroleum either for 2hours. It was boiled under reflux for 30 minutes with 200ml of a solution containing 1.25% of H_2SO_4 per 100ml solution. It was then filtered through linen or cotton cloth on a fluted funnel. It was washed with boiling water until the washings are no longer acidic. The residue was transferred to a beaker and boiled for another 30 minutes with 200ml of a solution containing 1.25g of NaOH per 100ml. The final residue was filtered, washed with boiling water several times until it was base (NaOH) free. The residue was finally washed twice with ethanol and qualitatively transferred into pre-weighed crucible and oven dried at 105^0C. It was then incinerated in a furnace at 550^0C for 4 hours. It was cooled in a desiccator.

Calculation;

% Crude fiber = $\frac{1_a - 1_o}{Weight\ of\ original\ sample\ taken} \times \frac{100}{1}$

Where;

I_o = weight of sample crucible

I_a = weight of crucible and its content after incineration (Ash fiber)

2.2.1.5 Total Carbohydrate Determination

Carbohydrate content was determined by difference using the method of Ihekoronye and Ngoddy (1985). This was done by subtracting the total sum of the percentage fat, ash, crude fibre and protein content from 100.

Calculation:

% Total carbohydrate = 100 – (protein + fat + ash + crucible fibre).

2.2.1.6. Moisture Content Determination

Two (2) g of each of the samples was measured into a crucible and dried in an air oven at 100oC for five

hours. The sample in the crucible was cooled in a desiccator and weighed. The experiment was repeated until a constant weight was obtained. Each experiment was replicated three times.

2.3. Analysis of Fatty Acids

Fatty acid analysis was carried out in FIIRO Lagos State of Nigeria using Gas Chromatography-Mass Spectrometry (GCMS-QP2010) Ultra Shimadzu. The total lipids were trans-esterified in triplicate and the analysis was carried out according to the method of Suli Zharo (2014).

2.4. Sensory Properties

Sensory properties were determined using a consumer panel of twenty (20) students from the Department of Food Science and Technology, University of Uyo, Nigeria. Statistical analysis was carried out using Statistical Package for Social Science (SPSS, version 20), Significant means were separated using Duncan's multiple Range test at 5% probability.

3. Results & Discussion

Table 1: Proximate composition of avocado food spread

Sample	Moisture %	Fat %	Protein %	Fibre %	Ash %	Carbohydrate %	Energy value calorie
AVP_1	60.07^{a} ± 0.03	12.35^{a} ±0.05	16.25^{a} ±0.02	$1.3\,3^{a}$ ±0.03	4.00^{a}±0.04	6.00^{c}±0.04	200.1^{b}±0.02
AVP_2	60.00^{b} ± 0.05	13.30^{b}±0.03	16.00^{b} ±0.04	1.30^{a} ±0.02	4.05^{a} ±0.05	40.5^{c}±0.02	345.7^{c}±0.002
MARG	16.29^{c}±0.01	67.90^{a}±0.05	1.00^{c}± 0.02	0.00^{b}±0.00	0.50^{b}±0.02	14.31^{b}±0.01	672.34^{b}±0.04

AVP1 = Plain Avocado food spread, AVP2= Enriched Avocado food spread 2. MARG = Margarine (Blue Band).

Values are mean ±SD of triplicate determination mean in the Column with different superscript are significantly different at $p<0.05$.

Table 1 shows the proximate composition of Avocado pear spread (AVP1); Avocado pear food spread enriched with egg yolk and corn starch (AVP2) and margarine (MARG). Enrichment of plain avocado with egg yolk and corn starch increased the fat and carbohydrate contents. Margarine contained the lowest amount of moisture (16.29%) and the highest energy value (672.34 calories). Margarine and shortenings are produced by the hydrogenation of unsaturated fats. Vegetable oils are most commonly used as the source of fats and catalysts such as Nickel are used to hasten the hydrogenation process. The use of these catalysts also promotes the production of trans fats. They are produced as a side reaction, when catalysts are used for the hydrogenation process. Fats in the trans configuration are not absorbed by the digestive system of humans. Consumption of trans fats is therefore unhealthy for humans. The degree of hydrogenation affects the consistency of the product. The nutrient composition of the edible portion of the Hass avocado fruit has been determined. The values were however determined for one fruit weighing 136g [21].

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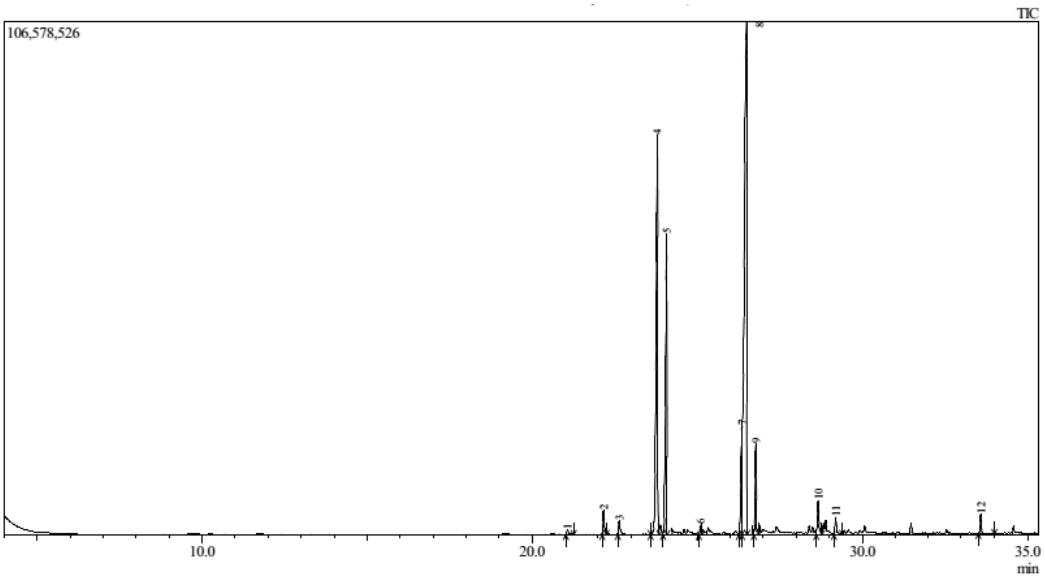

Figure 1. Fatty Acid Profile of Avocado Food Spread Oil

8 = 9-Octadecanoic acid (Z)-, methyl ester
4 = 11-Octadecanoic acid, methyl ester
5 = Eicosanoic acid, methyl ester
7 = 9, 12-Octadecanoic acid methyl ester (E-E)
9 = Docosanoic acid, methyl ester

Figure 1 shows the chromatogram for the fatty acid profile of the oil extract from Avacado pulp. Twelve peaks (5 major and 7 minor peaks) were identified. The peaks had retention times of 21.07-33.59 minutes and % peak areas of 1.23-45.69. The major peaks were; 9-Octadecanoic acid (Z)-methyl ester (Oleic acid); 11-Otadecanoic acid methyl ester; Eicosanoic acid methyl ester; 9,12-Octadecanoic acid methyl ester (E-E) (linoleic acid) and Docosanoic acid methyl ester. Avocados are rich in monounsaturated fatty acids (MUFAs)- up to 71% in the Hass Avocado variety. They also contain significant amounts of polyunsaturated fatty acids (PUFA)- up to 13% and about 16% saturated fatty acids (SFA) [6]. The oleic acid content of avocados increase as the fruit ripens [3].

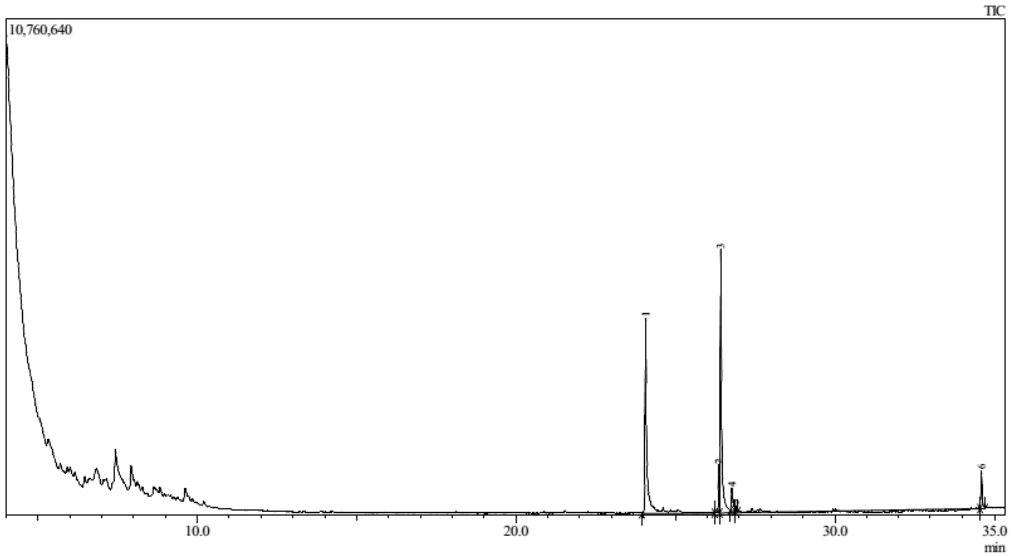

Figure 2. Fatty Acid Profile of Oil Extract from Margarine

3 = 9-Octadecenoic acid, methyl ester
1 = Hexadecaoic acid, methyl ester
2 = 9, 12-Octadecanoic acid, methyl ester
6 = Squalene

Figure 2 shows the fatty acid profile of margarine. Four major peaks with retention times ranging from 24.06-34.0 min were observed. The peaks were identified as hexadecanoic acid methyl ester: 9-octadecenoic acid methyl ester; 9, 12-octadecanoic acid methyl ester and squalene.

The results indicate that the oil from avocado pulp contains a wide array of fatty acids when compared with margarine. Avocado oil contains significant amounts of omega fatty acids which are known to improve eye health, brain development (especially in infants and young children), heart health, mental disorders and bone joint health [17, 16]. This oil is rich in monounsaturated fatty acids which are distributed in a water-based matrix; thereby enhancing their bioavailability [14]. Avocado pulp may lower Low density Lipoprotein (LDL), without raising the level of triglycerides [13]. Avocado pulp is a very good source of glutathione and vitamin E. It is high in beta-sitosterol (a compound that lowers cholesterol levels). It also contains significant amounts of lutein which protects the eye against macular degeneration and cataracts. This implies that the food spread from avocado pulp should have immense health benefits.

Table 2: Sensory properties of Avocado Food Spread compared with that of Margarine

Sample	Appearance	Taste	Flavour	Texture	Mouth feel	General acceptability	Sample
Bland Avocado food spread	6.00^{b}±1.58	7.30^{b}± 1.75	5.70^{b}± 1.45	7.10^{c} ±1.48	5.80^{c}± 1.70	6.00^{c}± 1.58	Bland Avocado food spread
Enriched Avocado food spread	7.80^{a}± 1.76	7.90^{a}± 1.48	8.00^{a} ±1.12	8.90^{a} ±0.30	8.30^{a} ±0.92	9.00^{a}± 0.00	Enriched Avocado food spread
Blue Band margarine	8.50^{a} ±0.68	7.70^{a} ±1.21	6.60^{b}± 1.66	8.00^{b}± 1.30	7.40^{b} ±1.23	8.10^{b} ±1.16	Blue Band margarine

Values followed by different superscripts are significantly different from one another (P≤0.05)

Table 2 shows the sensory properties of plain avocado food spread, enriched avocado food spread and margarine. The sensory scores of Avocado food spread, enriched with egg yolk and corn starch were the highest. There were no significant differences (p≥0.05) in the appearance and taste of enriched avocado food spread and margarine. There were no significant differences in the flavour of the bland avocado food spread and margarine. The flavor, texture and mouthfeel of enriched Avocado food spread was rated better than the texture of blue band margarine as well as the flavor of the bland Avocado food spread. Enrichment with egg yolk and corn starch improved the sensory perception of the Avocado food spread.

4. Conclusion

The egg yolk added to improve color also improved protein content of the avocado spread formulation.

Addition of corn starch improved the texture as well as the carbohydrate content of the spread. Oil from the avocado food spread was very rich in 9 -Octadecanoic acid (Z)- methyl ester and 11- Octadecanoic acid methyl ester which possess additional health benefits hence it is necessary to incorporate it into our meals.

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