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Effects of Citric Acid and Methanol Extracts of Banana and Plantain Peels on Stability of Refined Soybean Oil

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Abstract

Refined Soybean Oil (RSBO) was freshly obtained before adding any additive from a local Vegetable Oil factory in Owo, Ondo- State, Nigeria. Ripped peels of banana and plantain were removed from their fruits, cut, sun dried, ground, sieved and separately extracted with methanol. The methanol extracts were dosed at varying concentrations (0.02%-0. 10%) into RSBO. RSBO containing 0.02% and 0.04% of citric acid (CA) were also set up for comparison. The stability effects of methanol extracts and citric acid of RSBO were evaluated by monitoring the Free Fatty Acid (FFA), Acid Value (AV) and Peroxide Value (PV) of the oil sample monthly for a period of six months. The results indicated that RSBO containing both extracts (0.02%-0. 10%) and citric acid were more oxidatively stable than RSBO that contained no additive. Oil samples containing 0.08%-0. 10% banana peel extract, 0.08% plantain peel extract and citric acid (0.02%-0.10%) were more hydrolytically stable than oil sample that contained no additive. Plantain peel extract in RSBO competed more favourably with citric acid than banana peel extract in terms of oxidative stability of RSBO. The plantain peel extract had higher antioxidative activity than banana peel extract against oxidative deterioration of RSBO. Both extracts had optimal performance against oxidative rancidity of RSBO at 0.06% concentration.

Key words: Methanol extracts, Banana and Plantain Peel, Citric acid, Refined Soybean Oil (RSBO), Stability.

Introduction

Refined soybean oil is edible oil extracted from soybean seeds (*Glycine max*). The crude soybean oil that is solvent extracted is further subjected to refining which involves degumming, neutralization, bleaching and deodorization.(Wikipedia, 2007). The oil is in high demand because of its low level of cholesterol that makes it safer for human consumption (Arawande, 2005). Its organoleptic qualities are superb. When the oil is properly

refined, it has a golden yellow colour and it is a liquid even at temperature far below room temperature (-5^0C) (Lang, 2006).

One of the major problems of storing refined soybean oil is the development of rancidity (oxidative) which leads to deterioration of the oil's quality due to the multiple unsaturated bonds in the predominant unsaturated fatty acids such as oleic acid, linoleic acid and linolenic acid. These acids are very prone to oxidation (reaction with atmospheric oxygen) during storage of the oil thereby causing unnecessary economic loss. The oxidized oils not only deteriorate the taste of food to which they are added but are considered to create many health problems such as diarrhea, poor rate of growth and aggravate coronary heart diseases (Ullah *et al*., 2003).

The addition of antioxidants to lipids or lipid containing foods is one of the most efficient ways to prevent oxidation reaction between molecular oxygen and unsaturated fatty acids present in oils. Synthetic antioxidants such as Butylated Hydroxy Toluene (BHT), Butylated Hydroxy Anisole (BHA), Tertiary Butylated Hydroxy Quinone (TBHQ) and Propyl Gallate (PG) have been proved effective antioxidants against oil rancidity (Gunstone and Norris, 1983). But the use of most of these synthetic antioxidants as additives in foods have been discouraged in international market due to their carcinogencity, reduced food intake and growth inhibition (Carrasquerro *et al*., 1998; Mahdavi and Salunke, 1995; Lehman *et al*., 1995 and Naimiki, 1990). Therefore increasing attention has been directed towards sourcing for safer means of preventing lipid deterioration by using bioactive plant extracts (natural antioxidants) (Emmanuel and Mudiakeoghene, 2008; Erol *et al*., 2004; Tian & White, 1994).

In most cases, plants (fruits and vegetables) containing bioactive compounds called natural or pyhtochemical antioxidants are always possess coloured pigments (Oboh amd Rocha, 2006; Khanahmadi and Janfesha, 2006; Ruger *et al*., 2002). Therefore ripped banana and plantain peels that are major agricultural wastes, owing to their coloured pigment suggests that they contain bioactive or phytochemical antioxidants that can be extracted by suitable polar solvents. The objectives of this work are to separately obtain banana and plantain peel extracts using methanol as solvent and to investigate the average effects of these extracts and citric acid at varying concentrations on the stability of refined soybean oil (RSBO) by monthly monitoring their Free Fatty Acid (FFA), Acid Value (AV) and Peroxide Value (PV) of the oil samples stored in transparent plastic bottles over a period of six months.

Materials and Methods

The refined soybean oil (RSBO) used for this investigation was obtained (before being fortified with vitamin A or any additive) from Vegetable Oil Division, Jof Ideal Family Farms Limited, Owo, Ondo- State, Nigeria. The banana and plantain fruits were purchased at King's market in Owo, Ondo-State, Nigeria.

Preparation and Extraction of Banana and Plantain Peels

The ripped peels were removed by hand and cut into smaller pieces for easily drying. The dried peels were ground using electric blending machine and it was sieved with 40mm mesh size. The powdery samples were packed into a black polyethylene bags labeled appropriately prior to extraction.

Twenty gram of each dried powdery samples was weighed into a cleaned and dried reagent bottle; and 200ml of methanol was separately added to each bottle and left for 72hours during which it was intermittedly shaken on a shaking orbit machine. The mixture was filtered through a 0.45μm Nylon membrane filter. The extracts were evaporated to dryness under reduced pressure at 40^0C by a rotary evaporator.

Addition of Additives to Refined Soybean Oil.

Methanol extract of each peel at varying concentrations (0.02-0.10%) was added to refined soybean oil sample contained in transparent plastic bottles and it was thoroughly shaken for proper mixing. Refined soybean oil containing 0.02% and 0.04% citric acid and that which contain no additive (0%) were also set-up. Each container was labeled appropriately.

Chemical Analysis

The quality of RSBO samples was measured by determining selected quality parameters. Quality parameters such as Free Fatty Acid (FFA), Acid Value (AV) and Peroxide Value (PV) of each oil sample were determined at the start of the experiment and by monthly interval using standard method of analysis (AOCS, 1989) for a period of six months.

Results and Discussion

Table 1 revealed the average effects of varying concentration of Citric Acid (CA), Methanol Extract of Banana Peel (MEBP) and Plantain Peel (MEBP) of Refined Soybean Oil (RSBO) stored for six months. The result showed that oil samples containing 0.02% and 0.04% CA had lower value of FFA and AV than the oil sample that contained no additive over the six month period of storage. Oil sample containing MEBP and MEPP expect 0.08% and 0.10% MEBP and 0.08% MEPP had higher value of FFA and AV than the oil which contained no

additive. Hence 0.02% and 0.04% CA, 0.08% and 0.10% MEBP and 0.08% MEPP in RSBO are more hydrolytically stable than the oil sample which contained no additive thereby they are effective antioxidants against hydrolytic rancidity of RSBO.

Both FFA and AV are measure of hydrolytic stability of lipids and the lower these values the lower the degree of hydrolytic rancidity and the more stable is the lipid (Ihekoronye and Ngoddy 1985). The average assessment of methanol extract of both peels showed that at higher concentration (0.08%-0. 10%), the extracts were effective and competed favourably well with 0.02% and 0.04% CA against hydrolytic rancidity of RSBO. However, methanol extract of banana peel was superior to plantain peel extract at varying concentration expect at 0.08%MEPP.

Peroxide Value (PV) of any lipid is an index of primary products of oxidation as well as oxidative rancidity or stability of such lipid (Amir *et al*., 2005; Rossel 1994; Ihekoronye and Noggy 1985). The lower the PV of oil the more the oil is oxidatively stable. All the oil samples containing CA and methanol extracts of banana and plantain peels at all varying concentration had lower values of PV than the oil sample without any additive. This implied that these additives made RSBO more oxidatively stable although at vary degrees. Methanol extract of plantain peel was more superior to banana peel extract at all varying concentration examined in preventing oxidative rancidity of RSBO.

The range of PV of RSBO containing methanol extract of plantain peel (MEPP) and citric acid at the level of concentration examined were in close bracket hence MEPP competed favourably well with citric acid than MEBP. However, the optimal concentration level of both extracts against oxidative rancidity was 0.06%. In conclusion, plantain peel is a better source of natural antioxidant than banana peel because its methanol extracts at all varying concentration inhibits oxidative rancidity in RSBO in almost the same extends with that of citric acid. It equally inhibits hydrolytic rancidity of RSBO at 0.08% concentration than banana peel extracts. However, further investigation can be conducted on these fruit peels by using other polar solvents such as water, chloroform, ethyl acetate for extraction and examine the effect of the extract on the stability of other edible oils.

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Table 1: Mean Value of Free Fatty Acid (FFA), Acid Value (AV) and Peroxide Value (PV) of Refined Soybean Oil stored with varying concentration of Citric Acid (CA), Methanol Extract of Banana Peel (MEBP) and Plantain Peel (MEBP) over a period of six months.

Concentration (%)	Additive	*FFA (%Oleic acid)	*AV (mgKOH/g oil)	*PV ($meqO_2$/Kg oil)
0.00	No additive	0.449±0.109	0.900±0.272	19.731±10.082
0.02	CA	0.378±0.087	0.705±0.176	13.865±2.674
0.04	CA	0.405±0.102	0.809±0.185	14.348±3.148
0.02	MEBP	0.475±0.158	0.943±0.330	16.563±6.890
0.04	MEBP	0.474±0.103	0.944±0.207	16.373±4.554
0.06	MEBP	0.484±0.229	0.957±0.557	14.947±3.272
0.08	MEBP	0.432±0.335	0.861±0.671	16.153±3.699

0.10	MEBP	0.399±0.234	0.795±0.568	18.078±7.699
0.02	MEPP	0.519±0.238	1.035±0.470	14.917±7.908
0.04	MEPP	0.487±0.136	0.975±0.387	14.731±3.185
0.06	MEPP	0.499±0.207	0.982±0.451	13.874±2.745
0.08	MEPP	0.383±0.193	0.762±0.314	14.961±4.322
0.10	MEPP	0.486±0.149	0.932±0.390	14.387±2.682

*Mean Value ± Standard deviation, CA= Citric Acid, MEBP= Methanol Extract of Banana Peel, MEPP= Methanol Extract of Plantain Peel